

# Inclusive Digital Education



**EUROPEAN AGENCY**  
for Special Needs and Inclusive Education





**INCLUSIVE**  
DIGITAL EDUCATION

European Agency for Special Needs and Inclusive Education



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## LIST OF ABBREVIATIONS



Abbreviation	Full version
3D	three-dimensional
ACM	Association for Computing Machinery
Agency / European Agency	European Agency for Special Needs and Inclusive Education
AI	artificial intelligence
AR	augmented reality
ASD	autism spectrum disorder
AT	assistive technology
BYOD	bring your own device
COVID-19	Coronavirus disease 2019
DigComp	Digital Competence Framework for Citizens
DigCompEdu	Framework for the Digital Competence of Educators
DLGF	Digital Literacy Global Framework
e-communication	electronic communication
EU	European Union
G3ict	Global Initiative for Inclusive Information and Communication Technologies
GEM	Global Education Monitoring
HE	higher education
HEI	higher education institution
ICT	information and communication technology
IEEE	Institute of Electrical and Electronics Engineers
ISCED	International Standard Classification of Education
ISO	International Organization for Standardization
IT	information technology
K–12	from kindergarten to 12 <sup>th</sup> grade (American expression)
LGBTQIA	lesbian, gay, bisexual, transgender, queer/questioning, intersex, asexual
LMS	learning management system
MAWP	Multi-Annual Work Programme



<b>Abbreviation</b>	<b>Full version</b>
MOOC	massive open online course
MR	mixed reality
OECD	Organisation for Economic Co-operation and Development
OER	open educational resource
SDG	Sustainable Development Goal
SEN	special educational needs
STEAM	science, technology, engineering, the arts and mathematics
UDL	Universal Design for Learning
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNESCO IITE	UNESCO Institute for Information Technologies in Education
UNICEF	United Nations Children's Fund
US	United States (of America)
VET	vocational education and training
VLE	virtual learning environment
VR	virtual reality
W3C	World Wide Web Consortium
WAI	Web Accessibility Initiative
WCAG	Web Content Accessibility Guidelines



## FOREWORD

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The potential of information and communication technology (ICT) in education has been a focus of work by the European Agency for Special Needs and Inclusive Education (the Agency) since 1999, so almost since its establishment in 1996. Early activities<sup>1</sup> examined how ICT could enable the inclusion of learners with special needs, while later ones broadened the focus to how ICT can foster inclusive education for **all** learners.

ICT for inclusion has been an overarching issue in Agency work. Examples include the [ICT for Inclusion](#) (ICT4I) and [ICT for Information Accessibility in Learning](#) (ICT4IAL) projects and collaboration with [UNESCO](#) and [G3ict](#) on the [Model Policy for Inclusive ICTs in Education for Persons with Disabilities](#) (European Agency and G3ict, 2014).

The acceleration of technological advancements and changes in attitudes and policy developments towards more equitable education opportunities for all in recent years have led to new priorities and demands in relation to inclusive digital education and blended learning. This is also at the core of the European Union's [Digital Education Action Plan](#) (2021-2027) policy initiative, which 'offers a long-term strategic vision for high-quality, inclusive and accessible European digital education' (European Commission, no date). Its first priority area focuses on 'fostering the development of a high-performing digital education ecosystem' (ibid.).

The global COVID-19 pandemic and the current war in Ukraine spotlight the fault lines in and challenges for education systems in terms of their ability to provide continuous learning opportunities for all learners. Education systems have adapted to unprecedented circumstances during the pandemic. The Agency's [The Impact of COVID-19 on Inclusive Education at the European Level: Literature Review](#) shows that access to learning presents a challenge, especially for vulnerable learners (European Agency, 2021a). It also highlights that ICT's potential role in overcoming this challenge cannot be ignored.

However, only considering ICT's ability to keep classrooms and learners connected and provide teachers with access to their learners overlooks the multi-faceted issues around ICT and the opportunities it offers to foster more resilient education systems that provide continuous and equitable learning opportunities for all. The [concept note](#) for UNESCO's 2023 Global Education Monitoring Report, focusing on technology and education, highlights that the achievement of Sustainable Development Goal 4, on Quality Education, 'is dependent on opportunities and challenges posed by technology' (Global Education Monitoring Report Team, 2021, p. 2).

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<sup>1</sup> Examples include [Information and Communication Technology in Special Needs Education](#) and [ICTs in Education for People with Disabilities – Review of Innovative Practice](#). The Agency conducted the latter jointly with the United Nations Educational, Scientific and Cultural Organization Institute for Information Technologies in Education (UNESCO IITE).



It stresses that:

Technology's capabilities offer education systems tools to overcome longstanding inequalities along two key dimensions: reaching disadvantaged populations and ensuring content reaches all learners in more engaging and cheaper formats (ibid., p. 5).

In most areas of life, societies have moved from **digitisation** (converting analogue data into a digital form – for example, vinyl to MP3) to **digitalisation** (structuring social life around digital communication and media infrastructure – for example, MP3 to a digital streaming playlist created by a group of individuals). The growing use and presence of digital solutions in everyday life create the need for systemic change based on **digital transformation** in general and, more specifically, in inclusive education systems. The Digital Education Action Plan's second priority is 'enhancing digital skills and competences' that are needed for this digital transformation (European Commission, no date).

Based on our work, the Agency considers **Inclusive Digital Education as digital transformation** that goes far beyond applying suitably designed digital technologies in education. Inclusive digital education involves all education system levels – from the individual, to the educational institution, to the regional or national level. In inclusive education systems, this entails addressing inclusion, exclusion, digitalisation and the digital divide as interconnected and inter-dependent cross-cutting issues. This is vital if digital education is not just to be implemented for some, but is to be permanently anchored in the education system's structures to foster resilient education systems that provide equitable education opportunities for all learners.

The Agency collaborated with the [Institut für Technologie und Arbeit](#) (ITA), Germany, to develop this report. The Agency gratefully acknowledges the inputs of Harald Weber, Alina Elsner, Dana Wolf and Matthias Rohs. Their work in reviewing digital developments and trends will have an impact on the Agency's thinking in the area of inclusive digital education, as well as other related spheres, in the coming years.

**Cor Meijer**

**Director of the European Agency for Special Needs and Inclusive Education**



## EXECUTIVE SUMMARY



Education systems worldwide have adapted to unprecedented circumstances during the [COVID-19](#) pandemic. While there have been rapid and comprehensive steps towards a [digitalisation](#) of education, access to learning – especially for vulnerable learners – remains a challenge. This study aims to provide a thorough examination of new priorities and demands in relation to inclusive [digital education](#) and [blended learning](#).

The on-going [digital transformation](#) of social life with [digital media](#) and the increasing use of digital media and technologies for teaching and learning open up new opportunities to overcome exclusion. At the same time, new barriers to participation in society and in education are emerging. These can exacerbate the existing vulnerability of individuals or groups, but also create new forms of vulnerability to social and educational exclusion.

The relevance of new technologies is due to their use by different actors at different education system levels and depends on the conditions that support or hinder their use. In defining these levels, this study is guided by the Agency's [Ecosystem of Inclusive Education Model](#) (European Agency, 2019). At the individual level, the study distinguishes between learners and teachers as they may use different or the same [digital technology](#) in the context of their learning and teaching, both independently and together. Then, the educational institution level is considered as another relevant level in the context of inclusive digital education, linking the individual level with policy and the community. Finally, the national/regional level is relevant as it touches upon the legislative aspects of inclusive education. The analysis in this study was based on these dimensions throughout: [technology](#), learners, teachers, educational institution level and national/regional level.

A review of the research literature from 2016–2021 considers how technology can potentially contribute to equitable access to and participation in various life domains, particularly with regard to education. The review also analyses the requirements of inclusive education to examine the possibilities for using [information and communication technology](#) (ICT) or digital media and designing supportive conditions for their use to enable, support or improve inclusive teaching and learning.

Complementing the literature review, the study also examines implementation projects and conferences in the education field to discover whether and to what extent findings from the field of science are reflected in (or close to) practice.

The results obtained in this way were compiled and made available to selected experts to check their consistency and validity, but also to supplement them if necessary and to add an outlook on topics that are likely to be relevant in the near future.

In summary, the study concludes with the following key messages:

### *Technology level*

-  The development of inclusive technology should consider technology-centric or technology-driven approaches and the primacy of pedagogy (i.e. priority is always given to pedagogy over all other considerations) in a balanced way.



- When describing the target groups of technologies, a medical or deficit-oriented type of categorisation can still be observed, while in other fields there has been a shift to the social or biopsychosocial model.
- [User-centred design](#) approaches embracing the concept of universal design avoid disadvantages from the outset. [Assistive technology](#) (AT) should be used as a compensatory means only where universally designed technology does not (yet) sufficiently satisfy all users' needs.
- A more targeted use of ICT to create peer-learning opportunities at various levels offers much untapped potential.
- [Open educational resources](#) (OERs) are explicitly intended to improve accessibility to teaching materials.
- [Massive open online courses](#) (MOOCs) have become very popular recently.
- [Artificial intelligence](#) (AI) applications are available to support teaching children with autism, with learning disabilities or with sight or hearing problems.
- In some areas of technology, developments with potential future implications for education are emerging, e.g. domestic robotics, mobile [telepresence](#) systems, [chatbots](#) and [smart speakers](#).



### UNIVERSAL DESIGN

Universal design refers to the:

'Design of products, environments, programmes and services to be usable by all to the greatest extent possible, with no need for adaptation or specialised design' ([UNESCO, 2020](#), p. 420).

#### Learners level

- [Inclusion](#) in [digital education](#) is a multi-dimensional phenomenon, which is affected at least by society, technical equipment, the educational institution, the learning situation and the individual learners.
- Vulnerability to exclusion in digital education can be associated with learning-related phenomena that are strongly linked to societal mechanisms and can therefore be attributed to intersectionality.
- For individual learners, inclusion in digital education is reflected in terms of technical [accessibility](#), being present and visible, being actively socially involved, interacting and collaborating with one another and feeling appreciated and included in the learning community.



### INTERSECTIONALITY

Intersectionality means 'that a person, group of people, organisation or social problem is affected and impacted upon by a number of pressures, forces, levers, discriminations and disadvantages' ([European Agency, 2021b](#), p. 6).



- There is a wide range of contexts in which inclusion is a highly relevant topic for learning in digital education.
- Learners' digital competences play an important role, especially in communication, collaboration and safety, respectful and appreciative social interaction, the development and empowerment of oneself as a digital person, expressing one's own voice, critical reflection on digital media and self-protection against [violence in digital environments](#).
- When designing conditions conducive to inclusion in digital and analogue educational settings, it is necessary to combine the insights gained from different individuals or groups vulnerable to exclusion to derive measures for a holistic perspective on inclusion for high-quality education for all learners.

#### *Teachers level*

- [Distance learning](#) may have led to increased inequalities and school drop-out during the COVID-19 pandemic.
- Teachers need support in selecting inclusive teaching materials that present no or few barriers and are suitable for all learners.
- During the pandemic, digital media use could not compensate for the lack of contact and of necessary learning support by teachers, particularly for socio-economically disadvantaged learners.
- [Distance education](#) can be an effective short-term replacement when there are unavoidable limitations on personal contact.
- Competencies like [media literacy](#), [data literacy](#) and data-based decision-making are important in the context of inclusive digital teaching.

#### *Educational institution level*

- Educational organisations that embrace the digitalisation process in terms of content and funding can help to reduce social exclusion.
- Teacher empowerment is key and must be accompanied by organisational support measures, further training and consideration of teachers' individual needs.
- Due to an insufficient link between inclusive education and digitalisation, educational organisations must undertake [digital transformation](#) by themselves and at their own risk. This may explain hesitancy in implementation.



### *National/regional level*

- Without knowing what constitutes successful inclusive digital education, it is difficult to determine what enabling framework conditions the policy level should provide.
- Being prepared for inclusive digital education in terms of content, technology and organisation seems to indicate [organisational resilience](#) in case of crisis.
- The COVID-19 pandemic has deepened educational inequalities, but it also provides a unique opportunity to reform education.
- Currently, there is little consideration of policy-level initiatives to support networking among teachers or school leaders or to establish [professional learning communities](#).

So far, the education sector has not been involved enough in technology design and development, or in discussions on the ethical implications of using digital media and technologies to pro-actively address the requirements of inclusive education.

The term ‘digital transformation’, however, refers to much more than applying suitably designed digital technologies in education. Digital transformation requires all levels – from the individual, to the educational institution, to the regional or national level, with inclusion and digitalisation as cross-cutting issues – to be involved. This involvement is crucial if inclusive digital education is not just to be implemented on a case-by-case basis but is to be permanently anchored in the education system’s structures. However, there are very few examples from the education field showing what a successful transformation process involves and what concrete steps individuals, organisations and policy-makers should take.



### **BLENDED LEARNING**

‘Blended learning in formal education and training involves a diversity of approaches and is to be understood as a school (in primary and secondary education, including vocational education and training), teacher and trainer or learner taking more than one approach to the learning process:

- blending school site and other physical environments away from the school site (either with the presence of a teacher/trainer, or separated by space and/or time in distance learning);
- blending different learning tools that can be digital (including online learning) and non-digital’ ([Council of the European Union, 2021](#), p. 12).



# 1. INTRODUCTION



Education systems worldwide have adapted to unprecedented circumstances during the [COVID-19](#) pandemic. While there have been rapid and comprehensive steps towards a [digitalisation](#) of education, the [Agency's COVID-19 literature review](#) (European Agency, 2021a) has shown that access to learning, especially for vulnerable learners, remains a challenge.

ICT for inclusion has been an overarching issue across Agency projects and collaborations with UNESCO and UNESCO IITE. These activities have focused on how [ICT](#) supports inclusive education systems and on the importance of [accessibility](#).

This report is the outcome of an Agency activity entitled Inclusive Digital Education (IDE). IDE aims to thoroughly examine new priorities and demands in relation to inclusive [digital education](#) and blended learning during the period 2016–2021.

The report is structured as follows:

[Chapter 2](#) describes the context within which inclusive digital education is considered.

[Chapter 3](#) details the authors' understanding of vulnerability as an effect of (alterable) framework conditions on individuals, as opposed to an understanding that defines vulnerability as a characteristic of specific target groups.

[Chapter 4](#) presents the results of the research literature review. It is structured along the lines of the Agency's ecosystem model. The [technology](#) level ([section 4.1](#)) is examined, as well as the learner level ([section 4.2](#)), the teacher level ([section 4.3](#)), the educational institution level ([section 4.4](#)) and the education system level, which concerns regional and national issues ([section 4.5](#)). The last section highlights the didactic concept of blended learning ([section 4.6](#)). This is due to its relevance, but also because of the need for [digital transformation](#) at all levels (individual, institutional, regional/national) in order for blended learning to be permanently anchored and committed to inclusive education.

[Chapter 5](#) is dedicated to the thematic trends observed in European co-operation projects and in international specialised conferences in recent years. Thus it complements the information from the literature review by looking at current research and on-going practice-oriented projects.

[Chapter 6](#) summarises the results thus obtained and adds the results of an expert validation process, leading to an overall picture of inclusive digital education and of issues remaining to be tackled.

A [glossary](#) with the main terms used in the document and a list of the [references](#) cited conclude this report.

The use of **bold** in this document is intended to support good and targeted readability of the text.

Textboxes throughout the document highlight important terminology and present practical examples of European co-operation projects related to the research.



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This report is part of a package of materials from the IDE activity, consisting of the following:

- 🎯 [Methodology paper](#), detailing the methodology chosen to analyse the topic;
- 🎯 Project examples, collating a selection of Erasmus+ projects dealing with specific issues related to inclusive digital education (forthcoming);
- 🎯 Policy brief, detailing issues not yet sufficiently addressed in the field of inclusive digital education (forthcoming).

The [report publication page](#) will contain links to all the materials when they are available.



## 2. POLICY CONTEXT



This study has been prepared first and foremost in the context of the **United Nations (UN) 2030 Agenda for Sustainable Development** (UN, no date). Its 17 Sustainable Development Goals (SDGs) are a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity (UN, 2021). In particular, SDG 4, ‘Quality Education’, and SDG 10, ‘Reduced Inequalities’, address key issues relevant to inclusive (digital) education. SDG 4, among other things, aims for free, equitable and quality primary and secondary education, at eliminating gender disparities in education and ensuring equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations. SDG 10, among other things, aims to empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status.

Also of great relevance is the **UN Convention on the Rights of Persons with Disabilities** (2006). However, inclusive education has a much broader scope than a focus on disabilities; it aims to provide:

... high quality education in mainstream schools that effectively meets the academic and social learning needs of all the learners from the school’s local community ([European Agency, 2015](#), p. 2).

Article 9 of the Convention (UN, 2006) details access to information, communication and to information and communication technologies and systems. It highlights the promotion of technologies and systems that are designed, developed, produced and distributed with accessibility in mind from an early stage, as these solutions would be available at minimum cost. The Convention defines universal design as:

... the design of products, environments, programmes and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. “Universal design” shall not exclude assistive devices for particular groups of persons with disabilities where this is needed (ibid., Article 2).

The Convention obliges the States Parties to:

... undertake or promote research and development of universally designed goods, services, equipment and facilities [...], which should require the minimum possible adaptation and the least cost to meet the specific needs of a person with disabilities, to promote their availability and use, and to promote universal design in the development of standards and guidelines (ibid., Article 4, 1(f)).

Universal design is thus characterised as the primary design goal when developing [digital media](#), tools and environments for inclusive digital education, with ATs only being used as a compensatory tool when necessary.



Within the European Union (EU), the [Digital Education Action Plan 2021-2027](#) is a relevant document in the context of inclusive digital education:

Raising the quality and inclusiveness of education and training systems and the provision of digital skills for all during the digital and green transitions is of strategic importance for the EU (European Commission, 2020a, p. 2).

Education and training systems are part of the digital transformation that touches upon many aspects of daily life and work. Harnessing the benefits and opportunities and, at the same time, managing the risks of this transformation are seen as tasks of the education and training systems. Two strategic priorities are to be taken forward:

1. Foster a high-performing digital education ecosystem
2. Enhance digital skills and competences for the digital age (European Commission, 2020a).

The Digital Education Action Plan also addresses the accessibility of technologies and digital content. It does not, however, refer to educational technologies that are designed for all and therefore fundamentally usable for the widest possible range of users. Nor does it state that such technologies should take priority over compensatory technologies whenever possible. Universally designed technologies can prevent inaccessibility and its consequences, such as disadvantages, impediments or segregation caused by insufficiently designed technology.

A [Commission Staff Working Document](#) accompanying the Communication on the Digital Education Action Plan outlines the lessons learnt from implementing the first Digital Action Plan of 2018 and discusses the latest developments in digital education (European Commission, 2020b). It considers early evidence from the COVID-19 crisis and the more structural challenges facing digital education in Europe. Feedback on the new Digital Education Action Plan was collected via an open public consultation. Responses emphasised the ‘need to ensure [accessible](#) digital learning environments with adapted materials for learners with disabilities’ (ibid., p. 82).

The [UNESCO 2020 Global Education Monitoring \(GEM\) Report](#) is another key document that monitors and reports progress towards the education targets in the SDGs adopted by the UN Member States (UNESCO, 2020). A series of background papers provides in-depth information for the 2020 GEM Report. One of these deals with the architectural accessibility of schools and addresses the principle of universal design/[design for all](#) as a central feature in the future of inclusive schools and learning environments (Agarwal, 2020). Another background paper (Hersh, 2020), focusing on technology for inclusion, also emphasises these principles, for example, the role of [Universal Design for Learning](#) in supporting inclusive education. However, it does not recognise the relevance of the same principle for the design of educational technologies. Rather, ATs are seen as a solution to an accessibility problem that would not exist in a state-of-the-art technological design that takes into account the needs of the broadest possible user group.

A **UNESCO concept note** introduces the scope and approach for the 2023 GEM Report (Global Education Monitoring Report Team, 2021). The Report will focus on the theme of technology and education, so it is also relevant to this study. The concept note highlights that technology use in education requires system-wide conditions that allow it to reach its



full potential. It asserts that technology has the capability to overcome long-lasting inequalities. The concept note, however, emphasises ATs that have opened doors for learners with disabilities and [special educational needs](#) (SEN). It does not consider universal design as an approach that considers the needs of all users, including those with disabilities, from the outset and thus eliminates the need to develop and procure special technologies for specific types of disabilities.

Finally, it is important to note that inclusive digital education cannot be discussed without considering the intensive experience of digital education during large-scale school closures in the context of the **COVID-19 pandemic**. McAleavy, Joynes, Gibbs and Sims (2020) particularly highlight the need to explore the digital divide in more detail and to monitor distance education of disadvantaged learners qualitatively and quantitatively.

Finally, the Agency conducted a literature review in 2021 to map evidence and identify acknowledged ways in which COVID-19 has impacted on education in general – and inclusive education in particular – at European and national levels ([European Agency, 2021a](#)). This study takes into account the results of the Agency’s literature review, particularly those regarding remote and distance learning, and addressing the digital divide.



### DIGITAL DIVIDE

Digital divide refers to ‘the gap between those who can benefit from digital technology and those who cannot’ (Digital Divide Institute, cited in [UNESCO IITE and European Agency, 2011](#), p. 101).



### 3. VULNERABILITY AND INCLUSION



The concept of **inclusion** differs from those of exclusion, separation and integration due to its different perspective on diversity.

Exclusion, separation and integration always aim at an exclusionary distinction of one (more or less) homogeneous group from another (more or less) homogeneous group. In contrast, **inclusion** involves turning away from such exclusionary mechanisms through a comprehensive perception and appreciation of diversity within a less sharply defined community. Therefore, strictly speaking, the concept of inclusion does not focus on a specific ‘target group’.

From a **pragmatic research point of view**, inclusion is understood as a theoretical construct in the sense of a desirable goal, rather than as a current societal reality. In this context, it may firstly be useful to focus on individuals or groups who are particularly **vulnerable to exclusion by a system** to guide the design of inclusive conditions in the education system. Efforts to promote inclusion in digitally supported education continue to gain relevance, especially as on-going digitalisation permeates all areas of life, including education. The progressive digitalisation of social life and the increasing use of [digital media](#) for teaching and learning open up **new opportunities** to overcome exclusion. At the same time, new barriers to participation in society and education are emerging. These can exacerbate the existing vulnerability of individuals or groups, but also create **new forms of vulnerability** to social and educational exclusion.

The Agency aims ‘to ensure every learner’s right to inclusive and equitable educational opportunities’ ([European Agency, 2020](#), p. 2) and for ‘equal access to all levels of education and vocational training for the vulnerable’ ([UN, no date](#), SDG 4.5). ‘All aspects of Agency work must consider everything and anything that can marginalise learners and increase their chances of exclusion’ ([European Agency, 2021b](#), p. 6). In this context, the



#### INCLUSION

Inclusion is both a principle and a process:

‘Inclusion and equity in and through education is the cornerstone of a transformative education agenda [...] No education target should be considered met unless met by all’ ([World Education Forum, 2015](#), p. 2).

It can be seen as:

‘A process consisting of actions and practices that embrace diversity and build a sense of belonging, rooted in the belief that every person has value and potential and should be respected’ ([UNESCO, 2020](#), p. 419).

The term ‘inclusion’ was often associated with disability, but now extends to wider groups as:

‘... a response to increasingly complex and diverse societies. It treats diversity as an asset which helps prepare individuals for life and active citizenship in increasingly complex, demanding, multi-cultural and integrated societies’ ([Soriano, Watkins & Ebersold, 2017](#), p. 7).



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following discriminatory grounds are highlighted, in accordance with the 2020 GEM Report:

... gender, remoteness, wealth, disability, ethnicity, language, migration, displacement, incarceration, sexual orientation, gender identity and expression, religion and other beliefs and attitudes (UNESCO, 2020, p. 4).

The concept of **intersectionality**, which means that ‘a person, group of people, organisation or social problem is affected and impacted upon by a number of pressures, forces, levers, discriminations and disadvantages’ ([European Agency, 2021b](#), p. 6), is particularly important. It means that an individual can experience exclusion in different ways. Successful inclusion in education must therefore consider learners’ experiences of inclusion or exclusion not only in the teaching-learning situation, but in terms of influences from organisational, interpersonal and societal levels. These, in turn, are permeated and changed by the **increasing digitalisation of all areas of life**.

When designing conditions conducive to inclusion in digital and analogue educational settings, it is necessary to carefully consider an individual learner’s circumstances and special needs for inclusion in the educational context. However, to the same extent, creating **high-quality learning conditions for all learners** beyond a focus on individual cases is essential.

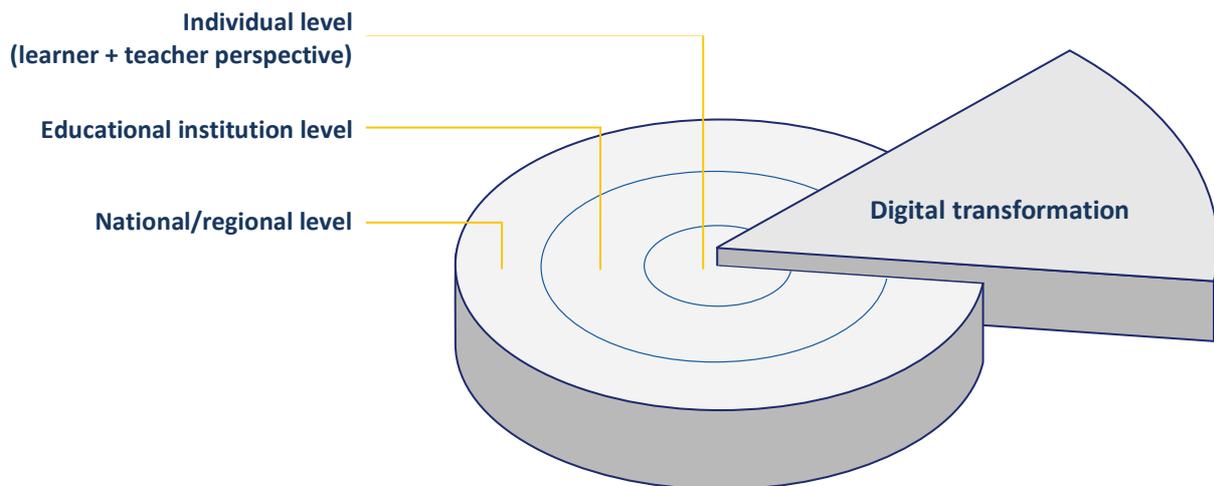


## 4. RESEARCH ON INCLUSIVE DIGITAL EDUCATION

This chapter presents a structured analysis of the research literature on inclusive digital education. As a first step, it considers two central perspectives:

1. Potential contributions/added value, but also risks, of technologies for access to and equitable participation in various life domains, and particularly with regard to inclusive education ([technology](#) perspective; see [section 4.1](#))
2. Based on the requirements of inclusive education, an examination of the possibilities for using ICT or digital media and for designing supportive conditions for their use to enable, support or improve inclusive teaching and learning (educational perspective, see sections [4.2](#) to [4.5](#)).

However, the importance of new technologies is due to their use by different actors at different education system levels and depends on the conditions that support or hinder their use. Therefore, this second perspective is subdivided to adequately address the relevant system levels. In defining these levels, this study is guided by the Agency's [ecosystem model](#) (European Agency, 2019).



**Figure 1. Simplified ecosystem model**

This study divides the **individual level** of the ecosystem model into a **learner** ([section 4.2](#)) and a **teacher** ([section 4.3](#)) perspective. In the Agency's ecosystem model, teachers are assigned to the educational institution level. This study deliberately deviated from this approach, as learners and teachers may use different or the same ICT in the context of their learning and teaching, both independently and together.

The **educational institution level** ([section 4.4](#)) links the individual level with the community and national/regional levels, hence dealing with inclusive leadership and [stakeholder](#) involvement.

The Agency's ecosystem model includes a community level. The participation of parents and families is considered in the description of the educational institution level ([section 4.4.3](#)). However, the literature review did not provide any relevant sources with



regard to other community stakeholders in relation to inclusive digital education, so the topic is not discussed further in this study.

The **national/regional level** ([section 4.5](#)) touches upon the legislative aspects of inclusive education, including, for example, governance, funding, quality assurance and accountability, and the use of ICT to monitor effectiveness and efficiency at this level.

Finally, the concept of **blended learning** is highlighted ([section 4.6](#)), as its successful design and implementation touch on and take into account the previously defined levels.

All levels – from the individual (learners and teachers), to the educational institution, to the regional or national level, with **inclusion and digitalisation as cross-cutting issues** – must be involved if inclusive digital education in general – and blended learning in particular – is not just to be implemented on a case-by-case basis but is to be permanently anchored in the education system’s structures (**digital transformation**).

## 4.1 Technology’s potential to advance inclusion

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This section aims to review technology in an inclusive education environment from a universal design perspective, pinpointing where AT is still necessary to enable access and participation.

[Section 4.1.1](#) gives an overview of [design for all/universal design](#), as well as [ATs](#) and their implications.

[Section 4.1.2](#) reviews technological trends in inclusive education environments, including [artificial intelligence](#) (AI), [virtual reality](#) (VR) and [augmented reality](#) (AR) and [gamification](#) approaches.

New trends in technology outside education are examined in [section 4.1.3](#). These include, for example, trends in the use of domestic [robotics](#) and AI-based [chatbots](#).

[Section 4.1.4](#) summarises the findings and presents initial reflections.

### 4.1.1 Design for all/universal design and assistive technologies

Since the early 1990s, ICT targeted at a maximally diverse group of users – for example, in education – has been expected (and later required by law) to be [accessible](#). At that time, however, [accessibility](#) predominantly meant **technical accessibility** and referred to concepts that made technology operable by people with different kinds of disabilities. Operable meant that the technology was somehow usable, but not necessarily equally fast, informative, convenient or enjoyable as for non-disabled users and hence not equitable (Weber, 2021).

At this time, the vision of **design for all/universal design**, which originated in the architectural field (Mace, 1985), was generalised and later further refined.

“Universal design” means the design of products, environments, programmes and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. “Universal design” shall not exclude assistive devices for particular groups of persons with disabilities where this is needed ([UN, 2006, Article 2](#)).



Universal design continues to be a **leading vision in ICT design**. Despite all the technical advances, there are still technical or economic limits that cannot yet be overcome and so compensatory technologies (i.e. AT) are still required. Meanwhile, [hardware](#) and [software](#) that are not implemented under a design for all paradigm can build upon tools that cover a wide variety of physical, cognitive or sensory support needs. Most desktop and [mobile technologies](#) have implemented **accessibility tools at the operating system level**, which ensure system-wide access functionality, without the need to add any compensatory, third-party AT (Weber, 2021).

Design for all/universal design is an essential technical prerequisite to achieve the goals of the [Qingdao Declaration](#), which states:

To achieve the goal of inclusive and equitable quality education and lifelong learning by 2030, ICT – including mobile learning – must be harnessed to strengthen education systems, knowledge dissemination, information access, quality and effective learning, and more efficient service provision (UNESCO, 2015, p. 1).

At the same time, key standards and legal regulations around the topic were also being developed. These include:

 international standards, such as:

- ISO 9241-171:2008 ‘Ergonomics of human-system interaction — Part 171: [Guidance on software accessibility](#)’, which focuses on interactive systems and on promoting increased [usability](#) of systems for a wider range of users (International Organization for Standardization, 2008).
- ISO 9241-20:2021 ‘Ergonomics of human-system interaction — Part 20: [An ergonomic approach to accessibility within the ISO 9241 series](#)’, which provides guidelines to improve the accessibility of ICT equipment and services for people with a wide range of sensory, physical and cognitive abilities, including those who are temporarily disabled, and the elderly (International Organization for Standardization, 2021).

 European regulations, such as:

- [EU Directive 2014/24 on public procurement](#), establishing rules on the procedures for procurement by contracting authorities with respect to public contracts as well as design contests, and including accessibility as a procurement criterion (European Parliament and Council of the European Union, 2014).
- European Standard EN 17161:2019 ‘Design for All – Accessibility following a Design for All approach in products, goods and services – Extending the range of users’, that aims to help organisations adopt a consistent approach to addressing accessibility for persons with disabilities (European Committee for Standardization, 2019). This standard specifies requirements that can enable an organisation to design, develop and provide products, goods and services that can be accessed, understood and used by the widest range of users, including persons with disabilities.



 national laws, such as:

- [Section 255 of the US Telecommunications Act](#), which regulates the accessibility and usability of telecommunications products and services by individuals with disabilities. It details the requirements for accessibility, usability and compatibility of new products and existing products (Federal Communications Commission, 1996).
- [Section 508 of the US Rehabilitation Act](#), which regulates the accessibility of products and technologies acquired by government bodies, including computer hardware and software, internet pages, telephone systems, fax machines and photocopiers in the US (Federal Communications Commission, 1998).



**Human vision** (to perceive visual, mostly textual, information), **fine motor skills** of the hands (to operate a keyboard, type on touch-sensitive surfaces and control a mouse or comparable devices) and **cognitive processes** to work with information provided by ICT are primarily used.

#### *Sensory requirements*

If the visual sense is limited, the operating system can format visual information differently (e.g. with a more recognisable font or higher-contrast colours) or enlarge it as desired (with screen magnifiers). Synthetic speech output can read any text aloud with high speech quality and customisable speed and voice.

If a sense is not available at all, then the general approach is to **offer information redundantly on another modality** as far as possible without loss of information (multi-modality). Blind users will continue to need ATs to convert texts into [Braille](#) and then make them accessible via touch.

However, most operating systems offer standardised interfaces to directly connect corresponding assistive devices. The state of the art in this area concerns the ability to automatically recognise the content of pictures, images, graphics, etc., and read them out to the user, for example. Currently, the recognition of content is limited to only a few, previously trained objects.

[Algorithms](#) are still unable to recognise an image's core message or distinguish whether an image is merely decorative or conveys a message of its own that may complement or even contradict the text.

In the past, hearing was the main sense needed when error messages were indicated via a warning sound or when there was direct communication by telephone or video telephony. However, nowadays, audio-visual media account for an increasingly large part of the content. Warning tones can



easily be replaced by, for example, a brief flashing of the screen or visual cues, while **automatic [subtitling](#)** of videos on the major streaming platforms is now of sufficient quality and is likely to find its way into private telephony and video telephony in the near future.

#### *Motor requirements*

User input into ICT usually requires motor activity. This may be typing (on a keyboard), tapping (on a touch-sensitive screen), moving a pointing device (e.g. mouse, trackpad or touchscreen) or articulating speech (e.g. to control a computer or dictate text).

Keyboards and mice are hardware that can only be reconfigured to a limited extent by software; they quickly reach their limits if users have greater adaptation requirements. In these cases, **alternative keyboards** (e.g. micro or screen keyboards) or **alternative pointing devices** (e.g. laser pointers or eye tracking devices) are used, for which operating systems must offer suitable interfaces. Meanwhile, the cameras built into many devices are of sufficient quality that they can be used for eye tracking and can, for example, sufficiently control the mouse pointer via eye movements. Similarly, single switches/keys or the visual detection of head movements can be used to operate all functions of an ICT via a switch control, even

for users with a high degree of motor impairment.

Finally, **[brain-computer interfaces](#)**, which have been in development for many years, do not require any physically recognisable movement; they can recognise and roughly distinguish brain patterns by means of sensors attached to (or in) the head and thus perform different actions.

#### *Cognitive requirements*

There are cognitive requirements for the use of ICT (e.g. use of common interaction patterns, consistency of use between different applications, and technical terminology, such as error messages) and for the perception and processing of information provided via ICT. The golden rule is that all simplifications, for example in the **[complexity of the user interface](#)** or the **language** used, benefit all users, including those with learning difficulties.

**Translation technologies** have now reached a sufficient level of maturity that automatic translation of foreign-language texts is relatively good. However, the translation of complex texts into **easy-to-understand language** or into **sign language** still requires human translators and sign language interpreters. Finally, automatic word completion and grammar checkers support users to enter texts that are error-free and grammatically correct.

The content dimension is also greatly influenced by the [World Wide Web Consortium](#)'s (W3C) [Web Accessibility Initiative](#) (WAI), which developed de-facto standards and support materials to help online content developers understand and implement accessibility.



One of the central elements developed in the WAI are the [Web Content Accessibility Guidelines \(WCAG\)](#). Although they are non-binding, they have had, and continue to have, an immense influence on the design of websites and web content and on corresponding legislation on accessible internet worldwide. The WCAG aim to make web content perceivable, operable, understandable and robust (with regard to compatibility with other tools and technologies).

As well as the user's personal characteristics, their context (environmental factors) may have an inclusionary or exclusionary effect. Although ICTs are widely used today, their acquisition represents an **economic barrier** that not all users can overcome. If the concept of design for all/universal design is interpreted more freely, then concepts such as [open source](#), [open access](#), open [online courses](#) or [OERs](#) can be seen as elements of open, barrier-free access to ICT and the content made available through it.

Beyond the economic barrier, there may be **socio-economic, infrastructural or other barriers** to access to digital technologies. As per *The Sustainable Development Goals Report 2021*, globally 73% of schools had electricity in 2019, 48% were equipped with computers and 40% had internet access (UN, 2021). Although these numbers indicate large growth compared to 2010, they show that a wider view of universal design is needed, that includes not only [accessibility](#) of the technology but also access to digital tools and content.

Finally, it should be added that even technologies implemented with a design for all/universal design mindset may offer different levels of **interaction quality (e.g. usability)** for different users.

Alternative interaction patterns, for example, require different amounts of time to make inputs or to capture content. Such differences can become relevant in the educational context. For example, there are usually time restrictions in assessment situations, so learners may be at a disadvantage if their interaction with ICT via alternative interaction patterns is more time-consuming or more tiring. These specific situations must therefore be taken into account for accessible ICT to develop its potential and provide users with equitable opportunities.

This design for all/universal design mindset is the aspirational standard in a preventive approach. The aim should be to implement educational settings that are built for all learners. This understanding of prevention is fully in line with the concept of Prevention-Intervention-Compensation policy approaches, set out in the Council Recommendation



## PROJECT EXAMPLE

### Interactive Digital Content Platform for All

This project's overall goal is to significantly contribute to increasing the number of online OERs accessible for learners with disabilities, with an emphasis on those with visual impairment. It will allow teachers and educators to easily produce rich online learning units which are accessible to learners with visual impairment and possibly other disabilities. An online course on inclusive education for the professional development of teachers, staff or any person interested in the education of learners with disabilities, will also be made available.

(Erasmus+ project, 2020–2023, project reference: 2020-1-ES01-KA201-083177)



on policies to reduce early school leaving (Council of the European Union, 2011). The Agency then extended this concept to the field of inclusive education. The goals of inclusive education are most effectively met when policy and practice:

- 🎯 **‘prevent** different forms of educational exclusion before they happen’;
- 🎯 **‘intervene** to ensure that good quality inclusive education’ is always available for all learners;
- 🎯 **‘compensate** with specific actions and provision when prevention and intervention are not enough’ to adequately meet learners’ needs in inclusive settings (European Agency, 2018, p. 18).

In this understanding, **ATs** are a compensatory approach. They should be used for learners vulnerable to exclusion whenever there are gaps that design for all/universal design do not yet fill. ATs have the functional goal of mitigating or eliminating motor, sensory or intellectual limitations, where other approaches reach their limits or where they are economically unfeasible.

To illustrate this with an example: before the [smartphone](#) era, it was not possible for users who were hard of hearing, deaf or had speech impairments to tele-communicate via normal telephones. There were technical solutions that allowed written

communication via the telephone network. However, it was not economically feasible to integrate this technology into all standard telephone devices, so there were specifically designed ATs, called text telephones (TTY), for this target group. These had to be available on both sides of the communication connection. With the advent of the short message service (SMS) and then smartphones with text-based chat functions built in as standard (plus further assistance functionality within the operating system for barrier-free operation), the need for this compensatory technology largely disappeared.

The rapid pace of technical progress therefore makes it necessary to repeatedly examine the extent to which accessibility, which until now could only be realised via AT, can be provided as standard in new products. Although this means that the amount of AT may decrease over time, these solutions still play an important role in filling existing gaps (at least transitionally). Accordingly, the definition of design for all/universal design already includes the requirement for interoperability with third-party (assistive) technologies.

ATs often come with disadvantages, like **poor usability** (as manufacturers rarely have sufficient knowledge of the field of user interaction) and **high costs** (AT is often produced in small quantities, so the development costs are spread over just a few units). **AT support** is often not available to learners with disabilities (Etscheidt, 2016) and the learners’ environment is **not always ready to integrate AT**. This also goes for teachers, who are often **not prepared to incorporate AT** in the classroom (Zilz & Pang, 2021). At the same



### **ASSISTIVE TECHNOLOGY (AT)**

‘Equipment, devices, apparatuses, services, systems, processes and environmental modifications used by people with disabilities to overcome social, infrastructural and other barriers to learning independence, safe and easy participation in learning activities, and full participation in society’ ([UNESCO, 2020](#), p. 419).



time, other educational technology is mostly incompatible with ATs. Some of these disadvantages may combine with a person's specific situation beyond their disability (e.g. low-income family, remote geographical location, second language user, etc.) to create new modes of discrimination and exclusion. Once again, this highlights the need to thoroughly consider intersectionality.

When designing AT, a participatory, [user-centred design approach](#) should be more widespread. Involving end-users in the development and design process of AT can improve not only its usability but also other quality aspects, like utility or attractive design (Bricout et al., 2021).

A recent development comes to the fore when reviewing the literature on the potential of [mobile devices acting as AT](#). Smartphones, [tablets](#) and [smartwatches](#) may serve to support behavioural interventions, provide users with checklists and reminders to structure their daily routines, issue rewards, support mood- or self-regulation, distribute surveys, or allow for task management.

A study that implemented a wearable application (app) to assist learners with intellectual and developmental disabilities showed the learners' enthusiasm and positive reaction to adopting a smartwatch and its features in class (Zheng & Genaro Motti, 2018). Another study showed that a tablet-based app efficiently supported adolescents with autism spectrum disorder (ASD) in self-regulating their emotions (Fage et al., 2019). Using mobile devices as AT has the advantage of lower costs and better availability than other specialised AT, which is subject to small production volumes, high development costs and a low level of standardisation. Mobile devices could therefore help make up the 'significant shortfall between the need for and provision of AT' (MacLachlan et al., 2018, p. 454), especially in developing countries.

#### 4.1.2 Technology in inclusive education

This section, as well as [section 4.1.3](#), focuses on specific technologies and presents their potential for supporting inclusion or inclusive digital education. The presentation of the technologies follows a frequently observed pattern of thinking:

- 🎯 What technologies are currently available?
- 🎯 What could be done with them in the field of education, and especially in the field of inclusive digital education?

This mindset is common and can be described as **technology-centric** or **technology-driven**. The advantage of such an approach is to stimulate innovative thinking and generate ideas that would never have emerged without knowledge of these technologies. Since the technologies already exist, it is easier for stakeholders from the respective application area, i.e. education in this case, to imagine their application, so they can develop transfer scenarios themselves and actively participate in their implementation.

However, this approach also has a number of disadvantages. On the one hand, it is in the interest of the technology manufacturers, as it promises an expansion of the market for their products. Accordingly, there is no critical partner in these manufacturers to carefully test the technologies in a new field of application, weighing up the advantages and disadvantages, and rejecting them if necessary. On the other hand, the problem known as the 'law of the instrument' or the 'law of the hammer' is that people who have become



familiar with a certain tool (here, a specific technology) tend to use it even in cases for which it was not actually developed.

Sections [4.2](#) and [4.3](#) will elaborate on why the **primacy of pedagogy** is essential to ensure inclusive digital education. The primacy of pedagogy is understood to mean that the selection, design and use of digital technologies and media exclusively follow the requirements of inclusive pedagogy and not vice versa. However, this does not mean that a **technology-centric approach** is inadmissible. The advantages of a technology-centric perspective described above can also be used under the primacy of pedagogy to develop ideas and innovations and to involve the users of these technologies – teachers, learners and other stakeholders – as experts in their own fields.

This overview follows a technology-centric view but still considers the aspects of pedagogy and inclusion. It looks at selected technologies to create [immersive learning environments](#) and their potential for implementing personalised and [adaptive learning](#). Immersive learning environments are closely related to recent developments in [VR](#) and [AR technologies](#), which are increasingly available in everyday life through smartphones or tablets. Other technologies, like [AI](#) and [big data](#), may impact on personalised and adaptive learning through, for example, [voice assistants](#), assessment tools, [chatbots](#) or [learning analytics](#).

### *Virtual and augmented reality*

[VR](#) and AR technologies allow users to **immerse** themselves – primarily visually – into an artificial world (VR) or to enrich the real world with additional information or content (AR).<sup>2</sup> Initial VR/AR systems – as well as current high-end products – consisted of head-mounted displays and suitable tracking technology so that head movements were translated (with the lowest possible latency) into corresponding perspective changes in the virtual or augmented world. This creates a very realistic impression, as if the user were actually in this virtual world, which is called immersion. These technologies used to be quite expensive and so were unsuitable for widespread use in education, despite their promising capabilities. However, technological developments, as well as the availability of VR/AR hardware and software components in the current generation of smartphones and tablets, have made this technology available in education.



### **AUGMENTED REALITY (AR)**

‘An enhanced version of reality created by the use of technology to overlay digital information on an image of something being viewed through a device (such as a smartphone camera)’  
([Merriam-Webster Dictionary](#), no date).

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<sup>2</sup> Another term sometimes used is mixed reality (MR), which is related to AR and allows physical and digital objects to co-exist and interact in real time. Finally, extended reality (XR) is an umbrella term that covers the entire spectrum of spatial computing technologies and accordingly includes AR, VR and MR, as well as possibly other, future technologies of a comparable nature.



There are **educational advantages** to using immersive learning technologies like AR and VR. The learners get realistic experiences of the issues they are studying. Such learner experiences often increase **learner focus and engagement**. Also, the learners are more actively involved through AR and VR. Furthermore, this visualisation makes it easier for learners to **understand abstract concepts** and they often get a **better understanding and assessment** of rare situations (Boyles, 2017). If designed in a user-friendly way, AR and VR **make the experience quite intuitive**. The technology's high degree of interactivity promotes **pro-active learning** and the assimilation of different situations. Regarding inclusion, AR has been judged to be capable of improving access to content and eliminating barriers (Del Cerro Velázquez & Morales Méndez, 2018).

Experts assume that VR and AR technologies will become further integrated into everyday life in the coming years. This means that learners should also be

**prepared to use these technologies** (Boyles, 2017). This assumption is underlined by the fact that the big technology players (Google, Microsoft, Meta, Apple) are heavily investing in the fields of VR and AR. The large investments being made, plus the technological expertise behind such companies, are promising prerequisites for the future of AR and VR technology (Elmqaddem, 2019). The use of AR and VR in combination with mobile devices is expected to be a main tool for accessing information in the future. Mobile devices are widespread, relatively easy to use, and usually already equipped with assistive features for accessible interaction. Accordingly, there are hopes that the use of smartphones or tablets could open up new possibilities in inclusive education. By using immersive learning technologies, like AR and VR combined with mobile devices, inclusive education processes may improve by **enabling lifelong learning** in an equal and high-quality manner (Del Cerro Velázquez & Morales Méndez, 2018). This would make the combination of AR and mobile devices an 'inseparable binomial' (ibid., p. 3446).

AR and VR technologies also have disadvantages. One of these is that **content creation** for such virtual worlds is laborious and not very intuitive. It therefore requires in-depth computer skills. The development of own content is realistically more relevant at higher levels of education. For example, in vocational education and training (VET), invisible or hidden mechanical, [electronic](#) or other effects, sequences or processes can be made accessible to sensory perception by means of AR and thus contribute to better understanding and learning.



## PROJECT EXAMPLE

### [#ShareEurope: Sharing interactive education in virtual and mixed reality](#)

The project aims to support the implementation of innovative teaching methods, by integrating VR and MR technologies in the educational approaches. One of the three main objectives of this project is to ensure high-quality and inclusive education, by enriching learning experiences while supporting effective use of digital technologies and encouraging activities that link learning with real-life experience, through the application of VR and MR.

(Erasmus+ project, 2019–2022, project reference: 2019-1-BG01-KA201-062321)



Currently, there is a lack of simple and universally usable **authoring environments**, so teachers usually have to limit themselves to the few existing offerings, which may only be available for purchase. Most teachers do not possess the capability to produce AR or VR material, as they never learnt how (Del Cerro Velázquez & Morales Méndez, 2018). Another disadvantage, although hardly discussed in the literature, is that these technologies focus on the **visual sense**. There are not any approaches to implementing universal design in this field, nor are ATs sufficient to create anything like a comparable user experience for non-sighted users. While there are many audience-specific applications in this area, there is no known application that allows every learner in a diverse class to participate equitably in the learning experience.

There follows a closer look at some [case studies](#) which offer insights into the use of AR and VR in inclusive education.

Before looking at the learning process itself, an interesting area of AR and VR application is in the **design of assistive products**. Choi (2021) looks at the use of AR and tangible augmented reality ([TAR](#)) when designing products, the latter adding interaction with the visual objects within the AR environment. AR and TAR tools can be used to evaluate design concepts of assistive products and solicit feedback. Through three-dimensional (3D) models of a product, the end-user can look at an assistive product in a real environment and can operate and interact with it. Immersive technologies can therefore be a useful tool to get end-users' feedback on and suggested improvements to assistive products (ibid.).

VR or AR tools can be used to **simulate classroom experiences** for educators (see also [section 4.3](#)). In this way, educators get guided practice in implementing classroom management strategies. This use is not only interesting for future educators but also for in-service training of educators. A feasibility and acceptability study with future educators showed that this technology holds potential for teachers in training, if it is used to reduce their stress and performance anxiety (Larson, Hirsch, McGraw & Bradshaw, 2020).

Garzón, Pavón and Baldiris (2019) undertook a literature review that covers 61 studies on AR in education. The review shows that, overall, **AR has a medium effect on learning effectiveness**. Learning gains and motivation are the most frequently mentioned advantages in the studies. One problematic finding is that only one of the AR systems covered in the literature included accessibility features (ibid.).



## PROJECT EXAMPLE

### Inclusive Peer Learning with Augmented Reality Apps

The project aims to streamline the adoption of AR technology in educational practice. The project will create innovative OERs for educators that help implement and integrate active and collaborative learning pedagogical approaches supported by AR. It plans to enrich teaching practice and support inclusive, peer-to-peer learning relevant to the requirements and preferences of the learners.

(Erasmus+ project, 2020–2023, project reference: 2020-1-DE01-KA203-005733)



Horace et al. (2016) aimed to examine how VR influenced the **social adaptation training** of school-aged children with autism. After training sessions with 100 learners using six VR scenarios, the children improved in three major aspects, namely social reciprocity, emotion recognition and affective expression (ibid.).

Another case study looks at the use of AR for learners who are deaf or hard of hearing. AR on tablets supported the learners in improving their **reading comprehension skills** and in **acquiring vocabulary**. Furthermore, this study showed that non-functional design features should not be underestimated, as many learners thought the glasses were not stylish enough to use in real classrooms (Ioannou & Constantinou, 2018).

Baragash, Al-Samarraie, Alzahrani and Alfarraj (2020) conducted a meta-analysis of 16 studies to look at **AR's effect on the skills** of individuals with different disabilities. The studies showed that AR's effect was largest on individuals' learning skills. Their social skills were also influenced, as well as their physical skills and living skills (ibid.). This highlights AR's potential influence in inclusive classrooms.

However, all these advantages of such technologies are often not considered. In their literature review, Carreon, Smith, Mosher, Rao and Rowland (2020) show that in [K-12](#) settings VR is mostly used in non-immersive simulations that are shown on a screen. Yet it is these immersive features that make VR an especially appealing tool for learners with disabilities (ibid.).

These studies show that AR/VR technologies impact the learning processes of all learners, including those with disabilities. Not only cognitive skills, like learning vocabulary, but also social, emotional and affective skills improve through the use of immersive technologies in the classroom. However, most case studies looked at learners with one specific disability, instead of looking at all learners and evaluating the technologies from a universal design perspective.

### *Artificial intelligence*

For the field of AI in education, a split picture emerges in the scientific literature. Meta-analyses of the opportunities of AI in relation to [personalised learning](#) tend to show a minor pedagogical effect (Nouri et al., 2019). However, at the same time, numerous publications emphasise potential opportunities, but in some cases do not conduct any evaluations and, therefore, do not provide any evidence.

Almohammadi, Hagra, Alghazzawi and Aldabbagh (2017) looked at how to develop an **adaptive e-learning system** that provides **personalised learning services and study materials** for all learners. The first step was to create profiles based on learners' knowledge and skill levels, their individual personalities and their affective states. AI then used this data to create an adaptive and personalised learning environment. Such a model, according to Almohammadi et al. (ibid.), can create appropriate pedagogy, building on the learner profiles, and adjust the e-learning environment to suit the pedagogies.



### **ARTIFICIAL INTELLIGENCE (AI)**

'The study of how to produce machines that have some of the qualities that the human mind has, such as the ability to understand language, recognize pictures, solve problems, and learn'  
([Cambridge Dictionary](#), no date).



They also claim that AI supports not only the generation of personalised learning materials, but also of **individualised feedback**. This feedback could be provided in an automated way through [machine learning](#) and [natural language processing](#). Another study shows that personalised feedback improves the learning process. There, learner performance improved by 22.95% when learners received automated, personalised feedback (Kochmar et al., 2021).

AI techniques, such as [deep learning](#) and [computer vision](#), could also be used to develop **smart learning assistance tools** for inclusive education. Srivastava, Varshney, Katyal, Kaur and Gaur (2021) propose such a tool, aimed at learners with hearing impairments, as well as those with speech and visual impairments. It provides them with different teaching-learning opportunities. This tool is expected to ensure two-way communication with peers and educators in the classroom, and to make learning easier (ibid.).

In 2016, Timms (2016) anticipated the emergence of more AI technologies designed specifically and solely for learning and teaching. These technologies would probably **combine the field of AI with robotics and sensor technology**. Timms assumed that, in the future, educational cobots (collaborative robots) would assist teachers in the classroom and that [smart classrooms](#) would use sensors to support learning for all learners (ibid.). However, these predictions are not reflected in the educational reality of 2022.

In addition to the many promised advances AI would bring to education, there were indications of the potential risks associated with introducing this technology.

AI can be a:

... disruptive technology and may deepen the existing inequalities and divides as the marginalised and disadvantaged population are more likely to be excluded from AI-powered education (Pedró, Subosa, Rivas & Valverde, 2019, p. 28).

According to this UNESCO report, there could be ‘a new kind of digital divide’, in the ‘use of data-based knowledge to inform intelligent decision-making’ (ibid.).



## PROJECT EXAMPLE

### **VRAILEXIA – Partnering Outside the Box: Digital and Artificial Intelligence Integrated Tools to Support Higher Education Students with Dyslexia**

The project aims to create a network of higher education institutions engaged in a memorandum of understanding for developing inclusion strategies for dyslexic learners and enhancing their opportunities for success during their academic career and integration into the labour market. The general objective is to develop strategies for inclusion of learners’ untapped talents and strengths. Among the tangible project results, development of an adaptive learning environment based on informed AI for supporting learners with dyslexia is planned.

(Erasmus+ project, 2020–2023, project reference: 2020-1-IT02-KA203-080006)



Therefore, what needs to be considered when using AI in education is, on the one hand, that all learners need to have the opportunity to benefit from the technology. On the other hand, the quality of data used to train the AI is highly relevant; **poor-quality training data** can severely bias the results AI generates (e.g. ethnic, cultural, racial, ability biases). If the training data is not based on all learners and does not represent an inclusive classroom, the algorithm will probably replicate this insufficiency in its results and so discriminate against certain learners, for example, by not considering their special educational needs. A large amount of data is required to train AI systems; this training data is time-consuming and costly to obtain. In various areas of AI research, training data is therefore also generated artificially for efficiency reasons. To what extent this approach also causes distortions remains to be seen. However, the problem lies not only in the collection of non-discriminatory and truly representative data, but also in the fact that a teacher or school manager is unlikely to be able to identify errors or poor quality in the data used to train an AI system.

### *Robotics*

Robots designed to assist humans is another field of technology that is gaining importance in inclusive education. [Robotics](#) is the scientific and engineering discipline dealing with the design, construction and operation of these robots. Papazoglou, Karagiannidis and Mavropoulou (2021) evaluated an intervention using **educational robotics** in primary schools in Greece and, specifically, its impact on learners with ASD. The study particularly looked at the social status of learners with ASD. Before the intervention, these learners' social status was rather low, and the evaluation results indicate that the use of educational robotics **improved their social status** (ibid.).

Other authors also looked at children with ASD and how robotics designed to assist them in social situations influenced their **learning processes**. Such robotics mainly use interactive technology, including educational video games, to motivate learners with ASD to use the technology as part of their communication tools (Paillacho Chiluzia, Solorzano Alcivar & Paillacho Corredores, 2021). Bratitsis, Ziouzos, Dasygenis and Alevriadou (2020) look at using educational robots for **empathy education** with the help of realistic simulations in classroom settings.



### **PROJECT EXAMPLE**

#### **Telepresence experience network – information on children's learning**

This project aims to establish a network to support children in marginalised situations, particularly those with long-term illnesses or who are hospitalised. It aims to have several ready-made, practical methods to make use of telepresence quickly and easily. This will particularly be aimed at staff and teachers who are directly in contact with learners using telepresence. The network plans to share knowledge on the topic of learning with technological aids and to share insights on work with telepresence and further developments in the field.

(Erasmus+ project 2020–2023, project reference 2020-1-DK01-KA201-075142)



Another application area for robotics is its use as a [telepresence technology](#), e.g. to allow hospitalised children experience their educational environment and stay in touch with their classmates, while the classmates have a physical point of contact through the robot, which is located, for example, in the hospitalised learner's seat in the classroom (see also [section 4.3](#)). Evaluation results indicate that such interventions can reduce loneliness and isolation, increase connectedness with peers and lift the mood of the participating children (Chubb, Fouché, Agee and Thompson, 2021).

As noted elsewhere, most studies focus on specific types of disabilities (e.g. ASD or intellectual disabilities) and test the contribution of technology (robotics, in this instance) to the learners' emotional or social development. However, in general, there is no consideration of the potential and the risks or disadvantages these technologies entail for the entire classroom context or of the technology's contribution to the implementation of inclusive pedagogical concepts.

### *Mobile learning*

Mobile learning (m-learning) is receiving attention from a growing body of scientific literature that looks at learners' interactions with mobile devices. As most users carry their mobile devices with them at all times, m-learning is possible **anytime and anywhere**, in [formal](#) or [informal](#) educational settings. Xie, Basham, Marino and Rice (2018) reviewed 47 studies in the field of m-learning. Their findings show that the studies are generally positive about m-learning's potential for inclusive education and for supporting learners with disabilities (ibid.).



### **M-LEARNING**

'M-learning is a teaching and learning methodology that uses mobile devices that have wireless connectivity, the use of these devices offers the opportunity to learn anytime, anywhere' ([Criollo-C, Luján-Mora & Jaramillo-Alcázar, 2018, p. 1](#)).

Learning with mobile devices can also be an important element of inclusive education as it supports economic equality. Classic ATs are often too expensive or not available at all, especially in developing countries or for people with low income (Ismaili & Ibrahim, 2017). Here, smartphones and tablets can be seen as a major **alternative to such ATs**, as most of the population already owns a mobile device.<sup>3</sup> These devices are already equipped with powerful ATs at the operating system level, which – in comparison to desktop computers – ensure significantly better accessibility.

For example, one study compared seven free [mobile apps](#) with seven AT devices. The findings show that mobile devices in combination with apps may be a real and efficient alternative to classic ATs, which are often mono-functional and expensive. These findings count both for formal and informal learning contexts (Ismaili & Ibrahim, 2017).

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<sup>3</sup> In 2018, there were more mobile devices in the world than people (Criollo-C, Luján-Mora & Jaramillo-Alcázar, 2018).



Ferreira, Pacheco, Berreta and Nogueira (2020) looked at m-learning as a tool for blind learners. One important aspect they found is that the **design of m-learning systems** must consider previous experiences and systems already known to blind users, so that they can rely on those experiences. In general, the findings also show that blind learners have a positive predisposition towards m-learning, as they are already highly involved with smartphones (ibid.).

In higher education (HE), m-learning may also offer opportunities. The trend in higher education institutions (HEIs) is for learners to bring their own mobile devices and use the institution's networks to access data and academic material. This policy is called **'bring your own device' (BYOD)** (Ruxawana, Msibi & Mahlangu, 2018) and has already been adopted in most HEIs, especially in developed countries. However, studies also report certain barriers, such as the institutions' lack of readiness regarding policies governing the use of those mobile devices and regarding the necessary infrastructure, and limited support for top management on BYOD strategies (ibid.).

M-learning does not only have to relate to smartphones and tablets. Smartwatches, as another category of mobile devices, could also become m-learning tools in the future, although their applications are relatively limited at present. Wright, McMahon, Cihak and Hirschfelder (2020) suggest the use of **smartwatches for learners with intellectual disabilities and ASD**. These devices can be used to remember and attend appointments on time and to complete associated tasks (ibid.); in an educational context, they could be used, for example, to ensure that learners follow the timetable or to remind them of assignments.

Similarly, Evmenova, Graff, Genaro Motti, Giwa-Lawal and Zheng (2019) reported on a smartwatch app designed to support learning, participation and independence. It also used prompting and reward systems to encourage learners' self-management and positive behaviours (ibid.).

### *Games and gamification*

**Digital games** are another way to improve the quality of learning in inclusive education. Gamification designs usually involve elements from classic computer games. The most common elements in games for education are collecting points, levels, badges or achievements, as well as leader-boards. Such elements can **motivate learners** and thereby support the learning process. **Increased class participation and attendance** were also reported when gamification approaches were used in the classroom. Furthermore, attendance and participation showed a positive correlation with **learner performance** (dela Cruz & Palaoag, 2019). Salvador-García (2021) studied the impact of gamification in remote learning environments during the pandemic. The results show statistically significant differences in learner participation when gamification was used. The author concludes by emphasising gamification as an effective tool to increase learners' participation and motivation (ibid.).



### **GAMIFICATION**

'The practice of making activities more like games in order to make them more interesting or enjoyable' ([Cambridge Dictionary](#), no date).



**Gamification** is an approach that is related to (digital) games, but can be fundamentally differentiated in terms of its purpose. In applications such as learning software, techniques from the field of games are being applied to, for example, make the user or interaction experience more positive, motivating, stimulating or satisfying.

Recent studies show that gamification approaches also support people with learning difficulties, particularly with regard to **reading and maths skills**, so that improvements in learning quality were observed (Lämsä, Hämäläinen, Aro, Koskimaa & Äyrämö, 2018).

Stone, Mills and Sagers (2019) looked at the influence of gamification approaches on learners with ASD. Observed data shows that multi-player games supported the **social interactions** of learners with ASD. In the games, learners needed to engage in reciprocal conversations, give commands to other players, share information with them and make requests. Such games promoted gesture, speech and writing interactions, not only in the virtual world but also in physical spaces. This study shows that gamification can serve to promote the capacity of learners with ASD in initiating and sustaining social interactions (ibid.).

Gamification can also be used in the context of assessments. Reed, Martin, Hazeltine and McMurray (2020) explored how learners with or at risk of reading difficulties perceived a decoding assessment with gamification characteristics. The results of their study show that learners **immersed themselves in the assessment and were motivated** by the tasks. One disadvantage was that the learners focused on design features or identifying patterns and game strategies, instead of concentrating on the skills actually being assessed (ibid.).

### *Learning analytics*

[Learning analytics](#) may also support inclusive learning environments by collecting and analysing relevant data in real time to better understand and enhance all learners' learning processes. Cooper, Ferguson and Wolff (2016) looked at the potential of learning analytics for supporting learners with disabilities. Their application scenario for learning analytics touches upon the fact that there is a gap in the retention rates between learners with and without disabilities. Learning analytics in their study aimed to **identify and better understand those discrepancies**. Based on this analysis, interventions had been designed to particularly **improve the retention rate** of learners with disabilities (ibid.).

Another tool combined learning analytics with gamification approaches. Most educational games are highly interactive and provide real-time data on the players' learning processes. The tool used this data, both during the game and afterwards, to **evaluate the learning and adapt to it** (Nguyen, Gardner & Sheridan, 2018). Through this mechanism, learning analytics is expected to have huge potential for **personalised learning** (Lenz, Pomp, Meisen & Jeschke, 2016). A similar attempt to link learning analytics with gamification aimed to **identify children at risk of reading disability**, as the analysis of their data and playing behaviour can be used for clustering and early identification of specific support needs (Niemelä et al., 2020). Therefore, this application of learning analytics might be used in inclusive classrooms to identify all learners' needs and to adapt to them in a timely manner.



#### 4.1.3 Technologies not yet in education

Generally, it is difficult or impossible to predict future trends and their impact on the education sector. Therefore, only a few indications of potential developments can be given below; these may be worth keeping an eye on and observing.

Educational robotics has already been addressed, but it is worthwhile to look at other robotic developments. One that influences people's daily lives is the fast-growing area of **domestic robotics**. Here, assistive robotics are being developed to help elderly or infirm persons carry out activities of daily living, to enable them to live independently for as long as possible. Engineering approaches are being explored that help to identify tasks that are problematic for the users and to support the users accordingly. However, the largest challenge currently for such robot design is the unstructured domestic environment in which they are expected to work flawlessly (Aquilina, Saliba & Fabri, 2019). Domestic robots can help with **basic activities of daily living**, but may also provide **social and cognitive support** in the future (García-Soler et al., 2018).

There are various favourable factors that make it seem likely that these technologies could also find their way into the education field. One of the supporting factors is that domestic robots serve a much larger market not as technical aids but as comfort technologies and are therefore becoming increasingly cheaper to acquire. Domestic robots, which can be used, for example, for room surveillance via video and can move through a house or flat independently or by remote control when the residents are absent, possess almost all the functions required for **mobile telepresence systems**. If these systems continue to develop in the areas of social or cognitive support, they will definitely have an impact in the area of home-based learning and will have to be taken into account accordingly.

However, these examples also point to the need to critically discuss technologies that have been developed for other areas of application and are then 'repurposed' for use in the education field with regard to their inherent risks (in this case, room monitoring, transfer of spoken data to company servers, privacy, data protection, etc.).

In fact, there is a large discrepancy between the number of publications on the topic of AI in the education field and the frequency of actual use of AI in this area. However, it is often overlooked that AI is already most often encountered in the form of [chatbots](#), which allow users to interact with an AI system in a natural language dialogue. For example, chatbots are capable of answering written questions in specified knowledge domains. The same technology, enhanced with [speech recognition](#) and synthetic speech output, is being used in [smart speakers](#), which replace the written dialogue with spoken dialogue. Meanwhile, these AI-powered chatbots are capable of more complex interactions (Gowtham & Amalanathan, 2019).

In inclusive education, more elaborate versions of these bots could provide **assistance to learners**, where, for example, educators cannot respond to all questions or demands immediately or in sufficient detail. Muncie (2020) argues that it is important to give **human traits and personality** to such chatbots. This would make the information from the chatbots more relatable and believable. Also, a chatbot with personality traits could better convey emotional messages. While Muncie's study (ibid.) particularly looked at chatbots in a military context, chatbots with personality and emotional traits could also be



enriching in an educational context. Particularly for some learners, it could be an opportunity to practise interaction with peers and educators in a **'safe' and forgiving environment**. At the same time, Muncie states that a similar type of chatbot could be used to train educators on appropriate interaction with all learners (ibid).

However, this vision does not take into account the discussion around AI in chat- or voice-based communication with humans that was triggered with the launch of Google's Duplex assistant in 2018. The system was able to make phone calls on the user's behalf and did so with such convincing quality that the other party was unaware that they were actually communicating with a technology and not with another human being. The discussions on **ethical considerations** and the resulting implications have not yet been finalised. Nevertheless, it became clear early on that a human-like communicating technology must identify itself as such (Wong, 2018), so that people are not led astray (O'Brien, 2018), and that precisely for this reason human traits in such technologies should be avoided as far as possible.

#### 4.1.4 Summary

In the search for technology topics in the most recent literature on inclusive education, it was particularly noticeable that **most studies deal with the use of technologies for very precisely specified target groups, often based on medical classification criteria**. Even if some technology applications have certain advantages for people with autism or blind people, for example, this does not mean that these applications can be used in an educational context in such a way that they promote inclusive education. In general, there was only a small overlap between literature on inclusive education and literature on digital education. The concept of universal design is not found to any significant extent among technology developers or among the users who apply these technologies in an educational context, even though it is a prerequisite for inclusive digital learning environments. However, fulfilling this prerequisite would only be the first necessary step, because after that, pedagogical potentials and the technology's interaction with other pedagogical concepts and methods would still have to be explored.

Looking more closely at the technologies and design approaches identified in this study, the following points stand out. VR and AR are fascinating technological approaches that can now be used on everyday devices, especially smartphones and tablets, and can therefore also be considered for the education field. However, little progress has been made in the field of content creation for VR and AR applications. If teachers (and learners) are unable to create content themselves, then there will only be a few selected and externally specified topics for the – hence inflexible – use of the technology in education. **As long as content creation for VR and AR applications is more difficult than creating a text document or a slideshow presentation, these technologies will only have a niche existence** despite all their potential.

Regarding the subject area of AI, the great discrepancy between the frequency of the topic in the literature and its actual low prevalence in educational practice is striking. In addition, the publications are mostly characterised by positive expectations of this technology and seldom address the challenges and ethical questions associated with it. **While it is easy to imagine AI fulfilling the role of an AT for individual users, so far there**



are only a few approaches (e.g. in the field of learning analytics) that focus on the entire classroom context.

## 4.2 Learners and inclusion in digital education

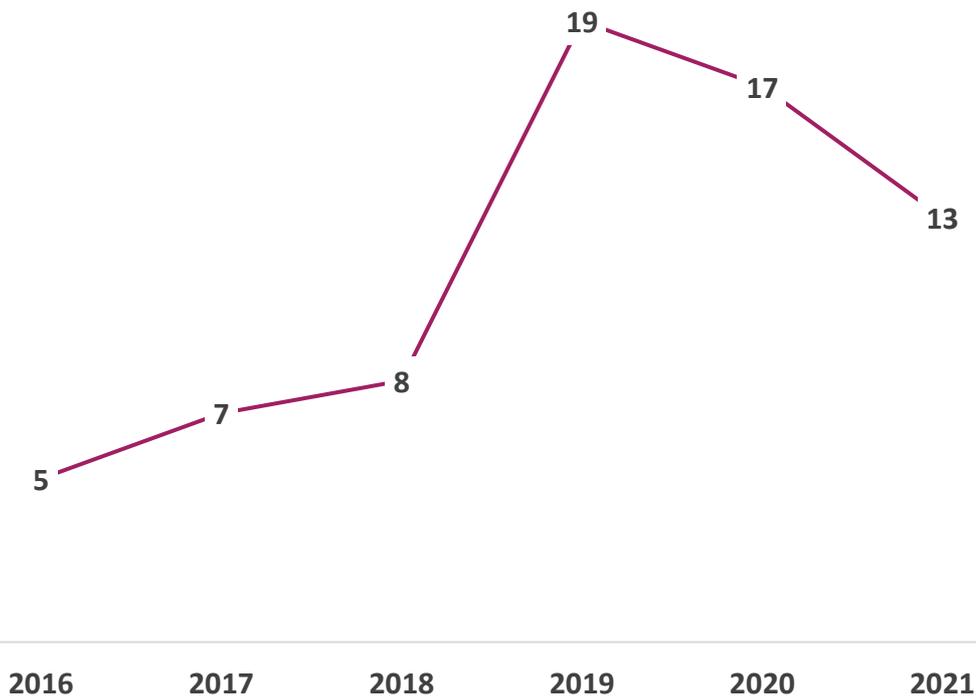
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Inclusion of all learners is essential for high-quality digital education but is also a complex issue. Digital learning environments and digital media use provide both support for and barriers to greater inclusion in education in general and in digital education in particular.

To identify pedagogical interventions to reduce exclusion and enhance the inclusion of all learners, it is necessary to carefully consider individual characteristics and capabilities, as well as environmental conditions influencing the learners' degree of inclusion in the educational setting. Therefore, this section presents and discusses the literature review's findings on characteristics of vulnerability to exclusion, the role of the educational setting, and learners' digital competences for inclusion in digital education.

A systematic key term search in relevant databases and journals led to the identification of 69 particularly relevant sources on the topic of learners in inclusive digital education. This literature was evaluated based on the information found in the titles and abstracts. The results of the evaluation are presented in more detail below. For a closer look at the methodology, see the separate [methodology paper](#).

[Figure 2](#) presents an overview of the publication years of the 69 literature sources found. As the figure shows, there is a clear increase in the relevant literature between the years 2018 and 2019. Although there is a slight decrease in 2020 and 2021, the numbers are still clearly higher than in the years before the increase (2016 and 2017). Considering that the year 2021 was still in course at the time of this study (November 2021), it can be concluded that there is increasing research interest in the inclusion in digital education of learners who are or may be at risk of exclusion. This is consistent with the findings on technological perspectives on inclusion ([section 4.1](#)).



**Figure 2. Literature search results per year (2016–2021)**

Based on [chapter 3, section 4.2.1](#) takes a closer look at vulnerable learners in digital education. The results are compared with and discussed in light of the Agency’s [Multi-Annual Work Programme](#) (MAWP) 2021–2027 (European Agency, 2021b) and UNESCO’s understanding of vulnerability to exclusion (UNESCO, 2020). [Section 4.2.2](#) analyses different learning environments and settings mentioned in the literature with regard to inclusion in digital education. Then, [section 4.2.3](#) discusses the identified digital competences of learners in comparison with UNESCO’s Digital Literacy Global Framework (Law, Woo, de la Torre & Wong, 2018). Finally, [section 4.2.4](#) summarises the chapter’s key messages.

#### **4.2.1 Vulnerability to exclusion in digital education**

As [chapter 3](#) shows, individuals’ vulnerability to (digital) exclusion in the learning process and education system can arise from different characteristics. To gain deeper insight into making ‘vulnerable learners’ in digital educational contexts a subject of scientific discussion, the considered literature was analysed with regard to the terminology of vulnerability and [intersectionality](#), as explained in chapter 3.

With reference to digitalisation, Table 1 shows an overview of ‘vulnerable’ learners identified in the literature reviewed in the context of digital education and compares this with the characteristics for vulnerability in the MAWP 2021–2027 (European Agency, 2021b) and the 2020 GEM Report (UNESCO, 2020). (Some literature findings on different types of vulnerable learners are given as exemplary sources, but are not meant to be exhaustive). The result shows that **vulnerability to exclusion** in digital education is not fundamentally different from a general understanding of vulnerability in education, as the characteristics for vulnerability in the MAWP 2021–2027 and the 2020 GEM Report can be



found in the considered literature. (Not all vulnerability characteristics mentioned in the MAWP 2021–2027 and the 2020 GEM Report were found in the literature, but this may be attributed to the limited number of sources considered). It is noticeable that the literature lists some additional vulnerability characteristics that seem to go beyond this understanding (e.g. in VET and employment, by educational background, by intellectual giftedness).

Furthermore, in some sources, vulnerability to exclusion in digital education is associated with learning-related phenomena that are strongly related to mechanisms of the (societal) system and can therefore be attributed to the concept of intersectionality:

- 🌈 **Vulnerability to exclusion based on societal inequalities and discrimination**, e.g. learners with disadvantaged backgrounds (Drane, Vernon & O’Shea, 2021), youth at risk (UNESCO Institute for Lifelong Learning, 2021), vulnerable groups in society (Checa Cabrera & Freire Cadena, 2021), ‘people who differ somatically, cognitively or culturally from other members of society’ (Schorb, 2019, p. 65; own translation)
- 🌈 **Vulnerability to exclusion based on the learning process**, e.g. struggling learners (Watkins, Treviranus & Roberts, 2020), non-traditional learners (Akella, 2019), low-performing learners (Aunio & Mononen, 2017), marginalised learners (Hayes, 2021)
- 🌈 **Vulnerability to exclusion based on learning with digital media**, e.g. due to individual decisions to go online or not (Hayes, 2021), digital inequity in learning (McLay & Reyes, 2019).

This could be an indication of a broad awareness in research of diversity and intersectionality of inclusion in digital education. Nevertheless, there is a wealth of literature that focuses on the inclusion of a specific group of learners (e.g. learners with autism, disabilities, from low-income backgrounds, etc.) through the use of digital media or [virtual learning environments](#). There seems to be a gap between solely addressing the needs and circumstances of a single ‘vulnerable’ group of learners on the one hand and the aim of dealing with all learners’ different, heterogeneous needs and circumstances on the other.

**Table 1. Vulnerability to exclusion in digital education – comparison of the considered literature with MAWP 2021–2027 (European Agency, 2021b) and 2020 GEM Report (UNESCO, 2020)**

<b>Vulnerability in learning (MAWP; 2020 GEM Report)</b>	<b>Learners in the considered literature with regard to vulnerability and inclusion in digital education</b>
<b>gender; sexual orientation; gender identity and expression</b>	<ul style="list-style-type: none"> <li>- gender (e.g. UNESCO Institute for Lifelong Learning, 2021; Slemmons et al., 2018; Bele &amp; Kvalsund, 2016)</li> <li>- LGBTQIA+ (e.g. Blume, 2021; Subramony, 2018)</li> <li>- sexuality (e.g. Blume, 2021)</li> </ul>



<b>Vulnerability in learning (MAWP; 2020 GEM Report)</b>	<b>Learners in the considered literature with regard to vulnerability and inclusion in digital education</b>
<b>age (e.g. children, youth, adults)</b>	age <ul style="list-style-type: none"> <li>- (young) children (e.g. Bosse, Schluchter and Zorn, 2019; Watkins et al., 2020)</li> <li>- youth (e.g. Drane et al., 2021; UNESCO Institute for Lifelong Learning, 2021; Kim &amp; Searle, 2017)</li> <li>- adults (e.g. Garland, 2019; UNESCO Institute for Lifelong Learning, 2021; Salmerón, Fajardo and Gómez-Puerta, 2018)</li> <li>- older people/pensioners (e.g. Haage &amp; Bosse, 2019; Bosse et al., 2019)</li> </ul>
<b>not explicitly mentioned</b>	personality and identity <ul style="list-style-type: none"> <li>- 'low confidence' (e.g. Lambert, 2020)</li> <li>- digitised and datafied identity (e.g. Hayes, 2021; McLay &amp; Reyes, 2019)</li> </ul>
<b>not explicitly mentioned</b>	intellectual giftedness (e.g. Eysink, van Dijk & de Jong, 2020)
<b>Disability</b>	health impairments <ul style="list-style-type: none"> <li>- intellectual/cognitive/learning disabilities (e.g. Shih, Chiang &amp; Lin, 2021; Stone et al., 2019; Konnerup, 2018)</li> <li>- developmental/mental health issues (e.g. Bele &amp; Kvalsund, 2016; Liontou, 2019; Baragash et al., 2020; Salmerón et al., 2018; Sorensen &amp; Andersen, 2017)</li> <li>- mobility issues (e.g. OECD, 2019a)</li> <li>- visual impairment (e.g. Sproul, Ledger &amp; MacCallum, 2021; Opie, 2018)</li> <li>- other physical disabilities (e.g. Baragash et al., 2020)</li> <li>- chronic diseases (e.g. Fisseler, 2019)</li> </ul>
<b>Wealth</b>	wealth and socio-economic status <ul style="list-style-type: none"> <li>- poverty (e.g. UNESCO Institute for Lifelong Learning, 2021)</li> <li>- (low) socio-economic background (e.g. Lambert, 2020; Aunio &amp; Mononen, 2017)</li> </ul>
<b>not explicitly mentioned</b>	educational background <ul style="list-style-type: none"> <li>- low literacy/alphabetisation (e.g. UNESCO Institute for Lifelong Learning, 2021; Bosse et al., 2019; Schorb, 2019)</li> <li>- low-skilled people (e.g. Lambert, 2020; UNESCO Institute for Lifelong Learning, 2021)</li> <li>- low educational level (e.g. OECD, 2019b; UNESCO Institute for Lifelong Learning, 2021)</li> </ul>
<b>not explicitly mentioned</b>	vocational training and employment <ul style="list-style-type: none"> <li>- work and family responsibilities (e.g. Haage &amp; Bosse, 2019; Ulzheimer et al., 2021)</li> </ul>



<b>Vulnerability in learning (MAWP; 2020 GEM Report)</b>	<b>Learners in the considered literature with regard to vulnerability and inclusion in digital education</b>
<b>remoteness</b>	remoteness - living in rural areas (e.g. de Klerk & Palmer, 2021; Nedungadi, Menon, Gutjahr, Erickson & Raman, 2018) - living in deprived areas (e.g. UNESCO Institute for Lifelong Learning, 2021; Nedungadi et al., 2018) - internationality (e.g. Smith & Arment, 2020)
<b>ethnicity (e.g. Sinti and Roma, indigenous people)</b>	ethnicity and culture - indigenous people (e.g. Williams, 2019; Nedungadi et al., 2018)
<b>migration; displacement</b>	migration and displacement - refugees, asylum seekers (e.g. UNESCO Institute for Lifelong Learning, 2021; Colucci, Castaño Muñoz & Devaux, 2017)
<b>intersectionality</b>	- vulnerability due to societal inequalities and discrimination (e.g. Bele & Kvalsund, 2016; Lambert, 2020; de Klerk & Palmer, 2021) - vulnerability in learning processes (e.g. McLay & Reyes, 2019; Akella, 2019) - vulnerability to digital exclusion (e.g. Asmar, van Audenhove & Mariën, 2020; Drane et al., 2021; Watkins et al., 2020)

The reviewed literature scarcely mentions **digital exclusion**: just nine out of 69 sources do so.<sup>4</sup> Within this limited number of sources, digital exclusion is mentioned in combination with different learning topics and perspectives:

- 🌍 In most cases, learners with different disabilities or from disadvantaged backgrounds (e.g. deprived areas (UNESCO Institute for Lifelong Learning, 2021)) are considered and can be categorised as children, young people or adults.
- 🌍 In some cases, learners who are marginalised or who struggle in the learning process are included (Watkins et al., 2020; Winters et al., 2020).
- 🌍 Online or distance learning frameworks or school closures are particularly addressed in the context of the COVID-19 pandemic. Drane et al. (2021), looking at vulnerable young learners from disadvantaged backgrounds, highlight the **risk of perceived disadvantage** through disengagement, poor technology management and increased psychosocial challenges.
- 🌍 Asmar et al. (2020) emphasise the **social nature of digital inclusion and exclusion** and Winters et al. (2020) deal with the question of avoiding **digital structural violence** in digital learning environments.

<sup>4</sup> Asmar et al., 2020; Drane et al., 2021; Garland, 2019; Haage & Bosse, 2019; Lambert, 2020; Opie, 2018; Ulzheimer et al., 2021; Watkins et al., 2020; Winters, Eynon, Geniets, Robson & Kahn, 2020.



- Ulzheimer et al. (2021) point out that even **learners who have previously studied without barriers** may face barriers in digital education (e.g. lack of technical equipment or [digital literacy](#)) and thus may turn out to be vulnerable to digital exclusion. Among other things, this is related to individuals' decisions to go online or not and their self-reflection on **being digitalised and datafied** (e.g. Hayes, 2021).

Thus, digital media has neither an overall positive nor an overall negative impact on inclusion in education. Furthermore, inclusion in digital education seems to be a **multi-dimensional phenomenon** (UNESCO Institute for Lifelong Learning, 2021), which is affected at least by society, the educational institution's technical equipment, the learning situation and the individual learners.

Inclusion in digital education for individual learners is, therefore, reflected not only in the opportunity to participate in learning opportunities, but also in having **technical access** and being both physically and virtually **present and visible**, together with other learners (Qvortrup & Qvortrup, 2018). Furthermore, inclusion is manifested in the possibility of **being actively socially involved**, of interacting and collaborating with teachers and other learners using digital media and of participating in digital learning environments (ibid.; UNESCO Institute for Lifelong Learning, 2021).

However, the individual learner's **perceived inclusion** also plays a role, in that it is associated with feeling accepted and belonging to the learning community (Qvortrup & Qvortrup, 2018). This may refer to **exclusionary mechanisms in the social environment** (e.g. inequalities or discrimination by peers or in society), but also to the perception of one's own ability to use media competently and to participate digitally in a self-determined way, e.g. learners with 'low confidence' (Lambert, 2020). This is directly related to the **development of digital competences** for learning: 'There are risks of new digital divides in terms of access to [emerging technology](#) and suitably literate training' (UNESCO Institute for Lifelong Learning, 2021, p. 46). [Section 4.2.4](#) discusses the topic of digital competences for learning in digital education in more detail.

In sum, the understanding of vulnerability in digital education in the literature reviewed is not fundamentally different from a general understanding of vulnerability to exclusion in education, like in the MAWP 2021–2027 (European Agency, 2021b) and the 2020 GEM Report (UNESCO, 2020). Within the considered literature, some additional vulnerability characteristics are identified, especially in the field of learning-related phenomena that are strongly related to mechanisms of the (societal) system.

In conclusion, intersectionality and multi-dimensionality seem to be essential for achieving inclusion in digital education. However, the reviewed literature scarcely mentions digital exclusion, indicating a clear need for further research.



#### 4.2.2 Learning environments and settings

In addition to analysing learners vulnerable to exclusion, this section reflects on the learning contexts mentioned in the literature considered regarding inclusion and digital education. Table 2 shows an overview of the different learning environments and settings analysed and discussed with regard to learning and inclusion in digital education. (Some literature findings on different types of learning environments and settings are given as exemplary sources, but are not meant to be exhaustive). The literature discusses learning and inclusion in the context of digitalisation in [formal](#), [non-formal](#) and [informal](#) learning settings, as well as with regard to specific education topics and digital educational settings.

Literature referring to **formal and non-formal education** mentions: children in pre-primary education, learners in primary and secondary level or special schools, in HE (including teacher education) and adults (including older people) in continuing education, but also learners in in-service training, in penal institutions and in educational offerings by galleries, museums and cultural centres. The field of **informal learning** considers [workplace learning](#), social work and assisted living as well as learning within the family, by using [social media](#) and with the internet as an information resource.

The issue of inclusion and learning in digital education is part of some literature, which focuses on **specific educational topics** like media education, (native or foreign) language or multi-lingual education, (trans-)cultural and international education, different teaching methodologies (e.g. mathematics, literacy) and providing support for learners. Unsurprisingly, inclusion in learning is mentioned in a range of literature results dealing with different **digital educational settings**: e.g. (multi-player) games and game-based learning; digitalised teaching-learning settings like virtual classrooms, [distance education](#), [blended learning](#) and [e-learning 4.0](#); use of virtual learning environments ([VLEs](#)) and [learning management systems](#) (LMS); face-to-face teaching enhanced by digital media (e.g. [BYOD](#)) and open educational practices (e.g. [MOOCs](#)).

Another interesting, recently emerged aspect is **emergency remote teaching and learning** (Pittman, Severino, DeCarlo-Tecce & Kiosoglous, 2020), which is directly related to school closures during the COVID-19 pandemic.



#### PROJECT EXAMPLE

##### **INCLUDEME – Inclusive Digital Environments to Enable High-Quality Education for Disadvantaged and Disabled Learners**

This project addresses core challenges associated with inclusive and accessible education. It envisions **technology-enriched interventions that target the specifics of disadvantaged learners and learners with disabilities**, and that are directly enabled by training initiatives to equip teachers and stakeholders with knowledge and skills.

(Erasmus+ project, 2021–2024)



**Table 2. Learning environments and settings in the considered literature with regard to inclusion and digital education**

Area	Learning environments and settings mentioned in the literature
<b>Formal and non-formal education</b>	<ul style="list-style-type: none"> <li>- early childhood education (e.g. McGlynn-Stewart et al., 2017; Aunio &amp; Mononen, 2017; Bosse et al., 2019)</li> <li>- primary-level school (e.g. Bosse et al., 2019; Salgarayeva, Iliysova, Makhanova &amp; Abdrayimov, 2021)</li> <li>- secondary-level school (e.g. Satsangi, Billman, Raines &amp; Macedonia, 2020; Adhikari, Mathrani &amp; Scogings, 2016; Bosse et al., 2019)</li> <li>- special school (e.g. Mejia, Gomez, Mancera &amp; Taveneau, 2017; Checa Cabrera &amp; Freire Cadena, 2021; O'Connor Bones, Bates, Finlay &amp; Campbell, 2021)</li> <li>- higher education (e.g. Meri-Yilan, 2020; McLay &amp; Reyes, 2019; Almeida, Santos, Batista, Pereira &amp; Sousa, 2016)</li> <li>- adult and senior/continuing education (e.g. Bosse et al., 2019)</li> <li>- in-service training (e.g. Saplacan, Herstad, Mørch, Kluge &amp; Pajalic, 2018)</li> <li>- penal institution (e.g. Bosse et al., 2019)</li> <li>- galleries, museums, cultural centres (e.g. UNESCO Institute for Lifelong Learning, 2021)</li> </ul>
<b>Informal learning</b>	<ul style="list-style-type: none"> <li>- internet as information resource, social media (e.g. Salmerón et al., 2018; Bele &amp; Kvalsund, 2016)</li> <li>- family (e.g. Ulzheimer et al., 2021)</li> <li>- workplace learning (e.g. Saplacan et al., 2018)</li> <li>- social work, assisted living (e.g. Bosse et al., 2019)</li> </ul>
<b>Specific education topics</b>	<ul style="list-style-type: none"> <li>- media education (e.g. Schorb, 2019; Haage &amp; Bosse, 2019)</li> <li>- (native or foreign) language education, multi-lingual education (e.g. Lambert, 2020)</li> <li>- (trans-)cultural education, international learning and collaboration (e.g. Smith &amp; Arment, 2020; Blume, 2021)</li> <li>- teaching methodologies (e.g. Satsangi et al., 2020; Tuedor, Franco, White, Smith &amp; Adams, 2019; Nedungadi et al., 2018)</li> <li>- support for learners (e.g. McGlynn-Stewart et al., 2017; Salmerón et al., 2018; Dirks, Bühler, Edler, Miesenberger &amp; Heumader, 2020)</li> </ul>
<b>Digital educational settings</b>	<ul style="list-style-type: none"> <li>- digital/online (multi-player) games, game-based learning (e.g. Blume, 2021; Bolstad &amp; McDowall, 2019; Stone et al., 2019)</li> <li>- virtual classroom, distance education, blended learning, e-learning 4.0 (e.g. Dirks et al., 2020; Colucci et al., 2017)</li> <li>- VLE, LMS (e.g. Dirks et al., 2020; Mejia et al., 2017)</li> <li>- BYOD classroom (e.g. Adhikari et al., 2016)</li> <li>- emergency remote teaching and learning (during COVID-19 pandemic) (e.g. Pittman et al., 2020; Drane et al., 2021)</li> </ul>



Like in the analysis of learners vulnerable to exclusion, the learning environments and settings that are analysed and discussed in the considered literature show a wide range of different contexts in which inclusion is a highly relevant issue for learning in digital education. This is furthermore related to the use of several **digital devices and applications** for learning, ranging from smartphones, tablets, digital whiteboards, [mobile applications](#), videos, wearable electronics, AI, AR, VR, humanoid robots, to special (educational) applications (e.g. Baragash et al., 2020; Dirks et al., 2020; Konnerup, 2018; Paul & Zöllner, 2019; Hayes, 2021; McGlynn-Stewart et al., 2017; Nedungadi et al., 2018; Checa Cabrera & Freire Cadena, 2021; Kim & Searle, 2017; Satsangi et al., 2020; Sproul et al., 2021; Slemmons et al., 2018; Tuedor et al., 2019).

The issue of **Universal Design for Learning (UDL)** is rarely mentioned in the literature reviewed (just nine out of 69 sources in this review<sup>5</sup>).

Rose, Meyer and colleagues developed UDL in 2002, based on the general principles of universal design (see [section 4.1](#)).

Furthermore, UDL ‘focuses on improving and optimising teaching and learning for all to ensure learners’ success and well-being’ ([European Agency, no date](#)). UDL principles

can be seen as highly relevant in the design of inclusive learning settings, as they support all learners’ participation beyond merely having physical or digital access to the setting (Edyburn, 2005).

UDL is closely linked with digitalisation in education: ‘[...] the basis of UDL is grounded in emerging insights about brain development, learning, and digital media’ (ibid., p. 16). Therefore, it deals with **accessibility of learning information**. However, in reaching for [deep learning](#), it goes far behind that: ‘Access is necessary but not sufficient. As a result, it is important to consider **how technology and digital media engages a student in meaningful learning activities**’ (ibid., p. 21).



## PROJECT EXAMPLE

### Digitalisation and inclusive education: Leaving no one behind in the digital era

This project plans to increase the participation of learners with various disabilities in digital education and respond to the ‘Innovative practices in a digital era’ priority by strengthening the profiles of teachers and so promote social inclusion. It aims to empower and train teachers from various age groups and different school types not only in the field of digital education but also in inclusive education. The project seeks to foster dialogue among European countries on inclusive and digital education for learners with disabilities, prepare teachers for this task and exchange examples of best practice.

(Erasmus+ project, 2020–2022, project reference 2020-1-AT01-KA226-SCH-092523)

<sup>5</sup> Dazzeo & Rao, 2020; Lyner-Cleophas, 2020; Smith & Arment, 2020; Brusca-Vega & Trekles, 2020; Khurana, 2020; Reynor, 2020; Watkins et al., 2020; Green & Tolman, 2019; Haage, Wilkens, Lüttmann and Bühler, 2021.



[UDL] sets a goal to allow all learners to achieve their optimal learning experience that matches inclusive education. [...] Implementation of [UDL] allows all learners to access, participate in, and progress in the general-education curriculum (Navaitienė & Stasiūnaitienė, 2021, p. 23).

Within the results of this literature review **focusing on learners' issues**, UDL is partly discussed with regard to its benefit for international learners, struggling learners and learners with disabilities, but mostly with a focus on the diversity and inclusion of **all learners** (e.g. Dazzeo & Rao, 2020; Lyner-Cleophas, 2020; Smith & Arment, 2020; Watkins et al., 2020). It is regarded in the context of digitally enhanced face-to-face learning, as well as distance education and pedagogical use of digital technologies (e.g. Brusca-Vega & Trekles, 2020; Dazzeo & Rao, 2020; Smith & Arment, 2020; Watkins et al., 2020). In the literature, the aim for implementing UDL can be summarised as **creating equity and support for learning** in digital educational settings (e.g. Dazzeo & Rao, 2020; Khurana, 2020; Green & Tolman, 2019). This emphasises the **importance of considering UDL together with issues of didactics**. Therefore, [section 4.3.1](#) takes a closer look at UDL from the teachers' perspective.

Baran, Cierpiałowska and Dyduch emphasised the value of UDL even for [online learning](#), shown during school closures due to the COVID-19 pandemic:

The extraordinary situation faced by teachers and pupils due to the need to switch to online learning, contrary to temporary concerns, has reinforced the changes brought about by the implementation of the UDL approach in the learning process (2021, p. 119).

Hence, UDL may tentatively be interpreted as having the potential to be an overarching preventive strategy for inclusive digital education. Further research on this idea is needed.

Analysis of different learning environments and settings with regard to digital education in the considered literature not only shows a wide range of learning contexts, but also diverse options in connections between them. For example, teaching in school and in higher or continuing education may take place through face-to-face or blended learning, and can additionally include the use of LMS, online games and MOOCs – which may be limited to learners in the same class or educational institution but can also be offered by another education provider and therefore open to a broader target group. So, especially regarding the use of digital media for inclusion in learning situations, there are diverse possibilities for interdependences between different learning contexts and different forms of digital media and the goals for using it for different learners and in combination with different teaching and learning formats.

In sum, the analysis of the considered literature shows – in line with the results of [section 4.2.1](#) – that inclusion is not limited to the learning situation and the digital media used within this context. It is also influenced by:

- 🌈 learning outside the educational institution (e.g. in social media, in the family, with peers or at other places like cultural centres, etc.);
- 🌈 the use of (educational) digital media from different providers (e.g. online games, information websites, different technical devices, etc.);



- inequalities in social interaction and society (which may be reduced, consistent, enhanced or even initially emerging due to digital learning).

Developing an inclusive learning setting requires an **understanding of inclusion as being influenced by several parts of the individual learner’s environment**, which are themselves influenced by digitalisation. These include the teaching-learning setting itself, as well as the educational institution as an organisation, the learner’s relationships with peers, teachers and other involved persons, and other relevant parts of the learner’s environment (e.g. family, society, etc.) (Qvortrup & Qvortrup, 2018).

### 4.2.3 Digital competences for learners

As [section 4.2.2](#) mentions, the inclusion of all learners in digital education requires the development of **digital competences**. They are an important factor in an individual learner’s perceived inclusion in the learning setting. For this reason, the literature was also analysed with regard to digital competences. In order to structure the findings systematically and get a better overview of the literature, they are compared to UNESCO’s [Digital Literacy Global Framework](#) (DLGF) (Law, Woo, de la Torre & Wong, 2018). The DLGF is built on the European Commission’s Digital Competence Framework for Citizens (DigComp 2.0) and the authors empirically developed it further.

**Error! Reference source not found.** presents an overview of the DLGF and compares it to learners’ necessary digital competences for inclusive digital education found in the literature. (Some literature findings on different types of digital competences are given as exemplary sources, but are not meant to be exhaustive).

**Table 3. Digital competences for learners – comparison of the considered literature with the DLGF**

DLGF competence areas (Law et al., 2018, pp. 23–25)	Competences in the considered literature with regard to inclusion and digital education
<b>‘prerequisites’ are not an explicit part of the DLGF model</b>	prerequisites - learn to learn (e.g. UNESCO Institute for Lifelong Learning, 2021) - cognitive skills (e.g. Schorb, 2019; Dirks et al., 2020)
<b>0. Devices and software operations</b> <b>0.1 Physical operations of digital devices</b> <b>0.2 Software operations in digital devices</b>	skill to use online systems, email, online messaging or video calling and recent technologies (e.g. Oyelere et al., 2020; Haage & Bosse, 2019; OECD, 2019b)
<b>1. Information and data literacy</b> <b>1.1 Browsing, searching and filtering data, information and digital content</b> <b>1.2 Evaluating data, information and digital content</b> <b>1.3 Managing data, information and digital content</b>	ability to use search engines for information (e.g. news and topics) and resource retrieval (e.g. UNESCO Institute for Lifelong Learning, 2021; OECD, 2019b; Pittman et al., 2020)



<b>DLGF competence areas (Law et al., 2018, pp. 23–25)</b>	<b>Competences in the considered literature with regard to inclusion and digital education</b>
<b>2. Communication and collaboration</b> <b>2.1 Interacting through digital technologies</b> <b>2.2 Sharing through digital technologies</b> <b>2.3 Engaging in citizenship through digital technologies</b> <b>2.4 Collaborating through digital technologies</b> <b>2.5 Netiquette</b> <b>2.6 Managing digital identity</b>	<ul style="list-style-type: none"> <li>- establishment and management of web services based on social networking (e.g. UNESCO Institute for Lifelong Learning, 2021)</li> <li>- ability to recognise, respect and deal with one’s own and others’ feelings and beliefs in a supportive way (e.g. Schorb, 2019; Lambert &amp; Dryer, 2018)</li> <li>- digital personal development and empowerment to express one’s own voice (e.g. Kim &amp; Searle, 2017; UNESCO Institute for Lifelong Learning, 2021; Lambert &amp; Dryer, 2018)</li> </ul>
<b>3. Digital content creation</b> <b>3.1 Developing digital content</b> <b>3.2 Integrating and re-elaborating digital content</b> <b>3.3 Copyright and licences</b> <b>3.4 Programming</b>	<ul style="list-style-type: none"> <li>- creation of digital media (e.g. Winters et al., 2020)</li> <li>- open coding, open analysis, open reporting (e.g. UNESCO Institute for Lifelong Learning, 2021)</li> </ul>
<b>4. Safety</b> <b>4.1 Protecting devices</b> <b>4.2 Protecting personal data and privacy</b> <b>4.3 Protecting health and well-being</b> <b>4.4 Protecting the environment</b>	<ul style="list-style-type: none"> <li>- <a href="#">eSafety</a> (e.g. Nedungadi et al., 2018)</li> <li>- critical data empowerment of current and emerging digital technology and digital practices (e.g. UNESCO Institute for Lifelong Learning, 2021; Sorensen &amp; Andersen, 2017)</li> <li>- resist digital structural violence/<a href="#">cyberbullying</a> (e.g. Hwang et al., 2018; Subramony, 2018)</li> </ul>
<b>5. Problem-solving</b> <b>5.1 Solving technical problems</b> <b>5.2 Identifying needs and technological responses</b> <b>5.3 Creatively using digital technologies</b> <b>5.4 Identifying digital competence gaps</b> <b>5.5 Computational thinking</b>	<p>problem-solving skills, technical understanding of digital media (e.g. OECD, 2019b; UNESCO Institute for Lifelong Learning, 2021)</p>
<b>6. Career-related competences</b> <b>6.1 Operating specialised digital technologies for a particular field</b> <b>6.2 Interpreting and manipulating data, information and digital content for a particular field</b>	<p>open coding, open analysis, open reporting (e.g. UNESCO Institute for Lifelong Learning, 2021)</p>



The analysis of the mentioned digital competences in the considered literature shows that all DLGF competence areas are represented, indicating their relevance for inclusion in digital education. Competences in the areas of **communication and collaboration** and **safety** were found to a slightly higher extent than those in the DLGF's other competence areas. This may indicate the particular importance of digital communication and collaboration competences, as well as digital safety issues for inclusion in digital education.

Within the 'communication and collaboration' competence area, competences for **respectful and appreciative social interaction**, development of oneself as a **digital person** and being **empowered to express one's own voice** (e.g. to represent one's own interests) are particularly mentioned in the considered literature (e.g. Schorb, 2019; Lambert & Dryer, 2018; Kim & Searle, 2017; UNESCO Institute for Lifelong Learning, 2021). This is closely linked to the findings in the 'safety' competence area, where competences for **critical data empowerment** and **self-protection against violence** in digital environments (e.g. [cyberbullying](#)) are mentioned.

The development of critical and safety-related digital competences and digital empowerment plays an essential role in limiting vulnerability in digital spaces beyond the traditionally discussed [digital divide](#):

An emergent set of **vulnerabilities that are harder to identify** do not arise from the traditionally identified digital divide (digital access vs non-access). [...] more **subtle forms of exclusion** are related to the **ability to critically and reflectively deal with issues** such as privacy, data misuse (by private and political entities), data ownership/authorship, and social media (mis)use. Even in contexts where access to new technologies and infrastructures exists, **disparities from within the digital platforms** may create further disparities and marginalization, limiting empowered usage (UNESCO Institute for Lifelong Learning, 2021, p. 101).

Going beyond DLGF, the literature mentions some prerequisites for developing digital competences. Besides required cognitive skills (e.g. Schorb, 2019; Dirks et al., 2020), there is the ability of learning to learn: 'In sum, education for the digital era needs to firstly equip people to be able to "learn to learn"' (UNESCO Institute for Lifelong Learning, 2021, p. 92). This also concerns dealing with the changing requirements of digital media and the progress of digitalisation (including prospective emerging digital technologies), indicating the (further) development of digital competences as a lifelong and less formal process:

[...] arguing that digital literacies do not require an 'upgrade' of skills, but a **new and deeper understanding of the digital**, with its own logics, modes of engagement and challenges [...], and with which we can engage citizens in the co-creation of new ways of doing and **less formal ways of learning** (ibid., p. 96).

So, one mission of digital education should be to facilitate learners' development of digital competences for **lifelong (digital) learning** and life outside the education system, such as 'social, economic, political and cultural life' (ibid., p. 92). 'Digital literacies are therefore



not only a topical focus for educationalists, but also a life-enabling framework for every citizen' (ibid., p. 95).

When looking at the DLGF's competence areas, it becomes clear that different digital education settings may require different digital competences for the learners. Table 4 gives some examples to better clarify this idea, but does not aim to be exhaustive.

**Table 4. Examples of digital competences required in different digital education settings**

Digital education setting	Examples of areas where digital competences are required
using the internet as an information source	devices and software, information and data literacy, safety
having LMS access	devices and software, information and data literacy, digital content creation, safety
collaboration in LMS	devices and software, information and data literacy, communication and collaboration, digital content creation, safety
learning in online multi-player games	devices and software, communication and collaboration, safety, problem-solving
workplace learning	devices and software, information and data literacy, communication and collaboration, digital content creation, safety, problem-solving, career-related competences

The development of required digital competences is therefore an important condition for having access to and being able to socially participate in digital education. It is also important for learners' perceptions of being included and able to participate in a self-determined way – this is particularly relevant for vulnerable learners, as [section 4.2.1](#) explains. At the same time, competences that are not directly related to digitalisation seem to play a role in inclusion in digital education, e.g. learners and teachers recognising and dealing with social inequalities and disadvantages.

In sum, different digital competences are required for inclusive access to and participation in digital education, as well as for the individual learner's perceived inclusion, with a sense of feeling accepted and belonging to the learning community (see [section 4.2.1](#)). Furthermore, different competences are required for different parts of the individual's learning environment to participate in the teaching-learning setting. This also applies to relationships with peers, teachers and other involved persons, and to dealing with the educational institution as an organisation and other relevant parts of the learner's environment (e.g. family, society, etc.) (see [section 4.2.2](#)).

#### 4.2.4 Summary

Inclusion in (digital) education is a **complex and multi-dimensional** issue (Qvortrup & Qvortrup, 2018). Digital environments and digital media use provide opportunities for greater inclusion of learners vulnerable to exclusion. However, they can also maintain or increase existing inequalities or even create new ones. To reduce the risk of exclusion in



digitalisation and holistically ensure inclusion in high-quality education for all learners, it is useful to consider:

1. 'Vulnerabilities of access and poor technical infrastructures'
2. 'Vulnerabilities of digitally marginalized groups and communities'
3. 'Vulnerabilities related to digital knowledge, literacies and practice'
4. 'Vulnerabilities related to political will, policy development and economic priorities' (UNESCO Institute for Lifelong Learning, 2021, p. 97).

Digital media can play different roles for learners in different areas and be used differently for learning. Additionally, digitalisation can affect the learning situation from different parts of the learner's environment (e.g. family, peers, society). Digitalisation can affect existing social communities (e.g. new forms of social communication), but can also create new parts of the (social) environment (e.g. virtual or game-based learning worlds, etc.). Furthermore, learners' digital competences play an important role, especially in terms of communication, collaboration and safety, respectful and appreciative social interaction, the development of oneself as a digital person, the ability to express one's own voice, critical data empowerment and self-protection against violence in digital environments.

Therefore, digital media use for teaching and learning, as well as the digitalisation of teaching, learning and societal life, can have a supportive or adverse impact on learners' inclusion. Consequently, the literature review findings confirm the assumption in [chapter 3](#) that successful inclusion in education must consider learners' experiences of inclusion or exclusion not only in the respective teaching-learning situation, but in terms of influences from the organisational, interpersonal and societal levels. These, in turn, are permeated and changed by the **increasing digitalisation of all areas of life**.

With regard to educational settings, it is necessary not to focus on individual cases but to aim for a holistic perspective on inclusion for all learners. This requires:

- analysis of the individual learners' level of inclusion with regard to access, social participation and perceived inclusion (Qvortrup & Qvortrup, 2018);
- analysis of relevant elements of the individual learners' environment that affect inclusion in the learning setting while considering their digitalisation. This involves:
  - the teaching-learning setting itself;
  - the educational institution as an organisation;
  - relationships with peers;
  - relationships with teachers and other involved persons;
  - other relevant parts of the learner's environment (e.g. family, society, etc.) (ibid.);
- careful examination of digital media's potential to reduce inequalities and support access, participation and inclusion;
- identification of pedagogical interventions to reduce exclusion and enhance the individual learner's inclusion and to consequently reflect inclusion for all (ibid.).



To ensure inclusive learning for all, inclusion in digital education requires **holistic and systematic consideration of individual** (e.g. digital competences) and **environmental** (e.g. social inequalities) **conditions** influencing the learners' degree of inclusion in the educational setting. This is in line with the Agency's ecosystem model (European Agency, 2019), introduced at the beginning of [chapter 4](#). As this approach is less commonly found in the considered literature, there is a need for further systematic research on conditions of learners for inclusion in digital education.

## 4.3 Teachers and digital education

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This section provides an overview of teachers' roles in inclusion in the age of digitalisation. Teachers play a key role in the education system. On the one hand, their actions have a significant influence on how inclusion measures are implemented in practice. On the other hand, their actions also depend on the conditions in the respective educational institution.

Teachers' roles and the changes in opportunities for inclusion as a result of digitalisation will initially be examined independently of the respective education sectors, as it is assumed that the basic requirements and opportunities will be similar. Nevertheless, possible differences, due, for example, to different goals or opportunities for action, will be addressed.

For this purpose, this section has the following structure:

- 🎯 [Section 4.3.1](#) deals with general approaches that play a role in the inclusive use of digital media. This essentially includes [blended](#) and [distance learning](#) and how these approaches influence the opportunities and challenges of making digital media inclusive. Furthermore, Universal Design for Learning will be part of this discussion. The focus will also be on AT and AI.
- 🎯 [Section 4.3.2](#) deals with possible health effects of inclusive media use. It addresses aspects of social interaction and the consequences for mental health. The teachers' perspective will always be taken into account.
- 🎯 [Section 4.3.3](#) takes a closer look at specific media-related competences that teachers must have to make the most of digitalisation's potential for inclusion and avoid the risks of exclusion.
- 🎯 [Section 4.3.4](#) discusses formal and informal teacher professional learning.
- 🎯 [Section 4.3.5](#) addresses technical equipment and support for teachers as key prerequisites to implement digital education for all.
- 🎯 [Section 4.3.6](#) explores the issue of access to learning materials, especially [OERs](#).
- 🎯 [Section 4.3.7](#) summarises the results on the topic of digitalisation and learning for all from the perspective of teachers.

### 4.3.1 Inclusive media didactics

First of all, it is important to emphasise that digital media does not work in isolation in terms of positively or negatively influencing learning success or inclusion. It must always be seen in interaction with other factors, such as teachers' competences and attitudes, as



well as technical and time resources and appropriate support. Digitalisation affects the micro-didactic level of teaching in the classroom and has an extensive impact on teachers' different areas of responsibility, such as administration, diagnostics, co-operation and communication (e.g. with parents), guidance and counselling, and their own professional learning.

Nevertheless, the effects of digitalisation can be primarily seen on teaching. This concerns not only public discussion, but also research and politics. However, it should also be noted that teaching is at the core of pedagogical action and therefore this area is also of particular importance for questions of inclusion.

Inclusion-oriented didactics aims to do justice to the diversity of heterogeneous groups. On the content side, it is necessary to examine which educational goals are relevant for all, taking into account their individuality. Methodologically, approaches that support self-directed and independent learning are important. Social and co-operative learning also play a special role. Additionally, individual and structural barriers must be kept in mind as individual prerequisites of the learners.

The **UDL** approaches, which are discussed here from a didactic-oriented perspective, are the basis for this. [Section 4.2.2](#) takes a closer look at UDL in general and from a learner-focused perspective. According to the Center for Applied Special Technology, the UDL approach leads to three principles for curriculum development:

- 🌈 'provide information through multiple means of representation (present information and content in different ways)'
- 🌈 'provide multiple means of action and expression (differentiate the ways that learners can express what they know)'
- 🌈 'provide multiple means of engagement (stimulate interest and motivation for learning)' ([European Agency, no date](#)).

Rose and Meyer (2002) emphasise that because digital media is inherently flexible, it especially facilitates more universally-designed teaching. Moreover, it is repeatedly stressed that the main potential of digital media and, in particular, of [adaptive learning](#) technologies lies in the individualisation of learning (e.g. Kabudi, Pappas & Olsen, 2021).

UDL addresses not only the learning materials and the learning software, but also the use, i.e. the methodical integration, of digital media. During the COVID-19 pandemic, teaching had to be redesigned and digitalised quickly. It has been shown that, under these emergency conditions, rapid digitalisation **reduced didactic quality**. For example, Duroisin, Bauset and Tanghe (2021) report that **differentiation decreased during the pandemic**.

One key measure during the pandemic, for example, was the **recording of lectures**, especially in HE. It can be observed that, in this context, little attention was paid to barrier-free access, i.e. the lecture recordings did not have [captions](#). The reasons for this could be a **lack of awareness** of the topic, as well as the additional effort involved. Moreover, universities generally have less close bonds with learners than schools do. This means that individual problems and learning difficulties are less noticeable. At the same time, it must be assumed that **inclusive pedagogy is not yet established** in many education sectors (Chupakhina, Shvaliuk, Proskurniak, Otroshko & Zadorozhna-Kniahnytska, 2021).



Educational media always has **limitations** in its use, not only in terms of accessibility, but also with regard to didactic opportunities. A certain form of utilisation is inscribed in them, so the applications only allow certain usage options. This limits the flexibility of use for teaching and for adaptation to learners' specific needs. Therefore, the interactions between digital media and didactics are highly important for education for all.

UDL should be the basis for developing and using digital media, but this is not the case – especially during the pandemic. Therefore, it is necessary to carefully observe the extent to which current developments also establish development paths of (media) didactic that counteract education for all. On the one hand, reference should be made to the inequalities inherent in algorithms, but also to the establishment of digital technologies for monitoring and diagnosis (e.g. [facial recognition](#) (Tonguç & Ozaydın Ozkara, 2020)), which is largely up to teachers. On the other hand, teachers themselves are limited in their decisions and scope of actions due to increasing **automation** (Selwyn, Hillman, Bergviken Rensfeldt & Perrotta, 2021).

### *Assistive technologies and artificial intelligence*

Another perspective is the consideration of **AT**, which primarily serves to reduce existing inequalities – which can arise from digital educational technologies themselves. It is assumed that AT in the hands of teachers is highly important to support inclusion and thus education for all. However, the conditions, i.e. the easy availability, as well as teachers' knowledge of, competences in and attitudes regarding AT, are relevant (e.g. Atanga, Jones, Krueger & Lu, 2019; Ravneberg & Söderström, 2017).

For example, a study by Alghamdi (2021) in the US shows that education and training (on AT) for special education teachers had a correlation with AT use in the classroom. Studies on elementary and middle school teachers in the US (Atanga et al., 2019) and special education teachers in India (Blossom Cygnet, Silamboli, Kanmani, Sujathamalini & Gunasekaran, 2019) confirm that the scant consideration given to AT in training is a reason for its infrequent use. The correlations are thus independent of whether they are special education teachers or not.

**AI** applications go one step further. Some have been developed, for example, to support teaching children with autism, children with learning disabilities or those with sight or hearing problems (UNESCO, 2021a). Thereby, a change in the teacher role is assumed:

The traditional view of teachers as controllers, transmitters and processors of knowledge seems to be fading away. Robots and some computer programs are increasingly taking over this role and have proven to be effective tutors and mentors to learners to some degree. AI technologies are becoming the brains driving the future of education processes and progress (ibid., p. 17).

At the same time, UNESCO (ibid.) emphasises that AI must not replace the role of the teacher, but support better teaching. This discussion also raises **ethical questions** that need to be clarified in the discourse of dealing with digital technologies and making them part of teacher training (Buchanan, 2019). A review of the current literature shows that, despite a large body of literature addressing ethical issues related to AI (which are also discussed intensively with regard to ICT use in general), the impact on people with



disabilities is mostly excluded (Lillywhite & Wolbring, 2021) and can therefore be considered lacking in this analysis.

### *Distance education*

[Distance education](#) offers the opportunity to give disadvantaged target groups access to improved education, e.g. people in **rural areas** (Stenman & Pettersson, 2020). However, it is also clear that teachers' access to communities and school contexts is significantly limited. There is still little evidence on how and under which conditions distance education can contribute to inclusive education in rural areas (ibid.)

Due to the COVID-19 **lockdown**, much of the teaching at all education system levels became distance learning. 'Recent evidence shows that learning losses during school closures have been widespread and especially intense among the more disadvantaged students' (González & Bonal, 2021, p. 607). According to the World Bank, UNESCO, UNICEF and OECD, this situation can **lead to disadvantaged children dropping out** or being at higher risk of doing so (Muñoz-Najar et al., 2021). The school closures varied widely across the world (see, for example, UNESCO's [global monitoring of school closures](#) (no date)), with different consequences.

Weighing up the advantages and disadvantages, distance education can be an effective short-term replacement when there are unavoidable limitations on personal contact. However, long-term distance learning shows deficits compared to face-to-face teaching and the **physical co-presence** of learner and teacher. The importance of direct interaction only became clear to many teachers and learners when they experienced distance learning. Informal conversations, direct eye contact, physical relationships and, above all, a physical assimilation of the world are completely or largely absent from digital learning, but are essential for successful educational processes and psychological well-being. For this reason, a **blended learning** approach is usually chosen as a compromise between flexibility and on-site social exchange – and to avoid inequalities.



### PROJECT EXAMPLE

#### IDEA – Inclusive Digital Education Access

IDEA offers guidance and tools that promote and facilitate inclusive digital environments in HE. The project centres on the concept of inclusiveness, which is defined as the provision of education that meets all learners' expectations, needs and constraints. This concept was largely ignored by digital education environments before the COVID-19 pandemic, while its contribution to the provision of quality digital education was largely underestimated.

Building on best practices observed during the first year of the pandemic, the project is developing a system to **help academic staff improve and monitor the quality and inclusiveness of their teaching**. It is complemented by self-evaluation instruments and pedagogical tools for academic staff. The objective is to adapt pedagogy to increase learner engagement and provide a more inclusive learning environment.

(Erasmus+ project, 2021–2023)



Teachers should pay particular attention to the possibilities that allow learners to continue to **participate** in lessons, even in the case of short-term changes to distance learning. This includes not only the technical equipment, the available software and the internet connection, but also the possibility to participate in class without being disturbed. This information is not always obvious and can also be associated with social stigma, so that learners do not give any information on this or give it incorrectly. Therefore, it is particularly important to maintain and strengthen social relationships with learners. This increases teachers' workloads even more and leads to stress and health risks.

Against this background, it is necessary to deal with different forms of [virtual presence](#), such as **telepresence or digital co-presence**, as mentioned from a technology-centred perspective in sections [4.1.2](#) and [4.1.3](#). Telepresence is presence in a virtual space through an avatar, such as in a game-based learning environment. In this setting, individual characteristics of social stigmatisation, such as physical differences, can be made invisible. Digital co-presence occurs, for example, in the context of virtual classrooms when a video of the teacher and learner is usually transmitted. [Holograms](#), which replace the teacher with a real image or cartoon, are still uncommon (Ali & Ramlie, 2021). All forms enable different methods of immersion and thus also the feeling of presence, which can mitigate the deficits of virtual presence.

A specific example is the use of telepresence **robots** in education, which can significantly contribute to inclusion. There are studies that prove the successful reintegration of people with cancer (Weibel et al., 2020). Another option is to support remote and underserved schools with teachers and school psychologists who are 'present' with the help of telepresence robots (Fischer, Bloomfield, Clark, McClelland & Erchul, 2019).

**Teachers' attitudes** towards the use of different types of robots for inclusive education depend on various influencing factors. Research shows that prior introduction could improve acceptance by teachers (Zoder-Martell, Floress, Schiuchetti, Markelz & Sayyeh, 2021). Overall, reluctance on the part of the teachers becomes clear here, which is also evident among learners (Guggemos, Seufert & Sonderegger, 2020). However, there is still a lack of studies that consider, for example, cultural and age-related differences.

Overall, the findings suggest that, despite all the advantages of distance learning, it may have led to **increased inequalities and school drop-out during the pandemic** (Duroisin et al., 2021).

In sum, the use of digital technologies must always be seen against the backdrop of pedagogical decisions. In turn, these decisions must be made against the background of the learners, the content and the conditions. Therefore, it is not possible to make a general statement about a particular technology's usefulness in pedagogical settings. In addition, the technologies' availability and the teachers' competences play a central role for appropriate use.

These conditions vary greatly between countries, but also between education sectors. Even in a comparison between schools, between universities or between vocational or further education institutions, there are great differences in the maturity of digitalisation. Thus, educational institutions with extensive resources and competences in digital media use have had better opportunities for digitalisation during the COVID-19 pandemic. At the same time, however, the learners and the content may set pedagogical limits for



meaningful digitalisation. Therefore, differences in the level of digitalisation between educational institutions can increase or even out.

### 4.3.2 Social life and mental health

Educational institutions are not only places of learning, but also of **social exchange**. Regular contact between teachers and learners, and between learners themselves, is not only an important element of socialisation and education, but of social life. The pandemic severely restricted social contacts, and the health consequences were described in many cases (Hamza, Ewing, Heath & Goldstein, 2021; Viner et al., 2022; Su et al., 2021).

Teachers, mostly, did **not manage to maintain social contact** with learners to the same extent during the pandemic. A study from Belgium showed:

Results indicate that 15% of teachers tried to contact students collectively on a daily or almost daily basis. A small proportion of teachers (34.5%) did not contact their students daily but tried to contact them collectively more than once a week. Some teachers (27%) tried to contact learners once a week and only 8.5% of teachers tried to contact students less frequently (Duroisin et al., 2021, p. 521).

This situation has far-reaching consequences for **mental health**. What is surprising here is that a study by Hamza et al. (2021) showed that the health of learners with pre-existing mental health problems did not worsen during the pandemic, while learners without pre-existing mental health problems showed a deterioration in their mental health, which was accompanied by increased social isolation. Therefore, this loss of social contact does not increase the problems of learners who are already dealing with mental health issues, but it does affect the wider group of all learners who turn out to need special support.

Digital media use could not – or could only to a limited extent – remedy the consequences of the lack of contact and of necessary learning support by teachers. These consequences were particularly intense for socio-economically disadvantaged learners, who were already at a disadvantage due to poorer technical equipment and poorer housing conditions. In addition, parents had to take over their care, leading to **additional stress for the parents** due to the double burden of work and care duties.

### 4.3.3 Teacher digital competences

Teachers' digital competences are an essential prerequisite for digitalisation. Overall, the academic literature identifies a deficit in digital competences among teachers (Fernández-Batanero, Román-Graván, Montenegro-Rueda, López-Meneses & Fernández-Cerero, 2021). The deficiencies became particularly evident in the context of the pandemic (Chupakhina et al., 2021). 'Insufficient digital skills among teachers were a challenge. A study of about 1,000 primary school teachers in Poland found that 52% reported some difficulty using digital tools' (UNESCO, 2021b, p. 142).

These findings are supported by the Teaching and Learning International Survey (TALIS) 2018, according to which 40% of teachers do not feel well prepared to use ICT (OECD, 2019b). So, it may well be that learners have a greater need to use digital media, while teachers lack the necessary skills. At the same time, it may be pedagogically justified not



to use digital media even if the learners want to. However, it can still be assumed that teachers – across all age groups and all education sectors – lack competences in digital media use, even though extensive further training has taken place during the pandemic (Cabero-Almenara, Guillén-Gámez, Ruiz-Palmero & Palacios-Rodríguez, 2021; Cattaneo, Antonietti & Rauseo, 2022; Dias-Trindade, Moreira & Ferreira, 2021; Garzón-Artacho, Sola-Martínez, Romero-Rodríguez and Gómez-García, 2021; Hämäläinen et al., 2021).

Basic digital competences can be seen as a prerequisite for education for all in the digital age (Falloon, 2020). One of the central models is the Technological Pedagogical Content Knowledge (TPACK) Framework (Koehler, Mishra, Kereluik, Shin & Graham, 2014), which is accused of not taking sufficient account of the teaching situation's context (Swallow & Olofson, 2017). Marci-Boehncke (2019) has therefore proposed extending the model to involve aspects of inclusion.

In contrast, the European [Framework for the Digital Competence of Educators](#) (DigCompEdu) has integrated facets of inclusion at the different competence levels. The aim here is to be aware of the possibilities and limitations of access through digitalisation, to counteract access difficulties in resource selection and creation, and to reflect on strategies for equal access to digital education (Redecker, 2017).

Nevertheless, **competences in the field of digitalisation and inclusion are still not sufficiently brought together** (Holzinger, Feyerer, Grabner, Hecht & Peterlini, 2019). Moreover, the competence models must first be included in the teacher training curricula. It is therefore unsurprising that a study from Brazil shows that 'there is still a lack of knowledge about the use of ICTs for Inclusive Education (technology and methodologies) by students and teachers of Pedagogy in Brazil' (Tomczyk, Martins, de la Higuera Amato, Eliseo & Silveira, 2021, p. 105). The lack of media-related competences can be observed across all levels of education.

For this reason, Cranmer points out:

... a wide range of benefits to digital use practices intended to enhance learning generally or to provide disabled children with access to the curriculum. Nevertheless, analysis of the data showed that some uses were necessitated by subject teachers' lack of awareness about how to support disabled children (2019, p. 322).

In addition to [media literacy](#), [data literacy](#) and **data-based decision-making** are becoming increasingly important for teachers (Clutterbuck, 2020). Data collection is relevant to analyse individual learning progress and evaluate learning success. Moreover, it should support the individualisation of learning. Individual problems should be recognised more quickly and effectively and appropriate individual measures can be adopted. However, ethical issues and data protection must also be considered. Teachers should therefore not only know how to use tools for learning analysis, but should also be able to reflect on their use (Mandinach, Parton, Gummer & Anderson, 2015; Wilcox, Fernandez Conde & Kowbel, 2021).

Teachers' knowledge about using digital resources to support learners with impairments seems to vary widely across educational levels (Cabero-Almenara et al., 2021). At the same time, knowledge alone is not decisive for the use of ICT. It is also essential to have



the **motivation and attitude** to use this knowledge in the classroom – this has a fundamentally positive impact on ICT use. A study by Medina-García, Higuera-Rodríguez, García-Vita and Doña-Toledo shows that in **infant and primary education**, ‘the use of ICT is more limited, either due to the interpersonal skills of the teachers themselves or due to their interest and motivation towards ICT’ (2021, p. 10)

The statement that ‘**teachers, in general, tend to be techno-optimists**’ (Tomczyk, Jáuregui et al., 2020, p. 2737) must be seen against the background of different cultures but also different private use. However, institutional framework conditions, previous experiences and habits also seem to play a role (Rohs, Bolten & Kohl, 2020; Tomczyk, Jáuregui et al., 2020).

However, there is also evidence that pre-service and in-service teachers are more critical of digital media use for learners with intellectual disadvantages (Chiner, Gómez-Puerta & Mengual-Andrés, 2021). It seems that teachers tend to be **more critical** in their assessment of the benefits of digital media, especially **in relation to vulnerable learners** (e.g. young learners, learners with SEN). Another reason may be a lack of competence among teachers at this stage (Medina-García et al., 2021; Palomino, 2018; Panesi, Bocconi & Ferlino, 2020).

The **pandemic** and the associated intensive discussion of digitalisation issues, the acquisition of digital competences, but also the various successes and failures will **play a role in the acceptance** and, thus, the further establishment of digital learning.

#### **4.3.4 Formal and informal teacher professional learning**

Based on the previous section, it is also consequential that the Council Conclusions on Inclusion in Diversity to achieve a High Quality Education For All:

... support teachers, educators and other teaching staff and foster their motivation and competences, including for example emotional intelligence and social skills, to deal with diversity through initial teacher education programmes and continuous professional development, including digital education, practical tools, ongoing support and guidance, while also encouraging a more diverse teacher force (Council of the European Union, 2017, p. 6).

This demand for digital education of teachers to support learners with SEN has been known for many years (Florian, 2004). Its anchoring in the curricula of teacher education varies. However, it is still possible, even in developed industrialised countries, to complete a teacher education degree without sufficient knowledge of ICT use. Thereby **teacher education itself is criticised** for being too focused on using digital tools or for not taking ethical, digital citizenship, health, well-being, safety and social/collaborative elements into account (Falloon, 2020). In particular, there is **hardly any close connection between the teaching of competences in the fields of digitalisation and inclusion**.

It is also problematic for education for all if the topics of **digitalisation and inclusion are considered separately** from each other in the early education levels (Knauf, 2019).



For training, it is important that the prospective teachers' professional self-image is also reflected upon to shape their decisions and their media-related actions at school more consciously (Marci-Boehncke & Vogel, 2018).

It must be seen as problematic that it is mainly teachers who already have good competences in the area of digitalisation who participate in further education on the topic (UNESCO, 2021b). Therefore, training is of particular importance. In addition, it is necessary to directly address teachers who do not yet have good digitalisation and inclusion competences.

In addition to formal continuing education, **informal practices** of acquiring media-related competences play an important role in teacher education. There are also findings on this topic in the field of adult education (Tomczyk, Mróz, Potyrała & Wnęk-Gozdek, 2020). Whether this also applies to the school and university sector must be questioned due to different cultures. Informal learning is particularly important when competences need to be expanded quickly, in a problem-oriented manner and no further training opportunities are available. In this sense, informal learning is **emergency education** and is **a useful complement to formal education and training**.

It must be considered that the training of future teachers depends to a large extent on the training content and the trainers' competences. It would therefore be fundamental to first establish inclusive digital education in the institutions that are responsible for teacher training.

#### 4.3.5 Technological equipment and teacher support

However, supporting the development of digital competences among teachers alone is not enough.

Lack of professional support and insufficient digital skills among teachers have often proved to be the main obstacles to education continuity. Teachers have pointed out that the guidelines they received were insufficient to support them. The guidelines did not indicate how to respond when teachers or students lacked access to internet or digital devices or when teachers lacked remote teaching skills (UNESCO, 2021b, p. 146).



#### PROJECT EXAMPLE

##### DIGITClue – Digital Inclusion in Teacher Education

The idea of DIGITClue is to equip teachers with the skills, knowledge and tools to use ICT-based interactive and e-learning technologies for inclusive teaching. The project will combine the latest research on inclusive pedagogy, ICT-based learning tools and transcultural education to develop software applications for teacher education. A central and innovative aspect of the project is ensuring the inclusion of teachers with special needs, multi-lingual teachers or hard-to-reach teachers working in remote and marginalised areas at every step of the development and delivery of teaching materials.

(Erasmus+ project, 2021–2023)



It seems essential for all forms of distance education that teachers receive the **necessary equipment and support**, especially with regard to the design of inclusive distance education. In the context of the pandemic, it became apparent that this support varied greatly in EU countries and was not equally adequate everywhere (European Agency, 2021a; UNESCO, 2021b). This problem is also particularly evident in countries that fundamentally have greater financial challenges to overcome, such as in Ukraine (Chupakhina et al., 2021). According to UNESCO reports, teachers from all education sectors reported insufficient access to technologies and guidelines with limited relevance to the new challenges (European Agency, 2021a).

Where government support has been insufficient, many bottom-up initiatives have developed (ibid.).

In Bosnia and Herzegovina, the Centre for Education Initiatives Step by Step, an NGO, involved members of the Community of Innovative Teachers and proposed more than 200 ideas for classroom practice, shared by teachers, that were posted on a web platform. In Ukraine, teacher teams collaborated on individualized plans for students with special education needs (UNESCO, 2021b, p. 146).

However, even where the equipment was sufficient for most teachers to continue teaching, about half of them reported difficulties with technology. This situation of **unequal opportunities for distance learning** can disadvantage individual classes (Duroisin et al., 2021). That is why the availability of ATs for teachers with special needs is crucial (European Agency, 2021a).

Only 10% of teacher responses declared that their school did nothing because there was no family in need. Teachers frequently (62%) indicated that their school did not lend digital devices to learners in need even if it was necessary. Only few teachers (20.5%) reported that their school provided a partial support to some families in need. Only some of the teachers (7.5%) reported that their school provided digital devices to almost all families in need. There is a significant difference between responses from secondary and primary teachers; secondary learners received more support from their school (Duroisin et al., 2021, p. 528).

#### 4.3.6 Learning materials for all

In addition to the technical infrastructure and digital tools or ATs, learning materials are an important prerequisite for inclusive access to educational opportunities. Some countries have made **web platforms** available to provide digital learning resources, including to learners with special needs.

In Estonia, e-learning materials are available on the digital study material portal e-koolikott (e-schoolbag), and students with special education needs have access to tailor-made e-learning materials. In Georgia, the Ministry of Education, Science, Culture and Sport has a portal with a digital library providing access to learning materials and cloud storage space to all teachers



and students; in addition, some special materials are available for blind students (UNESCO, 2021b, p. 96).

It has to be noted that there are great differences between countries ‘in terms of digital readiness of education and training systems, **including availability of [digital learning tools and materials](#)**’ (Council of the European Union, 2020, p. 1). However, from the teachers’ perspective, it appears they still **need support in selecting inclusive teaching materials** that present no or few barriers and are suitable for all learners (Rice & Ortiz, 2021).

This also applies to **OERs**, which are explicitly intended to improve accessibility to teaching materials. Although they offer the possibility of use – and, most of the time, of further development – due to their licensing, their technical and didactic design is not always suitable for all learners or they do not offer digital content suitable for users with disabilities (Navarrete & Luján-Mora, 2015). Zhang and colleagues state that:

... accessibility is still in its infancy within OER and that researchers should focus more on considering the four accessibility principles – perceivable, operable, understandable and robust – when providing OER (2020, p. 1).

This applies to **MOOCs**, too, which have become very popular in recent years as they respond to the call for education for all – even if they are not always free. On the contrary, it can be seen that MOOCs are mainly used by people who already have a high educational status.

This **can even reinforce educational inequalities** (Laurillard & Kennedy, 2017; Rohs & Ganz, 2015). However, MOOCs have the potential to improve access for disadvantaged groups of learners if the materials are designed with disadvantaged people and face-to-face learning support is also provided (Lambert, 2020).

In general, **few studies address the accessibility of OERs** for people with disabilities (Moreno, Caro & Cabedo, 2018).

#### 4.3.7 Summary

Digitalisation is not a fundamental solution for greater inclusion; it can mean further risks for the exclusion of learners. To ensure that digitalisation is used for greater inclusion and better access to education for all, teachers must have/consider the following:

-  **Access and equipment:** All learners and teachers have access to digital learning opportunities and have suitable ICT equipment.
-  **Attitudes and competences:** Teachers have the attitudes and competences to deliver inclusive digital education for all.
-  **Training and support:** Further training and informal learning opportunities are offered and technical support is available.



#### MASSIVE OPEN ONLINE COURSE (MOOC)

‘A course of study that is made available over the internet and that can be followed by a large number of people’ ([Cambridge Dictionary](#), no date).



- 🌈 **Mental health:** During remote teaching and learning in times of crises, such as the pandemic, attention is paid to the mental health of teachers, learners and parents.
- 🌈 **Design for all:** Learning content and environments are designed for the needs of all learners. Ethical aspects are also taken into account.
- 🌈 **Pedagogical primacy:** Digitalisation serves to improve learning for all and is not justified by itself.

In addition, it should be noted that education for all is increasingly being considered together with questions of digitalisation. DigCompEdu, for example, takes into account corresponding competences and could become a standard in teacher training. Despite a push for digital education and training for teachers, which is a fundamental prerequisite for high-quality digital education for all, there are still clear gaps in the competences, and many relevant aspects of inclusive digital education have not yet been sufficiently researched. These include, for example, ethical issues and the opportunities and risks of supporting gifted learners through digital learning.

## 4.4 The role of educational institutions in the digital transformation of inclusive education

This section highlights the role of the management of educational institutions in ensuring appropriate frameworks for inclusive digital education. The tasks involved are diverse. For example, digital transformation in inclusive education needs the educational institution level to create conducive conditions for teachers and learners to use digital technologies and media in education, which are permanently anchored institutionally and are in line with political objectives and requirements. At the same time, this transformation must not be limited to individual or classroom use of ICT; the use of digital technologies at the organisational level (e.g. in the administrative area, for networking with relevant [stakeholders](#), for collecting governance-relevant data) to ensure the best possible environment and appropriate infrastructure is also essential. Accordingly, the educational institution level forms an essential link between the individual and the national/regional level (see Figure 1) in the digital transformation of inclusive education.

[Section 4.4.1](#) addresses organisational readiness and [resilience](#). [Section 4.4.2](#) looks at collaboration practices at the management level. [Section 4.4.3](#) deals with the participation of parents and families in inclusive (digital) education. [Section 4.4.4](#) takes a closer look at



### DIGITAL TRANSFORMATION

Digital transformation is organisational transformation enabled by [digitalisation](#).

‘Digital transformation covers both the integration of digital technologies by European enterprises and the impact on society of new technologies, such as the Internet of Things (IoT), cloud computing, innovative digital platforms and blockchain technologies’ ([Negreiro and Madiega, 2019, p. 2](#)).



the role of school leaders and how they interact with internal stakeholders, learners' families and the community. Conclusions are drawn in [section 4.4.5](#).

#### 4.4.1 Organisational readiness and resilience

##### *Organisational readiness*

When looking at educational institutions' readiness for inclusive digital education, **different perceptions** of this readiness need to be considered. Bocconi, Panesi and Kampylis (2020) show that when asking school leaders, teachers and learners about their school's digital competence, the data obtained shows significant variance. Also, the different stakeholders have different perceptions of the levels of use of digital technology (ibid.).

Ferrari, Castiglioni, Mura and Diamantini carried out a case study in a disadvantaged suburb close to Milan, Italy, to investigate 'how access to information and the development of digital skills **mitigated aspects of social exclusion** and **triggered more active participation** in the life of the community' (2019, p. 7). The researchers observed different agents during the process of digitalisation for four years. They identified three facilitating categories:

1. 'Administrative promotion of inclusion'
2. 'School investment in equitable access to digital resources'
3. '[Capacity-building](#) among stakeholders' (ibid.).

The data obtained supported the argument that digital participation tools are of particularly great value for vulnerable people in communities, and that digital education is especially key to civic inclusion (Ferrari et al., 2019). The three facilitating categories identified for this are all located at the level of the educational organisation.

A study conducted in the Basque Country, Spain, aimed to measure teachers' perceptions of their own performance in remote teaching (Portillo, Garay, Tejada & Bilbao, 2020). The greatest difficulties, according to the study results, were **shortcomings in digital skills training**. Due to that perceived difficulty, teachers experienced a higher workload and negative emotions. Furthermore, a **digital divide between teachers** could be identified. Based on their gender, age and type of school, they had different perceptions of their performance in online teaching. Another finding was that educators at lower educational levels especially reported lower technological competences (ibid.).

Börnert-Ringleb, Casale and Hillenbrand (2021) studied the intention to use digital learning among teachers in special education. The **strongest predictors** for using digital learning were the [teachers' self-efficacy](#) and the **perceived organisational support** (ibid.). A literature review study looked at how faculty members' competences can be increased to provide inclusive digital education. Suitable training topics included legislation, disability and awareness, as well as methods of producing accessible digital material and inclusive digital learning environments (Bong & Chen, 2021).

Another study looked at the use of digital media and ICT in educational settings, particularly in VET, to improve organisational readiness for inclusion (Weber, 2018). The application of digital media and ICT has often been the subject of projects focusing on



classrooms and beyond. However, this work discussed an idea for a systematic analysis of the potential digital media and ICT offer **to increase** an educational organisation's **inclusive capacity** overall, not just at classroom level.

### *Resilience*

Looking at resilience in inclusive digital education, the current literature focuses on resilience specifically in the context of the COVID-19 pandemic. Kotula, Kaczmarek-Ciesielska and Mazurek (2021) see COVID-19 as an opportunity for leaders of HEIs to **strengthen their online presence**, as this could help manage the crisis. In the Italian context, research findings demonstrated a **high level of resilience** among HEIs. The system was able to react and successfully re-organise itself in just one week. It is hoped that the pandemic may result in stronger universities in Italy, with the ability to guarantee quality education through technological devices and to compete better at international level (Appolloni, Colasanti, Fantauzzi, Fiorani & Frondizi, 2021).



### **RESILIENCE/ORGANISATIONAL RESILIENCE**

'It is the ability of an organization to anticipate, prepare, respond, and adapt to exponential change and sudden interruptions to survive and thrive. It goes beyond risk management, towards a more holistic vision of health and business success' ([Vargas-Hernández, Barrios-Vargas & Mercado-Torres, 2019, p. 46](#)).

García-Díaz (2021) highlighted that, in Australia and New Zealand, resilient schools were not created during the pandemic. Rather, previous natural disasters meant that educational institutions had already had to use online resources and remote learning. Also, **home-schooling has legal status as an alternative education option** in both countries, so the governments could respond significantly faster during the pandemic. Nevertheless, COVID-19 showed the need to upgrade the school system to increase future resilience (ibid.).

#### **4.4.2 Collaborative practices**

Good co-ordination among school staff is important for successful inclusive education. In a pilot study to investigate the **co-ordination of learning and therapy** for learners with SEN, Siyam and Abdallah (2021) introduced the use of a mobile app. This app aimed to facilitate communication and information-sharing between different actors involved in the interventions. The study focused on learners with ASD. This app was centred around the [individual education plan](#). Results indicated good usability and satisfaction with the app (ibid.). This study shows how digital tools can enhance communication among different stakeholders and parties and hence support inclusive education.

Teacher collaboration within schools is also an integral part of effective inclusive education. It can improve the educational experiences and learning outcomes of all learners, including those with SEN. In inclusive education, **collaboration among learning support teachers, resource teachers and classroom teachers** is an opportunity for successful inclusive practice (Mulholland & O'Connor, 2016). A study conducted in Ireland shows that teachers are increasingly aware of the value of such collaborations and aspire



to working together. Challenges, however, include time constraints, limited professional development opportunities, and ad-hoc planning. These often inhibit a consistent approach (ibid.).

Finally, [social media](#) is another approach to **support teacher collaboration**. One study focused on how social media ([Instagram](#)) affects educators' collaboration, reflection and feedback loops when used as a professional development tool (Newton & Williams, 2021). The study looked at educators who created pictures or videos and added specific hashtags to insert their post into the community of teachers, known as 'Teachergram'. Newton and Williams show that 'Teachergram' can function as a high-quality, sustainable, technology-facilitated professional development tool (ibid.). The study showed that this platform's unique characteristics lead to teachers building affinity spaces and professional communities (ibid.).

#### 4.4.3 Participation of parents/families

Communication with parents is another integral part of inclusive education. Providing good means of communication and networking is therefore a task of the educational institution managers/school leaders.

In recent years, communication between educators and parents has largely shifted to digital systems. This has advantages, like time saving, but also comes with new problems. For example, it is currently up to the educators to decide **when to send information to parents** and **which communication tool to use** (e.g. phone calls, emails, communication via dedicated digital platforms). Parents, however, might have different preferences and may encounter problems finding the information they require.

This is particularly relevant for **parents with disabilities**, who might have individual needs regarding using such systems, communicating with the school or receiving information (Eftring, Rasmus-Gröhn & Hedvall, 2016). To solve this issue, Eftring et al. (ibid.) presented a project where they elicited parents' individual requirements for an **inclusive digital school system** through focus groups with parents and teachers. The goal was to identify together individual meeting and communication preferences. The individualised platforms tested received positive reactions from parents (ibid.).

Koskela, Pihlainen, Piispa-Hakala, Vornanen and Hämäläinen (2020) investigated the parents' perspective during the pandemic-related rapid shift to remote schooling. Results indicated that parents worried particularly about their children's well-being and learning. Furthermore, the management of daily life and the use of digital tools were other sources of worry for families. This highlights the relevance of communication and networking between schools and parents. Especially at times of great change, **parents' individual needs** must be considered (ibid.).

Nurjanah and Diana (2020) showed that ICT used particularly to **distribute information to parents** could help them to enhance their knowledge about inclusive education and increase the participation of parents who are reluctant to provide therapy for their children. However, the study also showed that parents' busy work schedules cancelled out the positive effects of ICT (ibid.).

Finally, a study by León-Nabal, Zhang-Yu and Lalueza (2021) explored how **digital mediation** via an app impacts on **school-family relationships**. The patterns of school-



family communication that were identified suggest that most conversations were initiated by the school regarding classroom activities. The advantages of using an app were direct and immediate communication, a closer relationship, and an inclusive response to diversity. Disadvantages identified were that some families rarely used the app and hence had difficulties maintaining personalised relationships (ibid.).

#### 4.4.4 The role of school leaders

Although the topics of leadership and digital transformation in education do not seem to be directly related, it is known that school leaders play a significant role in implementing and ensuring inclusive education (European Agency, 2019). The core functions of school leaders to promote inclusion can be divided into three areas:

-  Setting direction
-  Human development
-  Organisational development.

By fulfilling these core functions, school leaders can create an inclusive school culture, where every learner is valued and receives a high-quality education (ibid.).

Accordingly, the literature was examined to see whether leadership has a comparable role in the thematic field of inclusive digital education. One finding is that digital tools need to be increasingly integrated into the work of school leaders and leadership teams. Therefore, to increase the quality of expected education, '[technology-based leadership](#)' is seen as an important type of leadership that today's school leaders need to adopt. Umut, Zehra, Gökmen and Fahriye (2019) looked specifically at technology leadership self-efficacy and found that it impacts technology integration in educational processes. Furthermore, technology leadership self-efficacy has promoted the use of technology for learning and has enhanced communication with stakeholders (ibid.).

These studies show that, in inclusive digital education, school leaders can partly fulfil their core function of setting direction by



#### PROJECT EXAMPLE

**Inclusive Leadership – nowe podejście do wzmacniania i rozwoju osób ze środowisk defaworyzowanych** [a new approach to empowering and developing people from disadvantaged backgrounds]

This project aimed to increase the effectiveness of development programmes for individuals from disadvantaged groups by creating an innovative approach to inclusive leadership and introducing it into the practice of the leaders of those circles. The project's long-term goal was to contribute to increasing social competences and readiness to develop people from disadvantaged groups (migrants, refugees, people from rural areas and people with disabilities). The project developed tools to accompany those interested in inclusive leadership on their journey towards being an inclusive leader. These included an online tool for a low-threshold introduction to the topic of inclusive leadership and an initial self-assessment of one's own practice, as well as recommendations for next steps.

(Erasmus+ project, 2016–2018, project reference: 2016-1-PL01-KA204-026768)



implementing technology-based leadership that influences technology integration for the other teachers and for the whole school.

Several studies looked at **social media use** for school leaders to communicate within and outside their educational institution. A challenge, however, was found to be the proper selection and use of social media tools (Yusuf, Walters & Mohamed, 2020).

There are many reasons to use social media and advantages of doing so for heads of schools:

- 🎯 To improve leadership connectedness and efficiency
- 🎯 To mobilise and build consensus on important matters
- 🎯 To shape a vision of academic success for learners
- 🎯 To motivate academic staff in carrying out their duties
- 🎯 To build support for their efforts by communicating directly with parents and the community
- 🎯 To inspire teachers
- 🎯 To motivate learners
- 🎯 To enhance the management zone and extend learning beyond classrooms and schedules
- 🎯 To establish an empowered and dynamic [professional learning community](#) of educators where skills, knowledge and thinking are shared
- 🎯 To form their own [personal learning networks](#) to acquire and share resources, access knowledge, receive feedback, connect with both educational experts and practitioners, and discuss proven strategies
- 🎯 To create specific social media channels to collectively engage teachers, heads of departments, co-ordinators and community leaders
- 🎯 To attract the enthusiastic participation of stakeholders in school affairs
- 🎯 To engage the outside community appropriately to improve their institutional image and relationships with others (ibid.).

These multi-faceted advantages of using social media can help school leaders fulfil their three core functions – setting direction, human development and organisational development – by, for example, inspiring learners and teachers, forming personal learning networks and engaging the outside community. Fancera (2020) examined how school leaders in the US used **social media and networking for professional development**. Primarily, the school leaders used [Twitter](#) to provide teachers with opportunities for professional development. They also used Twitter for their own professional learning and development (ibid.).

Finally, a Swedish study looked at school leaders' perceptions of digitalisation and the digital competences needed. The results show that leaders see digitalisation as a wide and complex concept. The dimensions they find challenging are **technical, pedagogical, administrative** and **organisational**. These challenges run through all levels of the school organisation (Håkansson Lindqvist & Pettersson, 2019).



#### 4.4.5 Summary

The results of this section show that subjective assessment of an organisation's digital readiness is insufficient to assess the actual set-up; objective data is needed. However, this section also showed that **organisations that embrace the digitalisation process in terms of content** (through skills development) **and funding** (through investment in digital resources) **can help to reduce social exclusion**. Teacher empowerment is a central element. It must be accompanied by organisational support measures, further training and consideration of the individual needs of, and differences between, teachers with regard to digital topics.

**Collaboration between teachers and other stakeholders can be made more efficient through ICT**. However, it reaches its limits when the workload is too heavy and there are no resources left for ICT use. In parallel to the design of digitally supported work steps, there is still a need for 'classic' work design to minimise stress and strain on teachers.

Communication between schools, teachers and parents can also be made more effective and efficient through ICT. However, here too, different requirements and preferences on the part of teachers and parents must be considered regarding the choice of technical means, the frequency of communication and its content.

Resilience in the sense of crisis tolerance played an important role in the COVID-19 pandemic. **Organisations that had already prepared for inclusive digital education in terms of content, technology and organisation before COVID-19 seemed to fare better in the crisis**. However, the extent to which these results can be used to draw conclusions about a general crisis resilience that is independent of COVID-19 needs to be investigated.

Finally, the literature reconfirms the **essential role of leadership with regard to inclusive digital education**. Change processes need to be monitored, steered, demonstrated and orchestrated by leaders – both individuals and groups with distributed leadership responsibilities – and this is also true for digital transformation in inclusive education.

### 4.5 Responsibilities at national/regional level to enable inclusive digital education

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This section deals with issues that need to be addressed above the school level in the context of enabling inclusive digital education. This is called the national/regional level, recognising that, in some education systems, the regional and national levels have different functions and responsibilities. In a few cases, there are even instances involving international co-operation – these will also be subsumed under this level. This higher level could also be called the system level.

[Section 4.5.1](#) focuses on the role of national/regional-level education management in fostering inclusive digital education, while [section 4.5.2](#) deals specifically with monitoring education systems.

#### 4.5.1 Education system management

The central question that this study researched in relation to current literature is what additional tasks fall to the national/regional level of education management to enable



inclusive digital education. The COVID-19 pandemic has contributed to the digital transformation of education systems re-emerging (higher) on the policy agenda.

[Remote learning](#), which was widely applied during the pandemic, has **deepened educational inequalities** that existed before COVID-19, because it relies heavily on the support of families, available material and technological resources. According to Angelico (2020), the pandemic is a unique **opportunity to reform education**. Reform possibilities could include improving the links between schools, parents and communities and making sure that inclusive education is available to all learners. Furthermore, investments in accessible digital learning would be needed and resources should be distributed to meet the needs of all schools and learners (ibid.).

A literature review by Jesus et al. (2021) examined whether people with disabilities were more affected by the pandemic. The authors identified two central themes that dominated the considered literature. The **lack of a disability-inclusive response and of emergency preparedness** was one topic that was widely covered in the literature. **Structural, pre-pandemic disparities** were another key topic. Those problems created structural disadvantages, which led to the pandemic disproportionately affecting people with disabilities.

Furthermore, the authors identified 10 topics that were also underlined in the literature:

1. 'Disrupted access to healthcare' (beyond COVID-19)
2. 'Health and functional decline' through 'reduced physical activity'
3. Physical distance and inactivity leading to loneliness and social isolation
4. Disruption of community support networks and personal assistance
5. School closures' disproportional effect on children with disabilities
6. 'Disrupted routines, activities, and support' and their psychological consequences
7. Burden and stress for family and informal caregivers
8. 'Risks of maltreatment, violence, and self-harm'
9. 'Reduced employment and/or income exacerbating disparities'
10. 'Digital divide in access to health, education, and support services' (ibid., p. 1).

Digitalisation is only explicitly mentioned in the last point; however, digital technologies are available that could mitigate most of the other issues and hence could impact on personal lives beyond just inclusive education. Policy-makers at national/regional level need to consider how digital technologies can be adopted to address structural disadvantages, which additionally affect people with disabilities.

The education and training of teaching staff is a task that falls to the national/regional level. In the US, programmes on Digital Learning Competencies for Teachers and Digital Learning Competencies for School Administrators are being introduced for schools throughout North Carolina (Ellis, Lu & Fine-Cole, 2021). The programmes aim to **improve practice and build capacity in school staff** and to promote the learning process within schools. Ellis et al. (ibid.) collected data on the issue that supports the development of such digital learning certificates for teachers and educational leaders.



When looking at global levels of inclusive education, i.e. beyond a regional or national focus but still within the system level, various stakeholders are involved that form networks to exchange information and knowledge regarding political strategies for inclusive education. One way to build such networks is through digital tools.

Schuster, Jörgens and Kolleck (2021) explore the Twitter network that different stakeholders have formed around the topic of inclusive education. The authors' main finding is that **international organisations and disabled persons' organisations are at the centre of this network**. This enables them to influence the content and the flow of information in the network (ibid.). As such, in Twitter networks, these organisations are a main agent for setting the inclusive education agenda and for possible system change.

Governments themselves are, of course, important stakeholders in inclusive digital education management. Policy-making is their main tool to shape the digital transformation in inclusive education.

However, the analysis of national digitalisation strategies is beyond the scope of the research mandate, which is why here reference is made only by way of example to the topic of AI and the aspects that need to be taken into account.

Schiff (2021) identified more than 30 countries that had published **national AI policy strategies** up to 2021. These documents discuss AI's impact on different policy sectors, including education, as well as the social and ethical implications. The author looked at 24 of the policy strategies in depth and found that AI as a tool in education is largely absent from the papers. A priority in the policy conversations is on education as a tool to develop an AI-ready workforce and to train more AI experts. The ethical implications of AI in general, and in education in particular, are mostly not discussed (ibid.).

The fact that, besides these studies, no essential literature was found in national/regional-level approaches to provide policy support and resources to enable and enhance inclusive digital education is a finding in itself.

#### 4.5.2 Monitoring of inclusive (digital) learning

Monitoring is necessary at the national or regional level to assess the status quo of inclusive digital education. This data can serve as a starting point for further developments and improvements.



#### PROJECT EXAMPLE

##### Pan-EU network of digital education passport centres in higher education

This project addresses the challenges that digital transformation has brought to higher education, and that were accelerated by the pandemic. A lack of inclusiveness and personalised online teaching, and particularly a lack of mechanisms to foster inclusive education for at-risk social groups and learners from peripheries, have been observed. Hence, the project aims to (holistically) boost universities' digital readiness for online education, while connecting universities in the digitally transformed ecosystem (i.e. with policy-makers, businesses, third sector, parents, etc.).

(Erasmus+ project, 2021–2022, project reference: 2020-1-ES01-KA226-HE-095035).



For example, proposals have been developed to monitor policy conditions that may support or hinder the development of inclusive education within schools (Kyriazopoulou & Weber, 2011). With the focus on digitalisation examined in this study, two levels are relevant. Firstly, there is the level of expanding the monitoring content to include components that take digital education into account. Secondly, such monitoring mechanisms can only be implemented with the use of digital data collection instruments, at least if the aim is to provide the most up-to-date data possible for system governance. Although no relevant literature was found for the latter point, there is great potential in this aspect. By **digitalising monitoring activities at national or regional level**, schools could not only be called upon to collect relevant data but could also use the data for evaluation and assessment to further develop inclusive digital education.

In terms of expanding monitoring activities in the direction of digital education, Morales Romo (2017) considers **ICT use in inclusive education in rural schools**. ICT could help to minimise some disadvantages that learners in rural areas have or it could deepen the digital divide. The study's results showed that rural schools benefit more from ICT use than urban schools. However, the data obtained also shows a gap between predominantly rural areas and intermediate rural areas. In the latter, ICT contributed more strongly to inclusive education and bridging the digital divide. Therefore, while the digital divide between intermediate rural schools and urban schools is closing, predominantly rural areas cannot offer equal educational opportunities for all learners (ibid.).

Another topic of research is the monitoring of the gender gap, especially when it comes to enrolment in technological studies. A study analysing whether ICT use in learning mathematics affects this gender gap shows that ICT use results in higher motivation and better marks. Women's marks were better than those of men when using ICT. ICT use can achieve greater learner involvement and more meaningful and relevant learning. This can contribute to **bridging the gender gap** that still exists **in technological classes and studies** (Palomares-Ruiz, Cebrián, López-Parra & García-Toledano, 2020) and hence should be addressed at system level.

In Cyprus, a pilot **self-assessment framework for schools on digital skills development and ICTs in inclusive education** was implemented (Mavrou & Loizou-Raouna, 2017). The framework aimed to assess schools' performance in supporting children with disabilities with their ICT needs, particularly ATs. Such self-assessment can help educational establishments that include all learners to assess their current outcomes and to plan improvements in supporting learners with disabilities to increase digital literacy and develop digital skills (Hoogerwerf, Solander-Gross, Mavrou, Traina & Hersh, 2017). The results of the Cypriot pilot project showed that the participating schools identified themselves as 'getting started' or having made 'some progress' (Mavrou & Loizou-Raouna, 2017). This shows that schools perceive themselves as being only at the beginning of a process to promote inclusive digital education.

In Portugal, researchers proposed the introduction of a **national observatory** to measure how HEIs respond to inclusive challenges. A special focus of this observatory should be on the role of digital technologies and online learning (Almeida et al., 2016).



Blau and Shamir-Inbal (2017) examined how school principals and ICT facilitators in educational institutions assessed the systemic changes that occurred in their schools regarding technology integration. This study was carried out in Israeli elementary schools. Its findings show that the **variance in general school ICT culture** was explained by:

- 🎯 The percentage of teachers who frequently use ICT in lessons
- 🎯 Using technology to enhance pedagogy
- 🎯 Teachers' digital competencies
- 🎯 Use of digital content
- 🎯 Design of digital content by teachers
- 🎯 Pedagogical update of the class website
- 🎯 School portal updates (negative predictor)
- 🎯 E-communication with school staff
- 🎯 E-communication between teachers and parents (ibid.).

These predictors make up 63% of the variance in schools' ICT culture (ibid.) and hence could be used as **indicators to monitor digital transformation**. However, they would need to be complemented by indicators for monitoring the implementation of inclusive education.

#### 4.5.3 Summary

The national/regional level can be seen as the level responsible for ensuring that teachers and learners have supportive conditions for the implementation of inclusive digital education. However, for this task to be fulfilled, there must be (scientifically-supported) detailed evidence of how inclusive digital education needs to be designed. The previous sections have tried to explore the gaps in knowledge in this regard and show that much research is still needed before these supportive frameworks can be further substantiated.



#### PROJECT EXAMPLE

##### Lifelong education of people with Down syndrome or other intellectual disabilities: Innovation and inclusion in rural areas

This project focuses on the field of education for adults with Down syndrome or other intellectual disabilities (DS/ID) in inclusive settings and in rural areas. Its purpose is to promote, innovate and investigate training actions in rural areas that offer adults with DS/ID the possibility to acquire, update or expand their skills for personal, social and professional development in inclusive teaching and learning contexts.

Outputs include the definition, design and development of courses, training workshops, programmes, etc., linked to the on-going training of adults with DS/ID, focused on new concepts and visions of ID and powerful pedagogical methodologies, that respond to their current training needs: co-operative learning, project-based learning, support models, mediational didactic approach and service learning.

(Erasmus+ project, 2020–2021, project reference: 2020-1-ES01-KA204-083272)



Accordingly, many questions remain at the system (national/regional) level. For example:

- 🌐 If the pandemic is to be used as an opportunity to reform the education system, how should this reform be designed in concrete terms?
- 🌐 Have digital technologies increased the education system's general resilience during the COVID-19 crisis, or do they create new vulnerabilities due to technical systems' susceptibility to other – still unknown – types of disruption/crises, thereby even diminishing general system resilience?
- 🌐 If the pandemic affected learners already vulnerable to exclusion more than other learners, how can this be prevented from happening again in the future?
- 🌐 How can the simultaneous consideration and content-related coupling of digital and inclusive topics be ensured in teacher training and further education?
- 🌐 How can new technologies help education systems to compare themselves with others internationally and to learn from each other through more transparency regarding their approaches and the outputs achieved, but especially regarding outcomes and impact?
- 🌐 Which indicators are relevant at different system levels (from the classroom, to the school, to the regional or national level) to monitor the quality of inclusive digital education in sufficient detail and to be able to adjust it in a timely manner?

## 4.6 Blended learning

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This last section of [chapter 4](#) specifically addresses the issue of blended learning. The Council of the European Union defines it as follows:

... blended learning in formal education and training involves a diversity of approaches and is to be understood as a school (in primary and secondary education, including vocational education and training), teacher and trainer or learner taking more than one approach to the learning process:

- 🌐 blending school site and other physical environments<sup>6</sup> away from the school site (either with the presence of a teacher/trainer, or separated by space and/or time in distance learning);
- 🌐 blending different learning tools that can be digital (including online learning) and non-digital.

... teachers, trainers and schools will select and facilitate the use of these approaches as part of engaging and effective learning tasks that support broad competence development, as appropriate to the age, abilities and circumstances of the learners and intended learning outcomes (2021, p. 12).

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<sup>6</sup> 'Other physical environments may include ... the home; hospitals (in the case of sick or injured children); ... cultural and memory institutions; farms, companies and other workplaces; nature sites and outdoors; sports and youth spaces' ([Council of the European Union, 2021](#), p. 12).



Learners in blended learning environments show a significant increase in their average academic achievement compared to learners in face-to-face learning environments. Furthermore, blended learning has a medium-level impact on learners' levels of academic achievement (Saritepeci & Çakir, 2015). During the pandemic, when distance learning was widespread, the importance of direct interaction became evident, as mentioned in [section 4.3](#). Digital learning situations – up to now – insufficiently support valuable aspects of human interaction, e.g. informal conversations, direct eye contact, physical relationships and a physical assimilation of the world.

Similar observations relate to the COVID-19 pandemic's implications for the educational technology industry, as far as can be seen from the literature. In the years before the pandemic, the educational technology industry in particular was euphoric about developments in e-learning that would make face-to-face learning obsolete. As the pandemic hit and education was relocated to distance learning on a large scale, experiences emphasised the need for a different vision for teaching and learning, and – to some extent – the value of blended learning was rediscovered.

The implementation of blended learning goes hand-in-hand with a number of requirements. Routines, such as going to school every day or going online every day, are replaced by new, more complicated routines. For some, such routines provide security and structure; for others, alternating between, for example, online and face-to-face settings, can be motivating and varied. Technically and organisationally, educational organisations must be geared towards blended learning. The technical infrastructure must work reliably, be usable at all times and enable hybrid operation in face-to-face phases (e.g. if not all learners can be present).

All levels addressed in this [chapter 4](#) – from the individual (i.e. learners and teachers), to schools, to the national/regional level – plus digital technologies and inclusion as cross-cutting issues are involved if blended learning is not just to be implemented on a case-by-case basis but is to be permanently anchored in the education system's structures.



## PROJECT EXAMPLE

### Teachers Competencies for Social Inclusion of Migrants and Refugees in Early Childhood Education

This project aims to create a blended learning course for pre-service and in-service early childhood educators and primary teachers to improve their ability to promote the inclusion of migrant and refugee children (3 to 8 years old) in early childhood education settings and to address the risk of social exclusion those children face.

Furthermore, a virtual environment will be created to host multimedia materials and a blended learning strategy will be presented. This will include the selection of training activities and materials, learning assessment and a guide for teacher trainers.

(Erasmus+ project, 2019–2022, project reference 2019-1-PT01-KA203-060683)



However, solutions are more challenging than expected as, for example, blended learning approaches in the context of inclusive education may also have certain disadvantages. Evidence shows that, particularly for learners with SEN, alternating between face-to-face and distance learning can be stressful (Lütje-Klose, Geist and Goldan, 2021). Accordingly, further research is needed on how appropriate implementation concepts for blended learning can be designed to meet the needs of all learners.

The Council Recommendation on blended learning identified shortcomings when Member States had to shift rapidly to distance learning during the pandemic, citing ‘a widespread lack of readiness and resources’, which ‘highlighted and aggravated existing inequalities, gaps and needs’ ([Council of the European Union, 2021](#), p. 3). Hence the Council calls for an approach that includes face-to-face learning and teaching activities, distance, digital and blended learning, with a specific focus on ensuring equal opportunities. Technology’s potential to ‘facilitate more accessible, flexible, personalised and learner-centred learning’ is mentioned, as is the need to equip learners and teachers with appropriate ‘digital skills and competences’ (ibid., p. 4).

The Recommendation also stresses the need to strengthen ‘digital capacity in education and training systems’ (ibid.), by learning from the experiences gained during the pandemic and through closer co-operation at European level. This emphasises, once again, that inclusive digital education requires a transformation process that affects all system levels, as outlined in this chapter, and needs to be implemented simultaneously.



## PROJECT EXAMPLE

### Blended Learning for Inclusion

The project aims to empower educators in using blended learning in schools, in an attempt to deal with the social and educational exclusion of learners from disadvantaged backgrounds. Development of an innovative practical digital toolkit and a blended training course is planned that will help teachers to use blended learning in schools based on the principles of inclusive education. Learners from disadvantaged, migrant backgrounds and learners with educational difficulties are participating in this project.

(Erasmus+ project, 2019–2022, project reference 2019-1-FI01-KA201-060881)



## 5. THEMATIC TRENDS IN INCLUSIVE DIGITAL EDUCATION PRACTICE



Complementing the literature review, this study also examines implementation projects and conferences in the education field to examine whether and to what extent findings from the field of science are reflected in (or close to) practice. The question arises as to which topics, which may already be considered state-of-the-art in the academic literature, actually make their way into educational practice, and which practical challenges can still be encountered.

**Practice-oriented co-operation projects in the education field** that are dedicated to the exchange, transfer and implementation of findings can be used as an indicator here. The separate [methodology paper](#) presents further information on the methodology chosen and the rationale for using the Erasmus+ database for this investigation.

**Conferences** on the topics of **education, inclusion** and the **use of digital technologies** in this field can be seen as a gauge of which topics will be of interest to the expected target audience. It can be assumed that the chosen conference topics are up-to-date and relevant and thus have a high level of attractiveness. Topics that have already been sufficiently addressed and worked on in practice will find their way into conferences rather less frequently.

### 5.1 Co-operation projects in the education field

#### 5.1.1 Quantitative approach

Based on the literature review results, the search terms listed below were used to search the Erasmus+ project database for projects running during the period 2016 to 2020 (the number of hits appears after in parentheses).<sup>7</sup> Because the database is used in the education field, all search terms have an implicit connection to education.

The search was divided into three thematic spheres: terms in the field of [inclusion/inclusive education](#), terms differentiating [application areas](#) within education, and terms related to the use of [digital technologies](#) in education.

#### *Inclusion sphere*

The following search terms were selected for the inclusive education focus:

-  inclusion (4,427)
-  exclusion (1,437)
-  special educational need OR special educational needs OR SEN OR disability OR disabled OR handicap OR handicapped (1,840)
-  inclusive schools (105)

<sup>7</sup> In November 2021, the database listed 20,789 projects for the period 2016–2020. Projects initiated in 2021 were not part of the database at the time of retrieval.



- 🌈 inclusive primary education OR inclusive primary education and training OR inclusive secondary education OR inclusive secondary education and training OR inclusive vocational education OR inclusive vocational education and training OR inclusive higher education OR inclusive higher education and training OR inclusive VET OR inclusive HE (592)
- 🌈 inclusive teaching OR inclusive learning (143).

Figure 3 shows the relative frequencies of these search terms for the period 2016 to 2020. Each project was assigned the respective year of the call for project submissions. The majority of these projects run for several years, so it can be assumed that the topics (keywords) relevant in the year of the call will continue to be in focus throughout the project lifetime (usually up to three years), which is not reflected in the figures. Rather, the figures show which topics/keywords were mentioned in successful project submissions in the respective years. All values were normalised by year according to the total number of projects running in each case. Finally, the value for 2016 was set to 100 (%) throughout to make it easier to detect changes.

Due to the pandemic also occurring in Europe at the beginning of 2020, the question arises as to whether and what influence this crisis had or has on the topic areas relevant to the study. A first check shows that the terms 'corona' (165), 'COVID/COVID-19' (110) and 'pandemic' (1,126) appear in a total of 1,256 project descriptions. In a first approach to find out how trends and developments would have evolved without the pandemic, all these projects could be excluded from the final observations. The resulting trend curves are shown with dashed lines in Figures 3–7 below. The corresponding legends include an asterisk \*.

However, closer analysis shows that the terms 'corona', 'COVID', 'COVID-19' and 'pandemic' seem to appear in projects that began before the pandemic. For example, there are two projects with corresponding references in 2016, 96 in 2017, 272 in 2018, 27 in 2019 and 859 in 2020. How can this apparent contradiction be explained? Random samples of project descriptions of projects that started before the pandemic began show that the project descriptions in the database are revised at the end of the project and mention cross-references and implications of the pandemic if the project ended after the pandemic began. On-going projects, on the other hand, use data from the project application process in the project description; accordingly, the course of the pandemic mentions can be reconstructed and explained well. However, this also means that one cannot omit all projects that mention the pandemic on the assumption that these projects would not have existed without the pandemic. It can therefore be assumed that, if the pandemic had not occurred, the development of the trends would lie somewhere between the solid and dashed lines of the same colour.

In Figures 3–8, a slash / separates options, round brackets () enclose optional text elements and square brackets [] enclose required text elements.

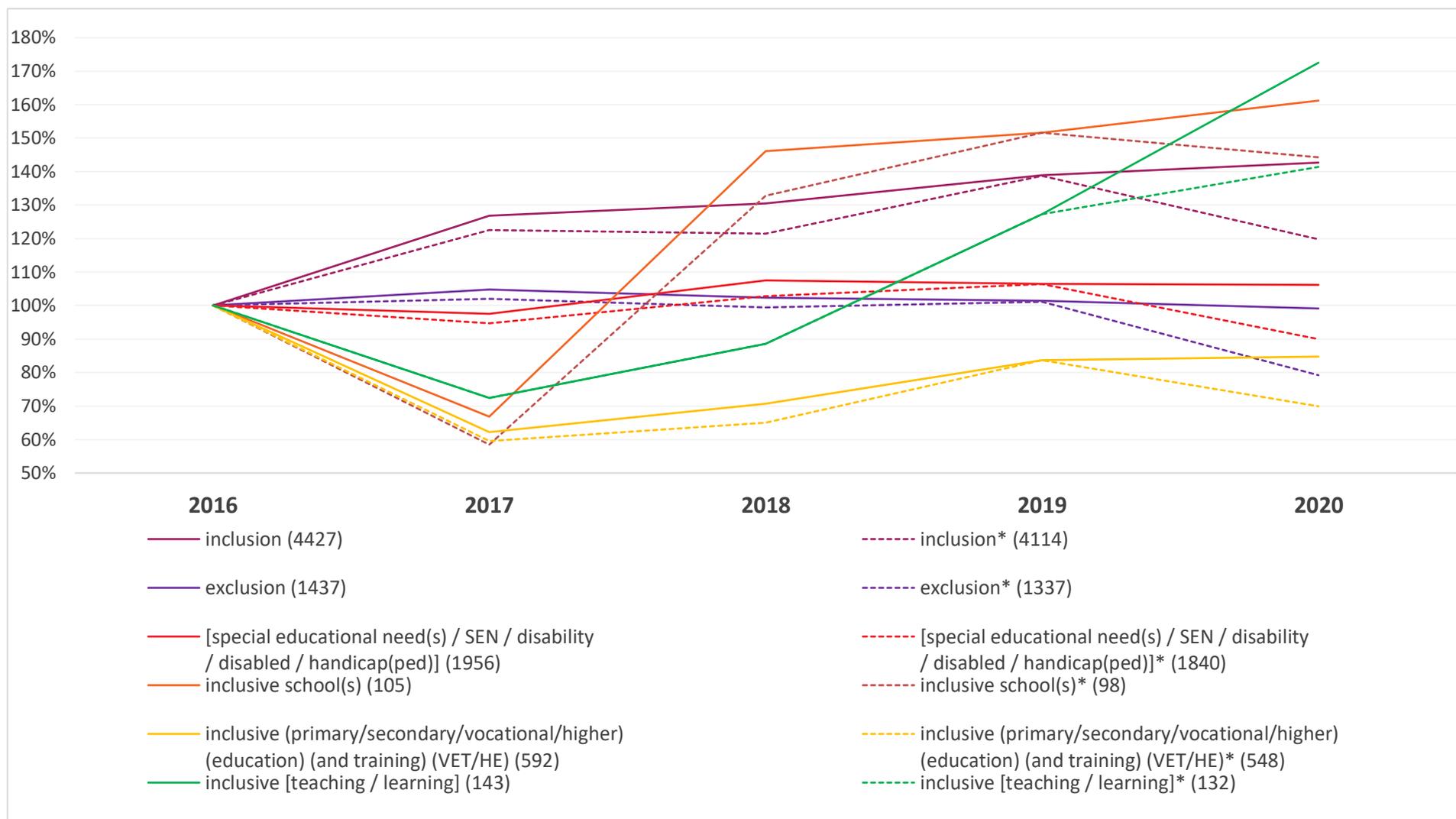


Figure 3. Occurrence of terms related to inclusion in Erasmus+ project descriptions 2016 to 2020 (normalised with 2016=100)



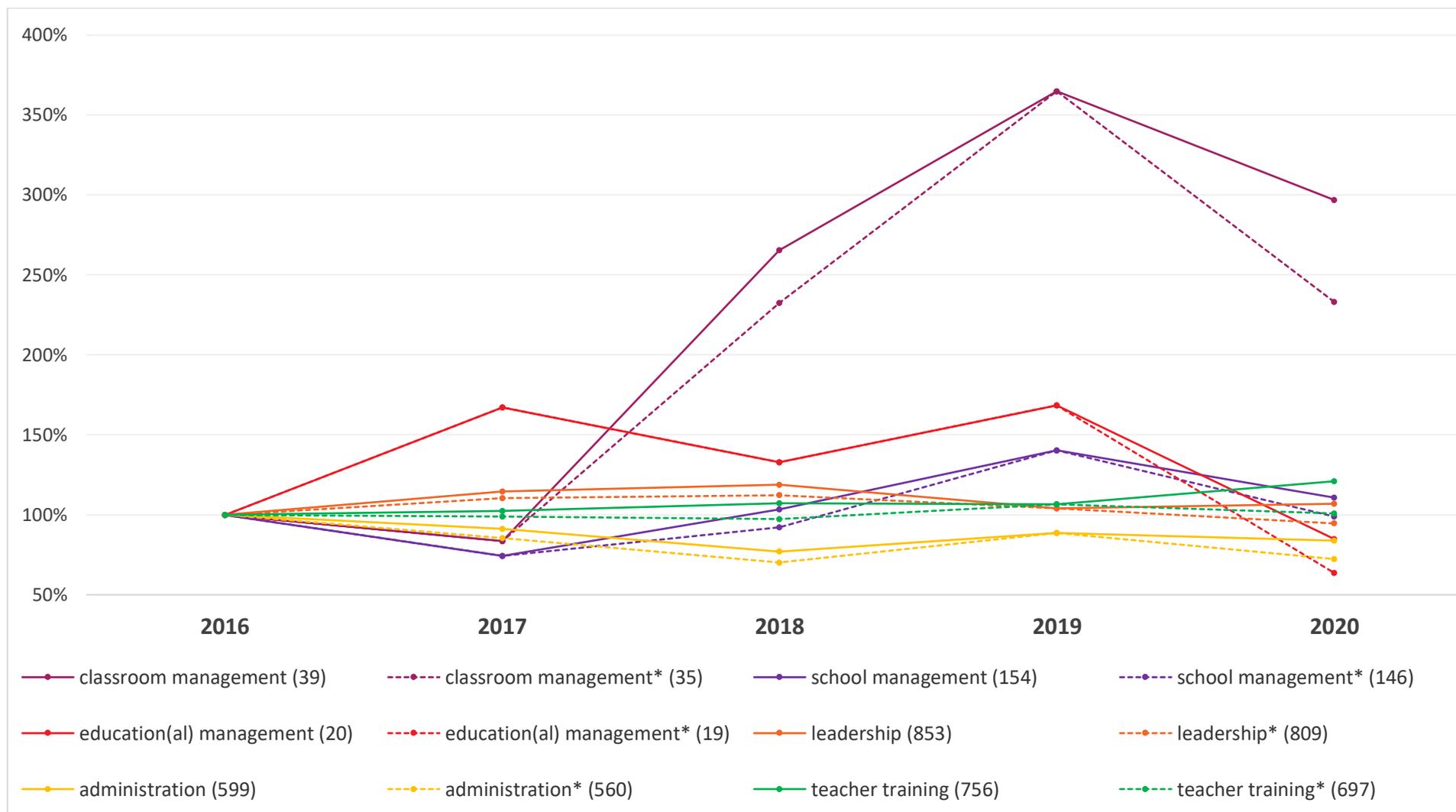
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### *Application sphere*

The following search terms were selected for application areas:

- 🎯 classroom management (39)
- 🎯 school management (154)
- 🎯 education management OR educational management (20)
- 🎯 leadership (853)
- 🎯 administration (599)
- 🎯 teacher training (756).

Figure 4 shows the progression of these terms over time in successful project applications. Here, too, the dashed lines show the respective curve when all pandemic-related projects are excluded. For the later interpretation of the data, it may be relevant to point out the relatively small numbers of hits in the subject areas 'classroom management' and 'education(al) management', especially since the curves would suggest a different interpretation without this information.



**Figure 4. Occurrence of terms related to the areas of application in Erasmus+ project descriptions 2016 to 2020 (normalised with 2016=100)**

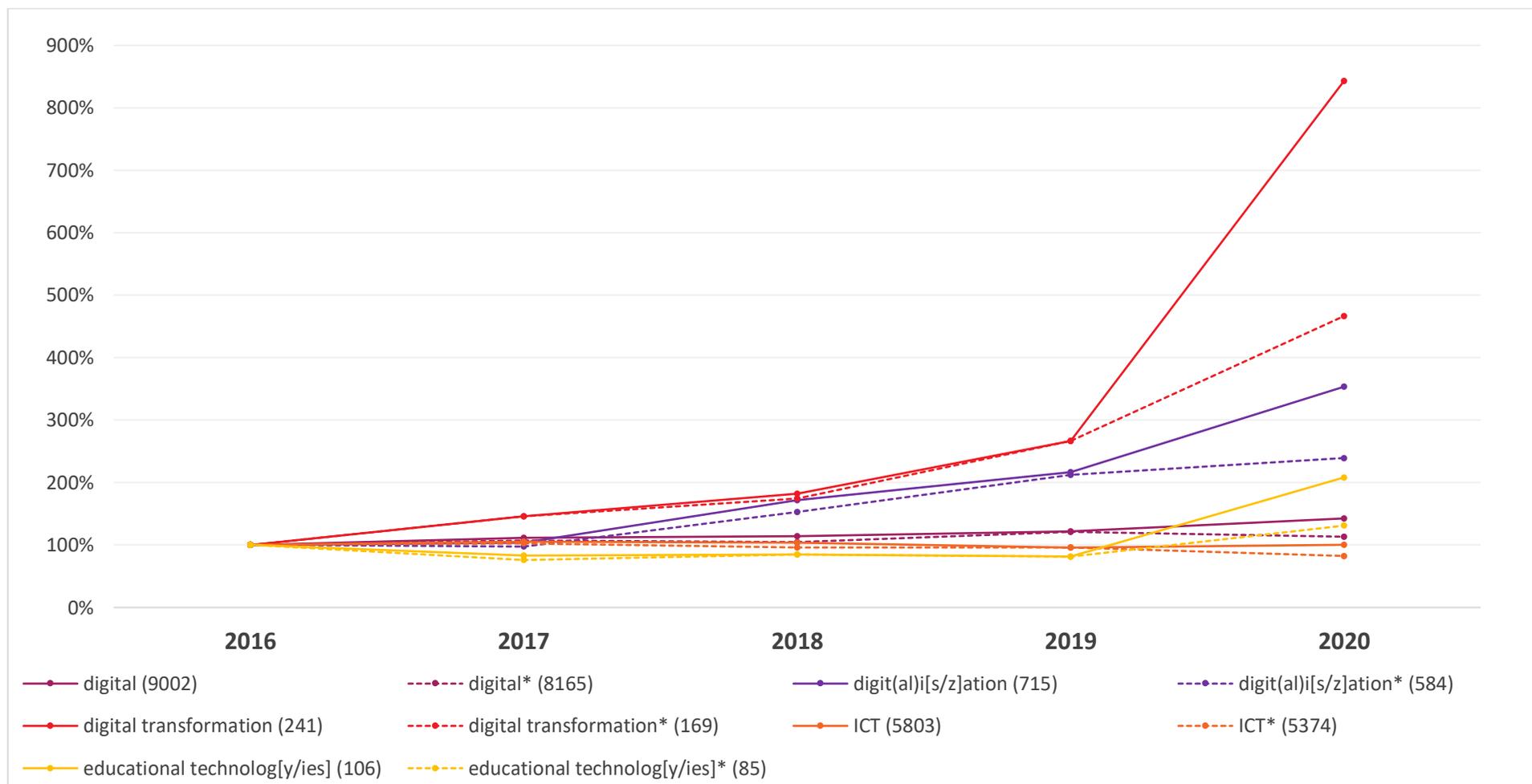


### *Technology sphere*

The following search terms were selected for the technology focus:

- 🎯 digital (9,002)
- 🎯 [digitisation](#) OR digitization OR [digitalisation](#) OR digitalization (715)
- 🎯 digital transformation (241)
- 🎯 information and communication technology OR information and communication technologies OR ICT (5,803)
- 🎯 educational technology OR educational technologies (106)
- 🎯 e-learning OR elearning OR web-based learning OR online learning OR remote learning (1,915)
- 🎯 blended learning (527)
- 🎯 massive open online courses OR MOOC OR MOOCs (556)
- 🎯 online course OR online courses (382)
- 🎯 virtual reality OR VR (261)
- 🎯 augmented reality OR AR (213)
- 🎯 artificial intelligence OR AI (155).

Figure 5 shows the evolution of the central concepts around the topic of digitalisation. The gap between the solid and dashed lines is more pronounced here than for the previous topics.



**Figure 5. Occurrence of technology-related terms in Erasmus+ project descriptions 2016 to 2020** (normalised with 2016=100) [Part 1 of 3]

Figure 6 summarises the trends in the mentions of terms related to spatially distributed learning and teaching. The most frequent synonyms for ICT-based learning – i.e. e-learning (1,478), elearning (55), web-based learning (11), online learning (468) and remote learning (39) – were combined,



even though there may be differences in their specific definitions or implementation. A distinction is made between MOOCs and online courses in general, i.e. the numbers for online courses do not include MOOCs.

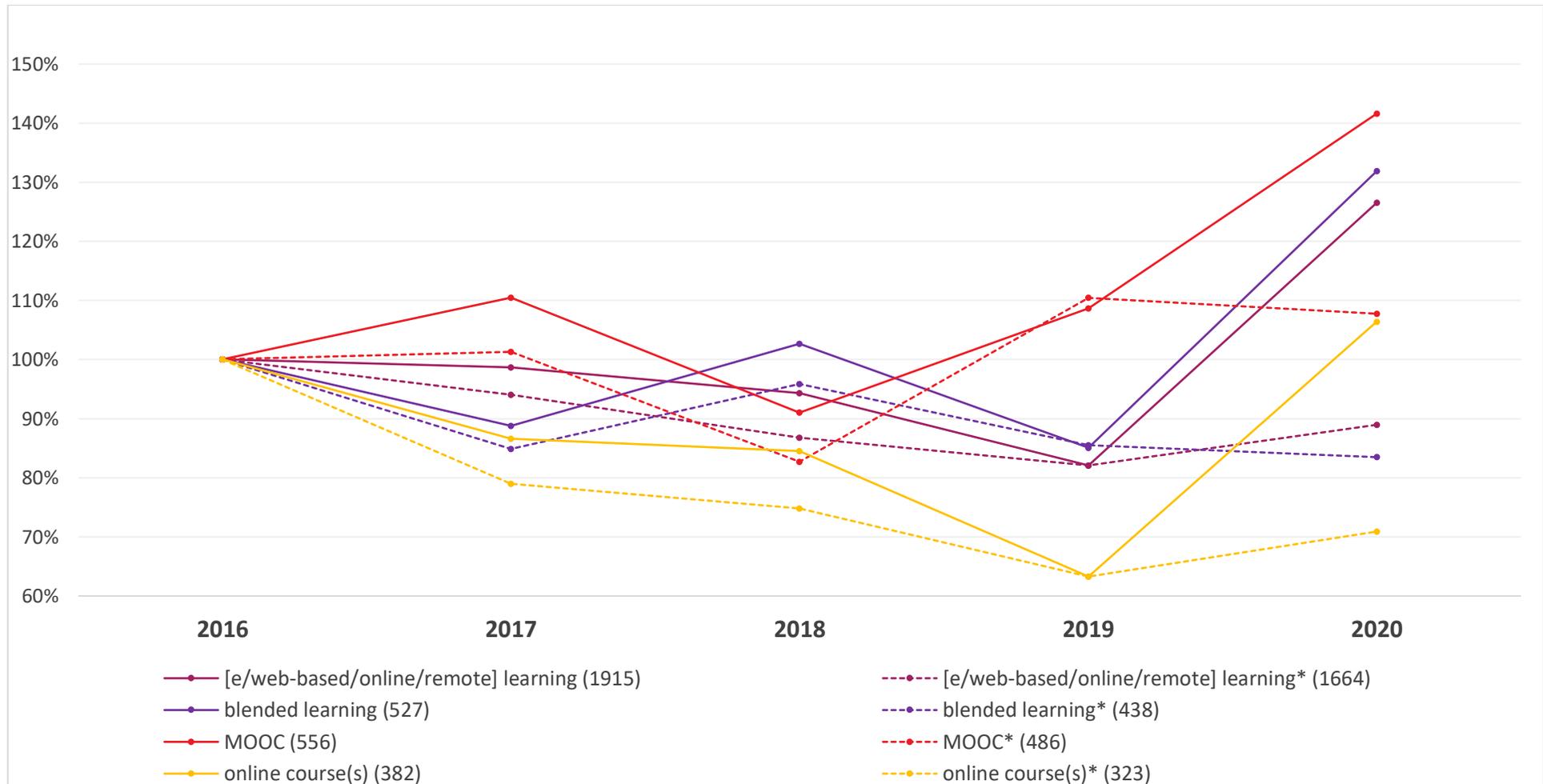


Figure 6. Occurrence of technology-related terms in Erasmus+ project descriptions 2016 to 2020 (normalised with 2016=100) [Part 2 of 3]



Finally, Figure 7 shows three key technologies and their trends in the Erasmus+ projects from 2016 to 2020. VR can be considered technically easier to implement than AR, which may be reflected in the absolute numbers. The topic of AI shows a very strong trend in Erasmus+ projects in recent years, even without the pandemic's potential impact. However, it is worth mentioning that in 2016, only three projects addressed the topic of AI, compared to 83 in 2020. This could lead to a distortion in comparison to other subjects due to the small number of cases at the time for which the normalisation to 100% took place.

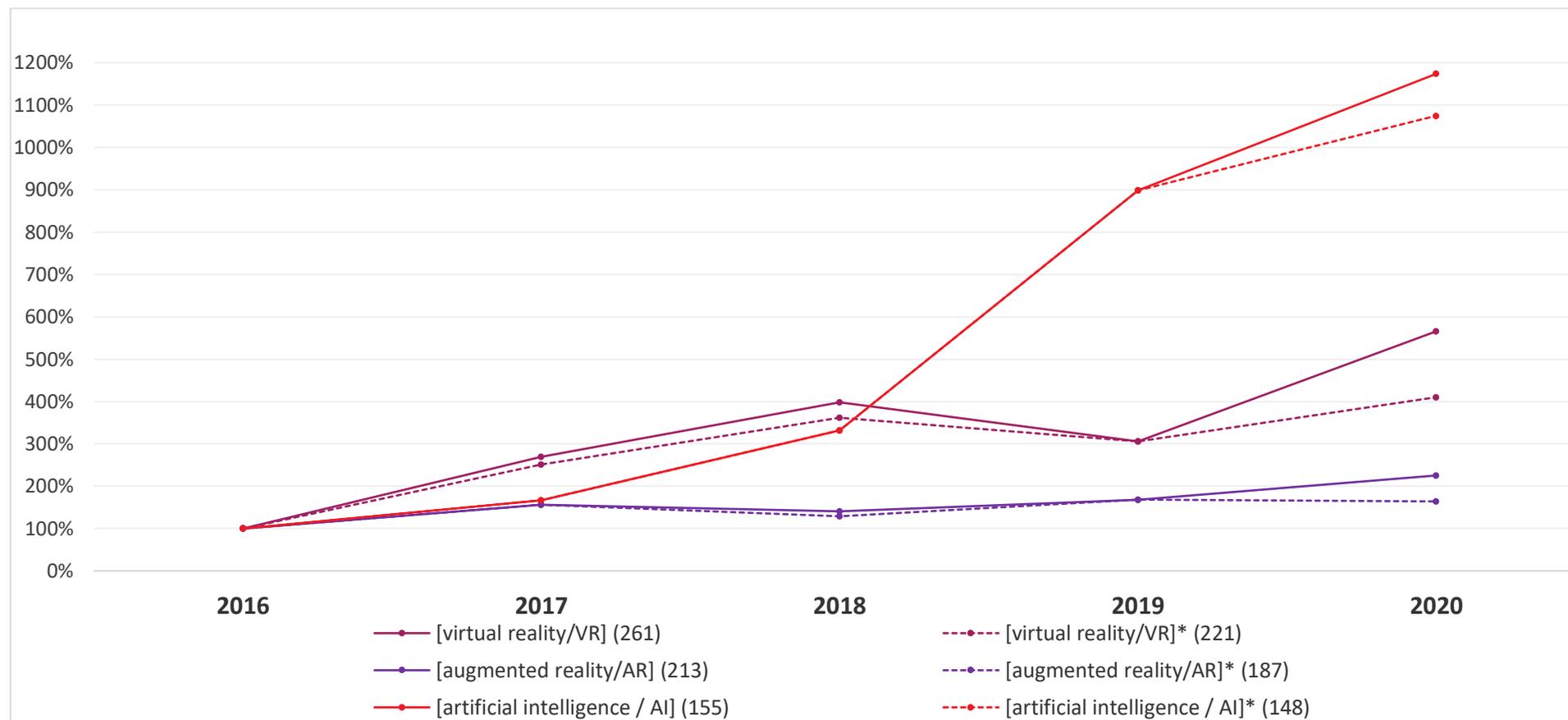


Figure 7. Occurrence of technology-related terms in Erasmus+ project descriptions 2016 to 2020 (normalised with 2016=100) [Part 3 of 3]



The topic of ATs is highly relevant for users of these technologies. On the one hand, they can be used as personal technical aids not only in the education sector but in other areas of life. On the other hand, incompatibilities often occur in their interactions with other technologies. However, the search term only yields 27 hits in the Erasmus+ project database.

### **5.1.2 Qualitative approach**

The quantitative analysis was followed by an examination of the projects based on their short descriptions in the Erasmus+ project database. In the case of on-going projects (at the time of the research, 13,356 projects in the database had the status 'on-going'), the brief project description reflects the planning status or the objective at the time of the funding application, while completed projects (at the time of the research, a total of 7,266 projects had the status 'finalised') contain a summary of the results achieved. However, this distinction can be disregarded in the context of this study, as it aims to examine trends and developments, but not to assess the extent to which these developments are promising or even successful. Accordingly, no distinction is made between on-going and completed projects.

Along the three spheres analysed in the previous section ([inclusion](#), [application](#) and [technology](#)), the overlapping areas were now examined. Projects located in these overlapping areas were looked at more closely. shows the terms used for the search. This section analyses the corresponding projects in more detail.

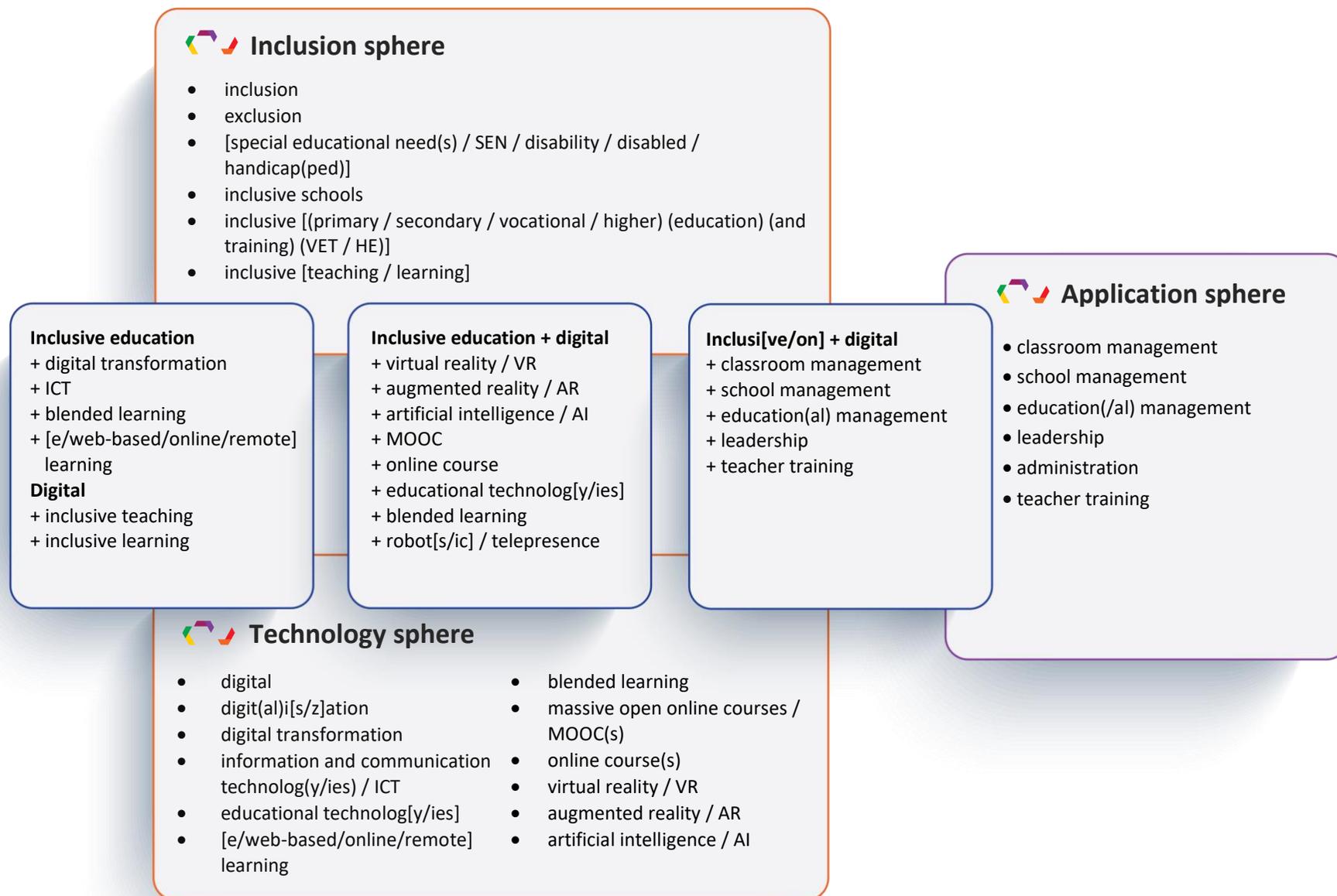


Figure 8: Selection of filter terms in the overlapping areas of the technology, inclusion and application spheres



In the course of the search, a total of 158 projects were examined more closely with regard to the study focus. In the following, the respective project contents of relevant projects are condensed to give an overview of the topic coverage; longer descriptions are available in the separate project examples document (forthcoming). These descriptions are structured under the following headings:

- 🎯 Digital transformation
- 🎯 Blended learning
- 🎯 Online courses, e-learning, web-based learning, online learning and remote learning
- 🎯 Inclusive teaching
- 🎯 Inclusive learning
- 🎯 Virtual reality (VR)
- 🎯 Augmented reality (AR)
- 🎯 Artificial intelligence (AI)
- 🎯 Massive open online courses (MOOCs)
- 🎯 Robotics and telepresence
- 🎯 Educational technologies
- 🎯 Leadership
- 🎯 Teacher training.

With regard to the digitalisation process, the term [digital transformation](#) is central in the most diverse areas of application, as the quantitative analysis for the education sector already showed.

In school education, projects addressing digital transformation aim to:

- 🎯 create innovative online resources with a view to high-quality, inclusive teaching of science, technology, engineering and mathematics, addressing learners aged 10–18, including learners who are disadvantaged due to low social and economic status;
- 🎯 reinforce education and training institutions' ability to provide high-quality, inclusive digital education via family training;
- 🎯 train educators via a novel VR-based pedagogical approach for virtual practice phases, aiming to promote the delivery of high-quality inclusive education and ensure that no learner is left behind, even in a pandemic crisis.

In VET, projects aim to:

- 🎯 support 50 VET colleges across the EU to adapt to new ways of digital working;
- 🎯 help leaders and teachers to adapt to more blended or online-only curriculum delivery models, as the pandemic-related restrictions had a heightened impact, particularly on learners from disadvantaged backgrounds.



In HE, projects relating to digital transformation aim to:

- 🎯 boost universities' digital readiness for online education by improving inclusiveness and personalised online teaching, and particularly mechanisms to foster inclusive education for at-risk social groups and learners from peripheries;
- 🎯 develop a toolkit that will support and empower HE teachers in building inclusive education materials, helping to reduce the pandemic's impact on learners with disabilities;
- 🎯 acquire new skills and competences that strengthen creative potential and thus contribute to the resilience of the education, cultural and creative sector.

A few other projects on digital transformation mention inclusive education, but it is unclear to what extent the project activities address it. Within school education, one project aims to design, develop and test a school teachers' resilience toolkit to equip educators with efficient strategies to prevent and handle burnout, as well as foster mental health and well-being. One project aims to promote [open-source](#) technologies in non-formal adult education to support the digital upskilling of both educators and learners, and to build training organisations' capacity to deliver high-quality, relevant digital skills training to adults to prepare them for the on-going digital transformation. Another project mentions the need for high-quality and inclusive education through enriching learning experiences while supporting effective use of digital technologies in the creation of OERs.

Several projects address **blended learning** in inclusive digital education. In them, blended learning serves to:

- 🎯 train professionals, e.g. in pre-service and in-service early childhood education and primary education to improve their ability to promote the inclusion of migrant and refugee children;
- 🎯 enhance inclusive education in botanic gardens using innovative blended learning models;
- 🎯 empower educators in schools to deal with the social and educational exclusion of learners from disadvantaged backgrounds;
- 🎯 develop professionals' capacity to ensure quality inclusive education for children and teenagers with visual and hearing impairments by increasing training provision for formal and non-formal education;
- 🎯 increase the participation of learners with various disabilities in digital education by strengthening the profiles of teachers;
- 🎯 use an interactive online teaching platform to simulate a physical class, enabling teachers to carry out activities online that are normally done physically in class.

Other projects address the challenges of distance learning for disadvantaged learners, for example by:

- 🎯 reflecting on the special situation caused by the pandemic that emphasised the opportunities and challenges in online distance education and blended learning;
- 🎯 remediating these negative impacts for underprivileged and migrant children and strengthening these children in a new situation of online and blended learning.



In HE, projects:

- 🎯 analyse the rapid transition from a predominantly face-to-face teaching model, to an online-only or heavily blended learning model regarding the impact on learners, particularly learners vulnerable to exclusion (ethnic minority groups, low socio-economic status, caregivers, those with additional learning needs and/or other disabilities, and those with a diagnosed mental health condition);
- 🎯 analyse access, success and belonging in HE for learners of varying sexual orientation, gender, ethnicity, skin colour, religion, able-bodiedness, or socio-economic status;
- 🎯 focus on learners who require some level of support or consideration to be fully included in HE, as particularly in HE, awareness of accessibility and support strategies tends to be in 'silos' of knowledge, such as equality and diversity units, student support centres, student enabling centres or faculty representatives for diversity and inclusion.

Another set of projects addresses the combination of **inclusive education and online courses**. These projects aim to:

- 🎯 foster the growth of informal learning environments that provide opportunities for young people to engage in craft-making with the support of digital technology, and to enhance the ability to set up more inclusive learning environments;
- 🎯 raise awareness among VET providers regarding the importance of inclusive entrepreneurship education to cater to the needs of disadvantaged groups through the lens of inclusion, diversity and intercultural integration;
- 🎯 significantly contribute to increasing the number of online OERs accessible to learners with disabilities;
- 🎯 develop a training package/course for VET teachers to familiarise themselves with digital pedagogy and develop a common inclusive digital-pedagogical model that will include online learning quality criteria, good practices and examples of inclusive online learning;
- 🎯 develop guidelines to support teachers in applying digital learning to promote teachers' sense of effectiveness and abilities, and by that means contribute to a purposeful integration of digital technologies in inclusive education.

A key term in the context of this study is [e-learning](#), with related concepts of [web-based learning](#), [online learning](#) and [remote learning](#). Several projects focus on these concepts specifically, addressing:

- 🎯 early school leaving by developing methods and creating conditions for personalised teaching and learning through modular and graduated e-learning units;
- 🎯 the specific needs of pre-primary school teachers in inclusive settings and determining existing pre-primary practices in the EU, leading to the design of an open e-learning portal;



- solutions in the field of effective and creative use of ICT in developing key competences of learners with SEN, but also familiarising school management staff with applying inclusive education and teaching methods;
- school drop-out and increasing NEET (not in education, employment, or training) rates by preparing pre- and in-service English as a foreign language teachers to face diversity in the classroom by raising their awareness, enhancing the quality of teacher training, and promoting ICT as an instrument to improve inclusion;
- the quality and efficiency of teaching and learning by giving equal opportunities to all types of learners, in mixed classes, implementing inclusive education, e-learning and ICT, with a particular focus on teacher collaboration;
- the acquisition of digital literacy not only for teachers, but also learners, the educational community and families;
- the rapid transition to new forms of e-training in the VET environment by supporting the digital upskilling of VET trainers/teachers and tutors;
- the preparation of young learners and refugees by equipping them with the soft skills, abilities and knowledge to be successful in a globalised world with its growing demand for flexibility, intercultural competence and ICT skills;
- opportunities for adults with Down syndrome or other intellectual disabilities to acquire, update or expand their skills by promoting, innovating and investigating training actions in rural areas;
- learners in HE (particularly vulnerable ones, who need more support and accompaniment) who became disengaged from the learning process during the pandemic, and supporting the transition towards more inclusive digital education;
- teacher trainers who are experts in the use of ICT (including the use of e-learning platforms) applied to inclusive education, providing the necessary skills to identify and articulate educational paths.

Another set of projects looks at **inclusive teaching** in combination with the use of digital tools/ICT, addressing specifically:

- a growing number of learners with behavioural problems whose skills acquisition is incomplete and using inclusive teaching as a means to foster efficient social integration and support the acquisition of life skills;
- the challenge for both teachers and learners to deal with learners from different cultural backgrounds – among other things, ICT use in the classroom and social media use are identified as important factors for an inclusive, professional teaching-learning process;
- educators using digital storytelling at all levels of the education system to help learners develop writing, presentation, organisational and problem-solving skills to reach effective digital inclusion;
- new learning opportunities for children with literacy problems, by training primary school teachers to use ICT-based methodologies and reading-fluency apps in a classroom setting;



- 🎯 teachers to deliver effective science education courses to their learners, within online/distance and blended settings, within a concrete educational framework that is designed to foster the development of learners' skills while addressing equity, diversity and inclusion challenges;
- 🎯 teachers – including teachers with special needs, multi-lingual teachers or hard-to-reach teachers who work in remote and marginalised areas – to develop their skills, knowledge and tools to deploy ICT-based interactive and e-learning technologies for inclusive teaching.

Another set of projects is addressing **inclusive learning** in combination with the use of digital tools/ICT, aiming to:

- 🎯 generate knowledge on the appropriate use of digital and mostly innovative technologies in early childhood education and to disseminate this knowledge through multiplier events and publications;
- 🎯 enhance schools' capacity to provide inclusive and efficient science, technology, engineering, the arts and mathematics (STEAM) education to learners with SEN to enrich their learning experience and employability opportunities;
- 🎯 develop a suite of training resources for educators to create genuinely engaging learning experiences in three key areas: diversity and inclusion with 'differentiated instruction' as a structured approach to pro-actively cater for learner diversity; innovation for 21<sup>st</sup> century skills; and digital technology;
- 🎯 explore the flipped classroom teaching methodology in VET centres, based on ICT and on an innovative learner-centred pedagogical approach, in order to increase the quality of teaching and learning, reduce school drop-out and support the modernisation of education and training systems;
- 🎯 build and strengthen VET teachers' capacities in the deployment of online resources that facilitate collaboration and inclusion among learners and reinforce VET providers' ability to provide high-quality, inclusive digital education;
- 🎯 improve/integrate the learning methodologies of university language centres through the development of innovative and inclusive learning tools.

The seven projects in the database that include the use of **VR** show a great diversity in their objectives, aiming to:

- 🎯 integrate AR/VR and 3D printing into staff training and educational practice;
- 🎯 improve the visual literacies of second language educators, making learning more visual through static, dynamic and interactive visuals (e.g. VR);
- 🎯 implement innovative teaching methods through the integration of VR and MR technologies in inclusive educational approaches;
- 🎯 build inclusion and understanding between disadvantaged groups of people and the majority of society, using an online storytelling tool to build critical thinking with VR technology;
- 🎯 integrate technology into VET courses to engage learners in immersive learning experiences, whether teaching in class or remotely;



- 🎯 develop VR and gamification for inclusion and language learning interaction in HE;
- 🎯 make European civic education more inclusive and accessible for everyone and raise awareness of European mobility by allowing learners to experience it through VR;
- 🎯 train and motivate teachers to use VR and AR in their classrooms to increase educational engagement, and to develop VR lessons for science disciplines and for cross-curricular topics.

With regard to the application of **AR** in inclusive education, just three projects match this combination of search terms, one of which has been mentioned in the previous paragraph. A second project aims to respond to societal demands for equal access to cultural goods for all, as well as to new social changes and challenges. The third project aims to streamline the adoption of AR technology in educational practice by creating innovative OERs for educators that help to implement and integrate active and [collaborative learning](#) pedagogical approaches supported by AR.

Although **AI** showed high growth rates in the quantitative analysis, the total number of projects on this topic is only 155. If the topic of inclusive education is also taken into account, the search yields only one project that meets these criteria. It is a school exchange partnership built upon the fact that studies have shown that employers and hiring managers value skills like creativity and collaboration over technical abilities, such as computing or knowledge of AI technology. The project aims to enhance those key skills. Replacing the search term 'inclusive education' with just 'inclusive', the database delivers the following projects with these key issues:

- 🎯 defining digital skills, including AI, for blue collar workers, creating training content to teach them and having an online tool so that they can keep up with digitalisation and have a sustainable work life in the digital age;
- 🎯 using AI as an indicator of today's technological development and aiming to make digital education equitable and inclusive by changing learners' perspectives on science and technology to contribute to their improved knowledge and skills;
- 🎯 recognising the context of rapidly developing new technologies (including AI) and highlighting the relevance of humanistic skill profiles for the future workforce;
- 🎯 promoting tolerance, respect for others and a sense of autonomy in favour of an inclusive society by performing a series of hackathons (events in which groups of people engage in collaborative computer programming);
- 🎯 supporting professionals in the youth sector in acquiring and developing creative sector skills in working with coding, AI and robotics;
- 🎯 supporting HE teachers in tackling their digital competence gaps and mismatches by creating an open platform which integrates a competence assessment tool and a complementary database of tools and resources that are available online, making use of AI;
- 🎯 developing an adaptive learning environment based on informed AI to support learners with dyslexia in HE;



- developing an online training course to support VET teachers in the application of digital technologies, as a response to the need for innovative, digital teaching approaches, such as simulations, AR/VR or AI, to teach practical skills in VET sectors such as tourism, hospitality and transportation;
- developing a course on AI which has the goal of introducing the technology to the general public, understanding what AI is and how it is entering the labour market;
- developing an AI-driven personal trainer capable of securing and supporting learning and upskilling processes. Beneficiaries are members of disadvantaged groups (low qualified persons, unemployed, adults at risk of poverty, etc.) and the results are expected to contribute to their social inclusion.

The search for **MOOCs** in combination with digital inclusive education returned 10 results. These projects had the following objectives:

- developing an innovative e-learning platform in the form of a MOOC, enabling learners from European universities to access entrepreneurial skills training, focusing on people with special needs and adopting an inclusive education approach;
- offering education on cultural tourism entrepreneurship to disadvantaged groups, using office technology, digital tools (MOOCs) and intercultural communication skills;
- developing a MOOC for teachers with a view to facilitating their training on the use of ICT in language classes for adult immigrants and refugees;
- setting up a MOOC to open up learning opportunities for teachers to acquire new skills and innovative methods and tools to be able to deliver high-quality teaching, build flexible, personalised and inclusive educational paths, and deal with complex classroom realities;
- supporting teachers and school leaders in excellent teaching and learning by developing online communities and resources to overcome barriers to participation;
- preparing MOOCs for teacher trainers, teachers working with persons with intellectual disability, adults with intellectual disability and entrepreneurs presenting persons with intellectual disability as potential employees;
- making accessible HE OERs and MOOCs, and personalisation using AI, that will enable better provision of open distance learning in India and Bangladesh for those who experience architectural/physical barriers;
- developing a MOOC for learners in textile education and new employers in the textile and apparel industry which uses digital education to decrease the induction time of new employees;
- developing MOOC modules for primary and secondary school teacher training, and a number of inclusive and equitable high-quality OER scenarios in STEAM-related subjects, including multi-disciplinary and civic/citizenship issues;



- developing a MOOC with professionally designed audio-visual material, providing new materials including a toolkit of educational AR apps and platforms supplemented by teacher guidelines, a compendium of best practices, and a competence framework for AR educators.

**Robotics** has also been addressed in a few Erasmus+ projects in relation to inclusive education, aiming to:

- support learners (aged 4 to 7 years) in pre-primary education who cannot be fully involved in traditional learning processes through an early robotics programme for the development of motor skills;
- use robotics to allow children of foreign origin who enter school late and often do not speak the local language, such as unaccompanied minors, and children with disabilities or long-term health problems to attend school regularly;
- use structured courses during staff training, with effective methods of interactive teaching and learning based on web tools 2.0 and robotics.

Another technological solution is **telepresence**, which can compensate for learners' lack of mobility due to various reasons (e.g. distant residence, bad weather conditions, disabilities or illness, force majeure conditions such as epidemics). Just four projects deal with this technology. All of them began in 2020 within the Partnerships for Digital Education Readiness action. None of them, however, clearly refers to inclusive education. Their objectives are to:

- provide VET learners with a set of study materials with an emphasis on advanced technologies that have not been widely used in education yet (e.g. spherical video, stereo video, telepresence, etc.) and organise virtual internships as a large-scale pilot to demonstrate and test this approach;
- establish a network to support children in marginalised situations, particularly those with long-term illnesses or in hospital, and provide several ready-made practical methods to use telepresence quickly and easily;
- use telepresence robots in educational institutions at the upper-secondary and HE levels and develop materials to support decision-making, guidelines for implementation, a set of innovative teaching scenarios, and a do-it-yourself guide;
- use VR-/AR-enabled telepresence that allows high-quality distance learning and self-learning, to offer learners a rich experience even if they cannot access laboratory facilities and/or get in touch with real components.

With regard to the topic of **educational technologies** in general, one project addresses the challenge presented by new educational technologies and the use of multimedia instruments within schools, which require new ways of designing, managing and organising learning paths and educational material. Another project introduces VR and AR as educational technology in the classroom, while a third project aims to deploy innovative educational technologies and methods to deliver quality and inclusive education.

With regard to **classroom management**, one project aims at preventing school failure and promoting a socially inclusive schoolwide framework to include the increasing number of



learners with diverse academic and behavioural needs. A second project aims at increasing interculturality, creativity and innovation and hence addresses teachers as its main target group. Among the expected results is the acquisition of information on classroom management for inclusive education.

The only project using the term **educational management** aims to improve the skills of teachers, trainers and key persons in inclusive and tailored learning processes in VET institutions, and ultimately to improve the quality of educational management.

**School management** is addressed in some projects that are aimed at:

- 🎯 implementing an intervention in HE that is expected to change the approach to teaching and learning history and the role and critical abilities of learners in secondary education by creating collaboration networks between history researchers, universities, regional educational entities, school management teams and associations of secondary education teachers;
- 🎯 secondary vocational schools that compare their education approaches with practical training in selected European countries and include the findings in a high-quality education process;
- 🎯 persons with learning disabilities and difficulties or who for other reasons are limited in taking part in internships, by developing more engaging, motivating learning and teaching experiences through the use of digital internships;
- 🎯 transforming schools and teachers through innovative digital infrastructures and services to enable learners, including those vulnerable to exclusion, to grow their talents and become active citizens.

The topic of **leadership in inclusive education** is addressed in few projects, aimed at:

- 🎯 increasing the effectiveness of development programmes for individuals from disadvantaged groups by elaborating an innovative approach to inclusive leadership and introducing it into leaders' practice;
- 🎯 developing existing state-of-the-art diversity and inclusion practices in companies and organisations, focused on improving the performance of managers and human resources to strengthen the potential of the most vulnerable workers;
- 🎯 small and medium-sized enterprises, small and medium-sized organisations and start-ups in their challenges arising from digital change by providing them with an up-to-date, inclusive leadership approach.

The latter two projects focus on companies and organisations without an explicit connection to the education sector; however, they could also provide exciting inspiration for educational organisations.

Another set of projects deal with **teacher training**, specifically aimed at:

- 🎯 improving teachers' pedagogical and digital competences to advance the educational environment and make learning more interesting, useful and accessible;



- developing a set of guidelines/recommendations for teachers to design and foster inclusive activities and practices through tangible digital storytelling strategies in childhood education (primary school age, 6–10);
- extending and enhancing secondary school teachers' skills and competences in the teaching of literacy, numeracy and/or digital skills to refugee and/or migrant children with learning gaps due to interrupted education and with minimal native (or English) language skills;
- teachers and special teachers in ISCED levels 1–3 to develop basic and digital skills in underprivileged children and children with SEN, who are more prone to early school leaving.

## 5.2 Conferences in the education field

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The search for relevant conferences was performed via ACM Digital Library, Google Scholar and the conference index of the World Academy of Science, Engineering and Technology (WASET). Eighty-eight proceedings, with a total of 6,005 individual conference presentations, from the following 26 conferences have been used for analysis:

- AIED – International Conference on Artificial Intelligence in Education
- ASEDU – International Scientific Conference on Advances in Science, Engineering and Digital Education
- CIPAE – International Conference on Computers, Information Processing and Advanced Education
- EMINENT – Expert Meeting in Education Networking
- FIE – IEEE Frontiers in Education Conference
- ICALT – International Conference on Advanced Learning Technologies
- ICBDE – International Conference on Big Data and Education
- ICCHP – International Conference on Computers Helping People with Special Needs
- ICDEL – International Conference on Distance Education and Learning
- ICDTE – International Conference on Digital Technology in Education
- ICEBT – International Conference on E-Education, E-Business and E-Technology
- ICEDS – International Conference on Education Development and Studies
- ICEEL – International Conference on Education and E-Learning
- ICEMT – International Conference on Education and Multimedia Technology
- ICETC – International Conference on Education Technology and Computers
- ICETM – International Conference on Education Technology Management
- ICETT – International Conference on Education and Training Technologies
- ICFET – International Conference on Frontiers of Educational Technologies



- 🌐 ICIEI – International Conference on Information and Education Innovations
- 🌐 ICISCAE – IEEE International Conference on Information Systems and Computer Aided Education
- 🌐 ICMET – International Conference on Modern Educational Technology
- 🌐 ICSET – International Conference on E-Society, E-Education and E-Technology
- 🌐 IC4E – International Conference on E-Education, E-Business, E-Management, and E-Learning
- 🌐 Koli Calling – International Conference on Computing Education Research
- 🌐 WAIE – International Workshop on Artificial Intelligence and Education
- 🌐 WiPSCE – Workshop in Primary and Secondary Computing Education.

A quantitative analysis of the frequency of mentions of certain keywords in the titles of conference presentations was carried out in close accordance with the search strategy for the Erasmus+ projects, as described in the previous section. The average frequency of keywords per conference and year serves as the unit of measurement (see Table 6).

In a first approach, the same keywords as in the previous analyses were used. The list was then extended by having a closer look at the 2021 conferences. The reason for this is that new topics that may arise would be reflected in the content of the most recent conferences. Their special consideration in the research, especially with regard to their relevance in the last five years, could help to identify new trends that are not yet reflected in published articles in the scientific literature.

The qualitative analysis of the conferences in 2021 yielded the following additional search terms, which were also included in the quantitative analysis: student modelling, predicting, prediction, machine learning, collaborative learning, pedagogical agents, learning analytics, data-driven, platform, participatory design, accessibility, usability, blended teaching, big data, gamification, gamified, microlearning, digital literacy, digital competencies, chatbot, conversational agents, cloud, 3D, data mining, simulation, recommender system, user experience, user interaction, multimedia, resilience, educational statistics, online assessment, social networks, social media, data literacy, game-based, educational games. Table 6 lists the results of examining the frequency of those search terms that reached a certain level of frequency in the period under consideration.

**Table 5. Number of conferences and papers per year (2017–2021)**

Conferences and papers	2017	2018	2019	2020	2021
Number of conferences per year	11	18	19	22	18
Number of papers per year	602	1,212	1,008	1,451	1,732

**Table 6. Average frequency of search terms per conference per year (2017–2021)**

(only terms with an average frequency greater than 0.5 in any year are listed; sorting is by frequency in 2021, from highest to lowest value)

Search terms	2017	2018	2019	2020	2021
<b>big data</b>	0.27	0.67	0.74	1.00	6.72
<b>platform</b>	0.91	1.11	0.74	1.36	4.61
<b>artificial intelligence OR AI</b>	0.00	0.56	0.53	1.41	3.17
<b>pandemic OR COVID related</b>	0.00	0.00	0.00	1.82	2.50
<b>cloud</b>	0.18	0.44	0.16	0.41	1.89
<b>simulation</b>	0.27	0.39	0.37	0.59	1.78
<b>virtual reality OR VR</b>	0.45	0.39	0.79	0.82	1.61
<b>data mining</b>	0.27	0.11	0.32	0.36	1.61
<b>multimedia</b>	0.09	0.39	0.21	0.55	1.50
<b>predicting OR prediction</b>	1.00	0.39	0.58	0.77	1.44
<b>online learning</b>	0.18	0.39	0.58	0.73	1.28
<b>accessibility</b>	0.27	1.89	0.26	0.27	1.28
<b>machine learning</b>	0.09	0.56	0.58	0.86	0.83
<b>learning analytics</b>	0.00	0.33	0.26	0.27	0.83
<b>3D</b>	0.09	0.28	0.21	0.27	0.83
<b>gamification OR gamified</b>	0.18	0.67	0.58	1.23	0.78
<b>remote</b>	0.18	0.22	0.16	0.27	0.72
<b>e-learning</b>	0.82	0.72	1.00	0.50	0.67
<b>augmented reality OR AR</b>	0.09	0.39	0.74	0.55	0.67
<b>blended learning</b>	0.18	0.61	0.95	0.82	0.67
<b>transformation</b>	0.18	0.28	0.16	0.45	0.61
<b>MOOC</b>	1.00	1.06	0.95	0.91	0.56
<b>information and communication technology OR ICT</b>	0.18	0.44	0.63	0.27	0.56
<b>game-based OR educational games</b>	0.73	0.39	0.21	0.27	0.56
<b>social networks OR social media</b>	0.45	0.61	0.42	0.18	0.44
<b>robotics</b>	1.00	0.72	0.53	0.45	0.22
<b>digitalisation</b>	0.00	0.06	0.00	0.73	0.06

For example, a value of 6.72 for the search term ‘big data’ in 2021 means that ‘big data’ was mentioned on average 6.72 times in the titles of contributions in each of the 18 conferences in 2021 (i.e. 121 hits in total for this keyword in 2021). The table was sorted according to the highest frequency values in 2021 to get a first impression of the most frequently mentioned topics in 2021. Their development in the previous years can be seen in the table.



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## 5.3 Summary

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The analysis of the Erasmus+ projects in the period 2016 to 2020 has provided insights into the evolution over time of the topics addressed in the study. Of particular interest is the influence that the COVID-19 pandemic has had on the choice of topics in the projects starting in 2020 and 2021 or already underway. In order to calculate this effect, to obtain a quasi pandemic-adjusted view of the project topics, all projects that referred to the pandemic in some form in their description were removed from the search results. Looking at this adjusted data allows further conclusions to be drawn on the issues relevant in educational practice.

In the thematic field of **inclusion**, increases can be seen in the period under review for the terms ‘inclusion’, ‘inclusive learning’, ‘inclusive teaching’ and ‘inclusive school’, both in the normal hit rates and in the adjusted data as described above.

Topics around **management in education** show a temporary increase in the relevance of the topics ‘education management’ or ‘educational management’ (from 2017 to 2019) and a significantly strong increase in the topic ‘classroom management’ (since 2018).

**Technology-related terms** show slight increases for ‘educational technologies’ and strong increases for the topics ‘digitalisation’ and ‘digital transformation’. The latter is mentioned over eight times more often in 2021 compared to 2016. At the same time, the graphs also show a large influence that the pandemic may have had on these topics.

Looking at the trends for another set of technology-related terms, there are very different results for ‘e-learning’, ‘web-based learning’, ‘online learning’, ‘remote learning’, ‘blended learning’, ‘MOOCs’ and ‘online courses’, depending on whether one examines the total data or the adjusted data. With the exception of ‘MOOCs’, all adjusted curves for 2021 provide values that are below the 2016 baseline; without the pandemic, these topics might not have increased in importance to the same extent.

When looking at ‘artificial intelligence/AI’, ‘augmented reality/AR’ and ‘virtual reality/VR’ technologies, which are also frequently found in the literature, all the curves (i.e. including the adjusted data) indicate a growing relevance in the period under consideration. The strong increase in the field of AI is particularly striking, although this may need to be put into perspective, as the baseline value for 2016 was calculated on the basis of just three projects identifiable in the database.

However, with regard to interpretation of these results, the following limitations must be taken into account:

- 🌈 The projects examined were submitted, evaluated and finally funded within the framework of funding calls. It can be assumed that the terms used in the application documents and project outlines replicate the terms used in the call for proposals to a certain extent. This means that the texts of the calls for proposals would have an influence on the choice of words and thus also on the terms that appear particularly frequently in the corresponding project descriptions, for example – however, an actual trend cannot necessarily be derived from this.
- 🌈 The research is based on texts that are created by the project leaders themselves and entered into the database. An analysis of the extent or depth to which the



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projects actually cover the topics mentioned in their descriptions is not feasible within the framework of this study.

- 🌈 The choice of 2016 as the reference point for normalising the frequencies of the search terms to 100% was arbitrary. There was no investigation into the extent to which 2016 is suitable as a base year from which to derive changes, or whether there were any effects in this year that make it unsuitable for these trend observations.

The qualitative analysis of co-operation projects shows that most of the topics have been addressed and further developed in European projects. However, the research also shows that the terminology used in the project descriptions in the fields of inclusion and digital literacy is diverse, which makes it very difficult to find relevant examples. It can be assumed that the research in the Erasmus+ database carried out in the context of this study could not identify all relevant projects. The basic accessibility of the information on all completed and on-going projects is seemingly not sufficiently designed so that stakeholders in the education field can benefit from it directly and comprehensively. Providing more user-friendly access to the results could increase the usefulness and the take-up of the information.

The analysis of conferences in the past five years largely confirmed the previous findings. However, the content analysis of the conferences in 2021 provided further indications of topic areas that are currently highly relevant. Particularly striking were the topics 'big data', 'platform', 'cloud', 'simulation', 'data mining', 'predicting/prediction', 'machine learning', 'learning analytics', 'gamification/gamified', 'game-based/educational games', which could be relevant for inclusive digital education.



## 6. DISCUSSION AND KEY MESSAGES



### 6.1 Discussion

#### 6.1.1 Initial assessment of main results

This section draws together and provides an initial assessment of this study's main results, based primarily on the literature review and supplemented by information from the examination of co-operation projects and conferences.

##### *Technology's potential to advance inclusion*

In the search for technology topics in recent literature on inclusive education, it was particularly noticeable that most studies still deal with the use of specifically designed technologies (particularly AT) for precisely specified target groups, often based on medical classification criteria. However, even if some technology applications have certain advantages for people with autism or blind people, for example, this does not mean they may be used in an educational context in a way that promotes inclusive education. Most studies do not take this focus – essential for inclusive education – into account. The concept of universal design is hardly ever taken up either among technology developers (with the exception of those who are obliged to implement universal access) or among the users who apply these technologies in the educational context, even though this concept is understood as a cornerstone for inclusive digital learning environments.

Looking more closely at some technologies and design approaches identified in the study, the following points stand out. VR and AR are fascinating technological approaches that can now be used on everyday devices, especially [smartphones](#) and [tablets](#), and hence are taken up in the education field as well. However, little progress has been made in recent years to facilitate easy content creation for VR and AR applications. If teachers (and learners) are unable to create content themselves, only a few selected and externally specified topics will remain for the – therefore inflexible – use of this technology in education. Furthermore, universal access to VR/AR applications has not been sufficiently addressed or solved yet.

Regarding the subject area of AI, the great discrepancy between the high frequency of mentions in the literature and its low prevalence in educational practice is striking. In addition, publications are mostly characterised by positive expectations of this technology, but rarely address evaluation results from its use in educational practice or the associated challenges and ethical questions. While it is easy to imagine AI fulfilling the role of an AT for individual users, so far there are only a few AI approaches (e.g. in the field of learning analytics) that focus on the entire classroom context. Hence, there seems to be little input yet from the educational and scientific community to shape AI so that it could be (re-)designed to support inclusive education ('inclusive by design').

##### *Learners and inclusion in digital education*

Inclusion in digital education is a complex and multi-dimensional issue. Digital environments and digital media use provide opportunities for greater inclusion of vulnerable learners. However, they can also maintain or increase existing inequalities or



even create new ones. Furthermore, learners' digital competences play an important role, especially in terms of communication, collaboration and safety, respectful and appreciative social interaction, the development of oneself as a digital person, the ability to express one's own voice, critical data empowerment and self-protection against violence in digital environments. Vulnerability to digital exclusion can arise from access or poor technical infrastructures or in digitally marginalised groups and communities. It is also related to digital knowledge, literacies and practice and depends on political will, policy development and economic priorities regarding digital inclusion.

Regarding educational settings, it is necessary to not only focus on individual cases but to aim for a holistic perspective on inclusion for all learners. Therefore, inclusion in digital education requires:

- 🎯 analysis of the individual learners' level of inclusion with regard to access, social participation and perceived inclusion;
- 🎯 analysis of relevant elements of the individual learners' environment that affect inclusion in the learning setting while considering digitalisation. This involves the teaching-learning setting itself, the educational institution as an organisation, relationships with peers, teachers and other involved persons and all other relevant parts of the learner's environment (e.g. family, society, etc.);
- 🎯 careful examination of digital media's potential to reduce inequalities and support access, participation and inclusion but also to consider the risks of digitalisation for exclusion and its prevention;
- 🎯 identification of pedagogical interventions to reduce exclusion and enhance the individual learner's inclusion and to consequently reflect inclusion for all.

### *Teachers and digital education*

Digital media does not diminish the importance of personal interaction between teachers and learners. It can be used differently for learning, and digitalisation can affect the learning situation from different elements of the learner's environment (e.g. family, peers, society). Therefore, digital media use for teaching and learning, as well as the digitalisation of teaching, learning and society, can have a supportive or adverse impact on learners' inclusion. To ensure digitalisation opportunities for greater inclusion and better access to education for all, the following are necessary:

- 🎯 **Access and equipment:** All learners and teachers have access to digital learning opportunities and have suitable ICT equipment.
- 🎯 **Attitudes and competences:** Teachers have the attitudes and competences to deliver inclusive digital education for all.
- 🎯 **Training and support:** Further training and informal learning opportunities are offered, and technical support is available.
- 🎯 **Mental health:** During remote teaching and learning in times of crises, such as the pandemic, attention is paid to the mental health of teachers, learners and parents.
- 🎯 **Design for all:** Learning content and environments are designed for the needs of all learners. Ethical aspects are also taken into account.



**Pedagogical primacy:** Digitalisation serves to improve learning for all and is not justified by itself.

In addition, it should be noted that education for all is increasingly being considered together with questions of digitalisation. The European [Framework for the Digital Competence of Educators](#) (DigCompEdu), for example, takes into account corresponding competences and could become a standard in teacher training. Despite a push for digital education and training for teachers, which is a fundamental prerequisite for high-quality digital education for all, there are still clear gaps in the competences, and many relevant aspects of inclusive digital education have not yet been sufficiently researched. These include, for example, ethical issues, but also the opportunities and risks of supporting gifted learners through digital learning.

### *Responsibilities at school level to link inclusion and digital transformation*

Review results with regard to organisational readiness for inclusive digital education (i.e. at school level) indicate that subjective assessment of an organisation's digital readiness is insufficient to assess the actual set-up. Therefore, objective data is required before any substantial change processes may commence. However, the results also showed that organisations that embrace the digitalisation process in terms of content (through skills development) and funding (through investments in digital resources) can help to reduce social exclusion. Teacher empowerment has been identified as a central element. Hence, it must be accompanied by support measures at school level, further training and consideration of the individual needs of, and differences between, teachers with regard to digital topics.

Studies show that collaboration between teachers and other professionals, e.g. curriculum and support teachers, psychologists and professionals from health or social services, can be made more efficient through ICT. However, this reaches its limits when their workload is too heavy and when, in consequence, no resources are left for ICT use. This highlights once again that in parallel to the design of digitally supported work-related tasks, there is still a need for 'classic' work design to minimise stress and strain on teachers.

Communication between schools, teachers and parents – another prerequisite for inclusive education – may also be made more effective and efficient through ICT. However, here too, different requirements and preferences on the part of both teachers and parents must be considered, regarding the choice of technical means, the frequency of communication and its content. The fact that parents may also be dependent on accessible communication is often not taken into account.

Resilience in the sense of crisis tolerance played an important role in the COVID-19 pandemic. Organisations that had already prepared for inclusive digital education in terms of content, technology/infrastructure and organisation before COVID-19 seemed to fare better in the crisis. However, the extent to which these results can be used to draw conclusions about a general crisis resilience that is independent of COVID-19 still needs to be investigated.

Finally, the literature reconfirms the essential role of leadership in inclusive digital education. Change processes need to be monitored, steered, demonstrated and orchestrated by leaders – individuals as well as groups with distributed leadership



responsibilities. This is also true for digital transformation in inclusive education. The review identified a few studies that looked at digital tools to support leaders in fulfilling these roles and responsibilities.

### *National/regional-level responsibilities to shape inclusive digital education systems*

At the national/regional level, on the one hand, the pandemic deepened educational inequalities. On the other hand, it was also seen as an opportunity to reform education at system level and to create better links between schools, parents and communities through digital solutions in general. Yet, the COVID-19 outbreak clearly showed a lack of disability-inclusive responses and emergency preparedness beyond the school level. For the future, digital education may contribute to mitigating these problems and thereby to improving inclusive education.

Monitoring activities implemented at national level indicate that schools perceive themselves as being only at the beginning of a process to promote inclusive digital education. Furthermore, a variance in general school ICT culture can be observed/monitored at national levels. This variance can be explained through various factors/determinants. These include teachers' digital competencies and the use of digital content to enhance pedagogy, as well as the extent of e-communication among school staff and between teachers and parents.

The national/regional level can be seen as the level responsible for ensuring that schools, along with their teachers and learners, encounter supportive conditions or frameworks for implementing inclusive digital education. However, for this task to be fulfilled, there needs to be (scientifically-supported) evidence of how inclusive digital education should be designed in detail. The review section tried to explore the gaps in knowledge that still exist in this regard and showed that more research is needed before these supportive frameworks can be further substantiated. Accordingly, many questions remain at the system level.

### **6.1.2 Discussion, retrospective and outlook**

This section aims **to further discuss and to align and enrich the previous findings** through [expert interviews](#).

So far, this report has mainly focused on reviewing scientific literature, implementation projects and conferences. Therefore, it is possible that the findings lag behind some of the most recent developments because publication of such information takes some time and so a slight gap between the latest developments and scientific literature arises.

Methodologically, the chosen approach was also unsuitable to identify topics that, for example, had been of relevance before 2016, but have not been discussed or further developed since then.

To fill this gap, five experts were identified. They received the intermediate findings (see previous section) and were then interviewed individually in January 2022. They are:

Natalia Amelina	Senior National Project Officer in Education, Chief of Unit, Unit of Teacher Professional Development and Networking, UNESCO Institute for Information Technologies in Education, Moscow, Russian Federation
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Manos Antoninis	Director of the Global Education Monitoring (GEM) Report since 2017, UNESCO, Paris, France
Björn Fisseler	Researcher at Faculty of Psychology, research focus on accessibility, concepts of universal design in education, and academic success, especially of learners/students with disabilities, FernUniversität in Hagen, Hagen, Germany
Klaus Miesenberger	Researcher and professor, research focus on assistive technologies, human-machine interaction especially for people with disabilities, accessibility; Head of Institute Integriert Studieren and Support Centre for Students with Disabilities; Johannes Kepler University Linz, Austria
Isabel Zorn	Researcher and professor at Institute of Media Research and Media Education, Faculty of Applied Social Sciences, research inter alia at the intersection of inclusion, media education/didactics and e-learning, Technische Hochschule Köln, Cologne, Germany

This summary of the expert interviews follows the structure used in [chapter 4](#), i.e. starting out with technology, continuing with the learners and teachers as focal points, and finalising with the experts' views on the institutional/school and the national/regional levels.

#### *Technology's potential to advance inclusion*

Regarding technology in education, the experts largely confirmed the literature review's findings. They agreed with the view in this report that [universal design](#) should be the **aspiration** and that [AT](#) is a compensatory approach. Also, [UDL](#) was appreciated as a **pro-active** and hence **preventive** approach. However, the experts mentioned the risk that this could lead to the use of low-quality OERs, as there is no central authority/supervision of this quality. It was also confirmed that many systems are still developed and used today that focus on the users' lack of abilities (deficit-oriented) rather than their capacities.

According to the experts, **digital technologies like AI, AR/VR, learning analytics, education data mining, etc., are important for inclusive education** as they support teachers' roles and tasks. They have the potential to simplify or enable:

- 🎯 more efficient differentiation between learners than a single teacher could do;
- 🎯 an automated assessment of users' abilities, knowledge and the context of use;
- 🎯 joint coaching of very diverse learners together;
- 🎯 identification of needs for specific support;
- 🎯 new possibilities for personalised support through adaptation;
- 🎯 reduced labelling and greater empowerment of learners by supporting them where needed, because there is no outwardly visible stigmatisation.

At the individual level, AI systems could build an **understanding of an individual's knowledge and comprehension**, using a variety of additional information and data (e.g. linguistic utterances, facial expression recognition, [biofeedback](#)). However, so far



there are **no directly usable (AI) building blocks** that could serve to design corresponding systems. There is also a question as to whether it is currently even possible to **collect data from individuals in sufficient quantities** for the underlying AI systems to be trained adequately to achieve satisfactory results. The interviews confirm the current low levels of AI use in educational practice. However, the experts see **huge potential for its application in the future** and assume that the trend in this field will continue to increase.

Although the potential of **VR, AR and MR** was also seen, the discussion revealed the limitations of this technology. Currently, its use relies primarily on the visual sense, and the synchronisation of head movements with the generated image data displayed in a user's visual field creates an effect called immersion. This **deep immersion** is the desired effect, but it cannot be equally achieved when visual information is replaced by audio information for blind or visually impaired users, for example. Even if it were possible to make VR/AR/MR accessible to as many users as possible according to the principles of universal design, it is still questionable whether the central effect, namely immersion, can be achieved equally for all users.

However, the technology itself does not produce positive effects for inclusive education. For example, an expert emphasises that AI – as it is currently often developed and used – can lead to discrimination against marginalised groups. This shows **the importance of carefully considering didactic design and critical positioning** with regard to promising digital technologies for inclusive education.

The experts report that technologies for inclusive education often lack competent and comprehensive implementation of accessibility and privacy to the same extent. This means that **research, experience and high-quality information for educators and decision-makers** are needed at this point.

According to the experts, **further research is urgently required** in the area of **developing inclusive educational technologies** in line with privacy and accessibility requirements. Research is also needed in the area of AI and its potential for inclusion and participation, while recognising the risk of discrimination.

Furthermore, research is required in the area of **didactic-pedagogical anchoring of technologies** in education under the aspect of inclusion (e.g. self-regulated learning, technology as a cognitive tool or aid for guided learning), as well as in the **acceptance of technologies and long-term effects** of integrating technologies in inclusive educational contexts. Furthermore, research on integrating technologies into inclusive education processes is needed beyond existing concepts to create other ideas, models or concepts; universal design does not necessarily have to be the be all and end all.

One expert states the **need to map available or needed technologies** to support inclusive education as a first step in gaining an overview of what is available and could be used, as well as of which technological solutions have yet to be developed. In a second step, the question of how to inform teachers about provided technologies must be answered. This seems not to be done enough, but is absolutely necessary. One way to do this is through teacher education and training.



### *Learners and inclusion in digital education*

As the experts confirm, the literature on learners and inclusion focuses very much on the **individual learner**. This may be due to research methodology, because teachers and learners are easier to reach and investigate than actors who are located at institutional management and policy level. In line with the literature review's key findings, the experts emphasised the importance of taking **different stakeholders in the learning process** into account, not just learners and teachers.

One expert sees **social isolation of learners** as a possible risk of digital technology use. Inclusion also refers to socialisation and including the person in societal activities, whereas technology itself – as it is designed and used today – is often more isolating, as experienced during the COVID-19 pandemic.

One expert alludes to the topic of **transitions between different educational stages** in an individual's life, which can use and be supported by technology. This topic is underrepresented in the literature in terms of technology and inclusion. Therefore, further research is needed in this field.

### *Teachers and digital education*

The experts see the development of inclusive technologies as an important catalyst for improving actual inclusive (digital) education. Based on their experiences, the experts believe **teachers are highly motivated and interested in providing high-quality inclusive education**. Accordingly, there is no need to further raise their awareness or motivate them. Rather, they merely require suitable tools and explanations. Without this support, the state's responsibility to provide inclusive education is shifted onto teachers. In the experts' observations, teachers take up concrete solutions very quickly once they are pointed out.

However, the resources available to teachers should always be considered. They are expected to hold classes, prepare and develop learning materials, contact parents and much more. On top of that, they are expected to **acquire new skills and competences**, especially regarding inclusive digital education. This is a very time-consuming issue, which is why there is a need for a special policy to support teachers with their time resources and enable them to build new competences on top of their normal workload.

One expert highlighted that **teacher education curricula** need to include inclusive education and digital transformation more than has been the case. Both topics have been relevant in society for decades but are not yet represented accordingly in curricula. Inclusive digital education needs to find a way into the curricula of future teachers and into the organisation of schools. Furthermore, inclusive digital education is a specific area, because the teachers need strong digital competences as well as a background in inclusive education – this makes the topic even harder to implement in teacher education. One expert therefore proposes introducing **new teacher professional standards**.

The experts report that knowledge about technological developments is still uncommon among teachers. On the other side, computer scientists and IT professionals have limited knowledge about the tasks and goals of pedagogical, and especially of inclusive, contexts. In consequence, there is a need for a stronger integration of the topics of diversity, disability, accessibility, inclusive education and the role of inclusive technologies in many



study and training programmes, e.g. for (prospective) teachers, educational management, computer scientists and IT professionals. Similarly to, for example, medical or business computer scientists, there is an urgent **need for educational computer scientists**. Furthermore, there is a demand for qualified experts and for the creation of higher-level positions to **make specialised expertise available for teachers and decision-makers on demand**.

#### *Responsibilities at educational institution level to link inclusion and digital transformation*

According to the experts, there is a **strong focus on the relevance of specialised technologies as individual assistance in schools**, as this is how these technologies are institutionally located and financially covered in this field. In relation to general technologies in connection with inclusion and accessibility, which cannot necessarily be described as ATs, there is still the **question of financing** – and this is one reason why only limited information on this topic can be found in the literature. This is similar to the gap identified in the literature review between solely addressing the needs and circumstances of a single ‘vulnerable’ group of learners on the one hand and the aim of dealing with all learners’ different, heterogeneous needs and circumstances on the other (see [section 4.2](#)).

The experts all emphasise that leadership is important for implementing and ensuring inclusive digital education. School leaders need to enable and encourage learners and teachers in their development towards inclusive digital education. Therefore, they should also be supported with clear recommendations.

However, **leadership is often a shared responsibility**, within organisations and across organisational borders. It concerns the institution as a whole and other stakeholders at individual, regional and national levels with different responsibilities. Together, they share the responsibility of enabling and supporting inclusive education by **providing the necessary structures, the financial resources and suitable technical solutions**.

According to the interviews, one important stakeholder – which is barely mentioned in the research literature – is the educational institution itself. Again, this justifies the ecosystem approach adopted in previous Agency projects and in this study, too. Issues of accessibility, inclusion and design of technology must be viewed from this organisational perspective.

In addition to the educational institution, other stakeholders are involved in creating conditions for inclusive educational settings and the necessary digital (infra-)structure (e.g. parents, therapists, peers, government, etc.). Therefore, as mentioned by the experts, there is **widespread expertise** that could be useful for creating inclusive learning structures for all learners. However, there does not yet seem to be a place that brings together these innovations and expertise.

#### *National/regional-level responsibilities to shape inclusive digital education systems*

According to the experts, the technologies that large companies, especially from the US, make widely available are usually easily accessible. In the EU, the legal situation has recently changed so that accessible procurement exists in public administration and [software](#) and [hardware](#) developers are explicitly required to address accessible design. So,



in the experts' estimation, **reaching the goal of fully accessible technologies in society is a longer, on-going process.**

The experts emphasise the importance of compliance with legal requirements, such as those set out in the UN Convention on the Rights of Persons with Disabilities, the General Data Protection Regulation (GDPR) and specific school laws. The respective **states are responsible for ensuring accessibility, data protection and avoiding discrimination.** In line with the key findings of this literature review, the experts agree that this is actually far from being the case. Appropriate technologies, infrastructures and advisory services are not available in a way that ensures suitability, accessibility and privacy for inclusive digital education. Therefore, **strategies to develop inclusive technologies and provide on-demand expertise for inclusive digital learning** are needed.

This is also affected by national-level funding policies. One expert gives the example of **political funding structures for software companies** that are engaged in the education sector at federal level in the US, taking the concept of universal design and UDL into consideration. For example, educational/training/learning software providers are explicitly requested to pay attention to accessibility and usefulness for inclusive settings during development. According to the expert, this goes beyond the development of specialised technologies as individual assistance and also relates to questions of **start-up culture and innovation funding**, by supporting the development of innovative tools to support flexible inclusive education. These technologies can probably not be developed and produced in a way that is compatible with the mass market at first. Funding structures can provide a means to bring them onto the market, e.g. through university-company collaborations. As the experts emphasise, this is also stimulated by **research funding policy**, e.g. whether there are calls for proposals that focus not just on learners and teachers but on educational institutions as stakeholders or on the didactic-pedagogical design of inclusive digital educational settings.

Experts also confirmed that technologies used in inclusive education must be user-friendly and should be designed with learners and their needs in mind. However, as technologies will be used mostly in a classroom setting, **teachers need to be equally involved in the design** of such technologies. In an inclusive classroom, the teacher is as much a user of different technologies as the learners. This should also be considered when designing inclusive technologies.

Stimulating and facilitating **networking of teachers** (e.g. via digital platforms), regionally, nationally and internationally, was proposed to support teachers in acquiring skills for both inclusive education and digitalisation. By exchanging practices, teachers could learn from each other (peer learning) and collaboratively develop and assess ideas. **Networking for school leaders** also needs to be encouraged. At the school level, but also at the regional and national levels, co-operations and partnerships are possible. Such partners could include **civil society organisations**, as well as **commercial organisations** that produce innovative technologies. All the involved stakeholders could benefit from interaction and exchanges among such partners, according to an expert.

Experts highlighted that the **policy level** needs to support school leaders and teachers in their tasks to implement inclusive digital education. For example, different policies should enable and encourage teachers and school leaders to network, co-operate and continue professional learning. However, more research is required on the question of **how**



**relevant information on the progress could reach policy-makers and ministries.** In one interview, it was highlighted that monitoring data is still patchy. Monitoring is made even harder due to different definitions of disabilities or of marginalised groups, so that different datasets vary in their prerequisites and the people they include. Internationally, for example, some countries cannot provide any data at all on the issue of inclusive digital education.

According to the interviews, governments cannot have unlimited expertise. They often **operate under pressure from various lobby groups** that favour, for example, the use of compensatory technology over preventive universal design approaches. That is why the **interface between research and government needs to be strengthened**, according to the interviews. Furthermore, many problems are cross-sectional and do not concern just one ministry. This is particularly true for the field of inclusive digital education, which is at the interface between the education and the digitalisation sectors. This complicates decision-making and necessitates even more co-ordination.

In summary, the expert interviews confirmed the study's findings and provided further insights into various topics. The interviews also served to place the current findings within a broader timeframe, even before the chosen focus of the study (2016 to 2021), and to provide outlooks and predictions for further trends.

## 6.2 Key messages

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This concluding section presents a synthesis of all findings in the form of key messages. The following points have been selected based on the literature review, the evaluations of practice projects and conferences, and the [expert interviews](#). They represent the views of this study's authors.

### *Technology level*

- 🎯 The development of inclusive [technology](#) should consider **technology-centric** or **technology-driven** approaches and the **primacy of pedagogy** in a balanced way. Further research is needed in this field.
- 🎯 Surprisingly, even recent studies still use a **medical or deficit-oriented type of categorisation** to describe the target groups for specifically developed (assistive) technologies, even though, for many years, other fields have shifted to the social or biopsychosocial model. Using the International Classification of Functioning, Disability and Health (ICF), for example, would help to shift the focus more to health and capabilities as well as environmental redesign, rather than focusing on impairments and limitations.
- 🎯 To take advantage of the full potential of technologies to be used in inclusive education, a [user-centred design](#) approach embracing the concept of [universal design](#) is a promising way to avoid disadvantages like poor [usability](#), high costs or a lack of IT support. [AT](#) is only used as a compensatory means where universally designed technology does not sufficiently satisfy all users' needs; its integration into teaching and learning processes in a classroom context must then be taken into account, including preparing teachers to use AT in their classrooms.



- 🟦 The absence of studies on the use of **ATs in inclusive settings** (and not only in 1:1 trials) is striking. So, too, is the absence of evaluations of this use not only from the individual user's perspective, but also taking into account, for example, the whole class and the implications for teaching.
- 🟦 **ICT** connects people communicatively, whether individually or through opportunities in a wide variety of group contexts. A more targeted use of ICT to **create peer-learning opportunities at various levels** (e.g. among learners, teachers, headteachers, schools, regions, policy-makers) – whether self-organised or under the responsibility of the respective higher system level – offers much untapped potential.
- 🟦 **ATs** are still often considered a solution to an [accessibility](#) problem that would not exist in a state-of-the-art technology design that takes into account the needs of the broadest possible user group (i.e. **universal design**).
- 🟦 **OERs** are explicitly intended to improve accessibility to teaching materials.
- 🟦 **MOOCs** have become very popular in recent years as they respond to the call for education for all, even if they are not always free.
- 🟦 **AI** applications are available meanwhile, for example, to support teaching children with autism, children with learning disabilities or those who have sight or hearing problems.
- 🟦 Generally, it is difficult or impossible to predict future trends and their impact on the education sector. However, some technologies give **initial indications of potential developments that may be worth keeping an eye on and observing**, e.g. domestic [robotics](#), mobile [telepresence](#) systems, [chatbots](#) and [smart speakers](#).

#### *Learners level*

- 🟦 **Digital media** has neither an overall positive nor an overall negative impact on [inclusion](#) in education, so **inclusion in digital education** seems to be a **multi-dimensional phenomenon**. It is affected at least by society, technical equipment, the educational institution, the learning situation and the individual learners. These, in turn, are permeated and changed by the **increasing digitalisation of all areas of life**.
- 🟦 **Vulnerability to exclusion in digital education** can be associated with learning-related phenomena that are strongly linked to mechanisms of the (societal) system and can therefore be attributed to the concept of [intersectionality](#). For example, vulnerability may be based on societal inequalities and discrimination, based on the learning process or based on learning with digital media.
- 🟦 **Inclusion in digital education for individual learners** can be reflected in terms of technical accessibility, being present and visible, being actively socially involved, interacting and collaborating with one another and the feeling of being appreciated and included in the learning community.
- 🟦 Learning environments and settings can differ, so the literature discusses learning and inclusion in the context of digitalisation in [formal](#), [non-formal](#) and [informal](#) learning settings, as well as specific education topics and digital educational



settings. Accordingly, there is a **wide range of different contexts** in which inclusion is a highly relevant topic for learning in digital education.

- 🎯 In the context of digital inclusive education, **learners' digital competences play an important role**, especially in terms of communication, collaboration and safety, respectful and appreciative social interaction, the development of oneself as a digital person, the ability to express one's own voice, critical data empowerment and self-protection against violence in digital environments.
- 🎯 When designing conditions conducive to inclusion in digital and analogue educational settings, however, it is necessary to not focus on individual cases, but to combine the insights gained from different individuals or groups vulnerable to exclusion in a structured manner to derive measures for a **holistic perspective on inclusion for high-quality education for all learners**.

#### *Teachers level*

- 🎯 Findings suggest that **distance learning** may have led to increased inequalities and school drop-out during the pandemic.
- 🎯 From the teachers' perspective, it appears they need **support in selecting inclusive teaching materials** that present no or few barriers and are suitable for all learners.
- 🎯 During the pandemic, digital media use could not – or could only to a limited extent – remedy the **consequences of the lack of contact** and of **necessary learning support by teachers**, particularly for socio-economically disadvantaged learners.
- 🎯 Weighing up the advantages and disadvantages, **distance education** can be an effective short-term replacement when there are unavoidable limitations on personal contact. However, long-term distance learning shows deficits compared to face-to-face teaching and the physical **co-presence** of learner and teacher. Therefore, a **blended learning approach** is usually chosen as a compromise between flexibility and on-site social exchange – and to avoid inequalities.
- 🎯 **Competencies like media literacy, data literacy and data-based decision-making** are highly important in the context of inclusive digital teaching. However, there are extreme difficulties, since the topics of digitalisation and inclusion are considered separately from each other in the early education levels.

#### *Educational institution level*

- 🎯 The literature review results showed that organisations that **embrace the digitalisation process** in terms of **content and funding** can help to **reduce social exclusion**. Furthermore, **teacher empowerment** is a central element and must be accompanied by organisational support measures, further training and consideration of the individual needs of, and differences between, teachers with regard to digital topics.
- 🎯 The **insufficient link between inclusive education and digitalisation** means that educational organisations have to tackle the **digital transformation** process by themselves and at their own risk. This might explain hesitancy in implementation.



### *National/regional level*

- 🌈 Without knowledge of what constitutes successful inclusive digital education, it is also **difficult to determine what enabling framework conditions** the policy level should provide. Accordingly, demands on policy are often condensed and focus mainly on providing additional financial resources or additional staff.
- 🌈 Being prepared for inclusive digital education in terms of content, technology and organisation seems to be an indication for [organisational resilience](#) in case of crisis, such as the [COVID-19](#) pandemic. General resilience at all system levels, however, needs further investigation.
- 🌈 While the **COVID-19 pandemic has deepened educational inequalities** by imposing [remote learning](#), it also provides a unique **opportunity to reform education**. This is closely related to better linking schools, parents and communities and **improving inclusive digital education for all learners**.
- 🌈 Currently, little consideration is given to **policy-level initiatives to support networking** among teachers or school leaders, to establish [professional learning communities](#) between schools, policy, research, technology development, etc., or to make successful approaches at the classroom or school level visible to regional or national audiences to enable and promote learning from each other.

So far, the education sector has **not been sufficiently involved** in technology design and development, or in discussions on the ethical implications of the use of digital media and technologies to pro-actively address the requirements of inclusive education. The education sector's deep domain knowledge would provide a contrast to the technology-centred approach often still found in technology companies. The education sector would offer a pedagogically-focused approach that consistently addresses the principles of quality education and passes them on to technology design and development as requirements and constraints. Currently, however, the education sector is predominantly understood in purely instrumental terms as serving to develop a future workforce that is prepared to use digital tools, media and technologies in the workplace.

The lack of evidence and relevant sources with regard to family and other community [stakeholders'](#) role in relation to technological design, development or implementation highlights another stakeholder group which has not been sufficiently involved in discussions around inclusive digital education.

The term '**digital transformation**', however, refers to much more than applying suitably designed digital technologies in education. Digital transformation requires all levels – from the individual (learners and teachers), to the educational institution, to the regional or national level, with inclusion and digitalisation as cross-cutting issues – to be involved. Such involvement is necessary if inclusive digital education is not just to be implemented on a case-by-case basis but is to be **permanently anchored in the education system's structures**. However, although use of the term 'digital transformation' has become much more frequent in recent years, there are very few examples from the education field showing what a successful transformation process involves and what concrete steps individuals, organisations and policy-makers need to take.



## GLOSSARY



The glossary contains terms used in this study and provides explanations of the terminology. It should be noted, however, that the cited literature may be based on other definitions, which could not be verified within the scope of the study.

### *Accessibility*

Article 9 of the UN Convention on the Rights of Persons with Disabilities defines accessibility as:

To enable persons with disabilities to live independently and participate fully in all aspects of life, States Parties shall take appropriate measures to ensure to persons with disabilities 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 (UN, 2006, p. 9).

Accessibility is a right to be ensured in all areas. These include education and the right to appropriate education and active citizenship through access to a flexible curriculum through [personalised learning](#) approaches ([European Agency, no date](#)).

### *Accessible*

‘Able to be reached, entered or understood’ ([European Agency, no date](#)).

### *Adaptive learning*

A method of education or training using computers, that uses algorithms (= sets of mathematical rules) to change teaching material, exercises, etc. according to the needs and performance of each learner ([Cambridge Dictionary, no date](#)).

### *Algorithm*

‘A set of mathematical instructions or rules that, especially if given to a computer, will help to calculate an answer to a problem’ ([Cambridge Dictionary, no date](#)).

### *Artificial intelligence (AI)*

The study of how to produce machines that have some of the qualities that the human mind has, such as the ability to understand language, recognize pictures, solve problems, and learn ([Cambridge Dictionary, no date](#)).



### *Assistive technology (AT)*

Equipment, devices, apparatuses, services, systems, processes and environmental modifications used by people with disabilities to overcome social, infrastructural and other barriers to learning independence, safe and easy participation in learning activities, and full participation in society ([UNESCO, 2020](#), p. 419).

### *Augmented reality (AR)*

An enhanced version of reality created by the use of technology to overlay digital information on an image of something being viewed through a device (such as a smartphone camera) ([Merriam-Webster Dictionary](#), no date).

### *Big data*

‘Very large sets of data that are produced by people using the internet, and that can only be stored, understood, and used with the help of special tools and methods’ ([Cambridge Dictionary](#), no date).

### *Biofeedback*

‘A method by which a person learns to control their heart rate or other physical or mental processes by using information from recordings of those processes’ ([Cambridge Dictionary](#), no date)

### *Blended learning*

Blended learning in formal education and training involves a diversity of approaches and is to be understood as a school (in primary and secondary education, including vocational education and training), teacher and trainer or learner taking more than one approach to the learning process:

-  blending school site and other physical environments away from the school site (either with the presence of a teacher/trainer, or separated by space and/or time in distance learning);
-  blending different learning tools that can be digital (including online learning) and non-digital.

Using their professional pedagogical judgement, teachers, trainers and schools will select and facilitate the use of these approaches as part of engaging and effective learning tasks that support broad competence development, as appropriate to the age, abilities and circumstances of the learners and intended learning outcomes. Other physical environments may include, for example, on the one hand: the home; hospitals (in the case of sick or injured children); and on the other hand cultural and memory institutions; farms, companies and other workplaces; nature sites and outdoors; sports and youth spaces ([Council of the European Union, 2021](#), p. 12).



### *Braille*

'A system of writing for the blind that uses characters made up of raised dots' ([Merriam-Webster Dictionary](#), no date).

### *Brain-computer interface (BCI)*

A brain-computer interface (BCI) is a communication system by which a person can send messages or commands without any use of peripheral nerves and muscles. BCIs record signals from the brain and translate them into useful communication. Thus, they are usable even by people who have no effective muscle control (Allison, Winter Wolpaw & Wolpaw, 2007, p. 463).

### *Bring your own device (BYOD)*

The practice of companies or schools saying that employees or students can bring their own computers, phones, etc. to work or school in order to do their work on them ([Cambridge Dictionary](#), no date).

### *Capacity-building*

Capacity-building is defined as the process of developing and strengthening the skills, instincts, abilities, processes and resources that organizations and communities need to survive, adapt, and thrive in a fast-changing world. An essential ingredient in capacity-building is transformation that is generated and sustained over time from within; transformation of this kind goes beyond performing tasks to changing mindsets and attitudes (UN, 2022).

### *Captions*

'Captions are intended for audiences who cannot hear the dialogue. In contrast to [subtitles](#), captions include a description of who is speaking, as well as sounds' ([European Agency](#), no date).

### *Case study*

'An intensive analysis of an individual unit (such as a person or community) stressing developmental factors in relation to environment' ([Merriam-Webster Dictionary](#), no date).

### *Chatbot*

'A bot is defined as software capable of performing an automated task. Chat-bots perform automated tasks through an interface that humans can interact with' (Gowtham & Amalanathan, 2019, p. 1632).

### *Cloud-based solutions/Cloud services*

'Cloud services are delivered via the Internet from' ... 'locations remote from the end user and their institution' ([UNESCO IITE, 2010, p. 2](#)).



### *Collaborative learning*

Opposed to individual learning, collaborative learning develops a community-centred approach. It is a recent trend in human learning and cognition that emphasises participation, joint meaning-making, discourse and dialogue. It is characterised by collaboration, creative processes and the use of new technology ([European Agency, no date](#)).

### *Computer vision*

Computer vision is a field of artificial intelligence (AI) that enables computers and systems to derive meaningful information from digital images, videos and other visual inputs — and take actions or make recommendations based on that information. If AI enables computers to think, computer vision enables them to see, observe and understand ([IBM, 2022](#)).

### *Co-presence*

‘Occurrence of two or more things together in the same place and time’ ([Merriam-Webster Dictionary, no date](#)).

### *COVID-19*

An infectious disease caused by a coronavirus (= a type of virus), that usually causes fever, tiredness, a cough, and changes to the senses of smell and taste, and can lead to breathing problem[s] and severe illness in some people ([Cambridge Dictionary, no date](#)).

### *Cyberbullying*

‘The activity of using the internet to harm or frighten another person, especially by sending them unpleasant messages’ ([Cambridge Dictionary, no date](#)).

### *Data literacy*

Data literacy is the ability to read, write and communicate data in context, with an understanding of the data sources and constructs, analytical methods and techniques applied, and the ability to describe the use case application and resulting business value or outcome ([Gartner Information Technology Glossary, 2022](#)).

### *Deep learning*

A type of artificial intelligence that uses [algorithms](#) (= sets of mathematical instructions or rules) based on the way the human brain operates ([Cambridge Dictionary, no date](#)).

### *Design for all*

Design for all is a ‘design approach to products and services, aiming to make them usable for as many people as possible’ ([UNESCO IITE and European Agency, 2011](#), p. 101).



Design for all 'is used to describe a design philosophy targeting the use of products, services and systems by as many people as possible without the need for adaptation'. Design for all is design for human diversity, social inclusion and equality ([European Institute for Design and Disability, 2004](#)).

### *Digital*

(as in digital content, digital devices, digital resources, digital technology) – essentially, another word for computers and computer technology. (Computers store and process information by converting it all to single-figure numbers – digits.) ([UNESCO and Microsoft, 2011](#), p. 90).

### *Digital divide*

Digital divide refers to 'the gap between those who can benefit from digital technology and those who cannot' (Digital Divide Institute, cited in [UNESCO IITE and European Agency, 2011](#), p. 101).

### *Digital education*

'Digital education is the innovative use of digital tools and technologies during teaching and learning'. It 'is often referred to as Technology Enhanced Learning (TEL) or e-Learning' ([The University of Edinburgh, 2018](#)).

### *Digital learning tool*

Digital learning tools can include, for example: smart boards and projectors for collaboration in classrooms; mobile devices, tablets and laptops with applications for designing, exploring and sharing work; television and radio for following programmes; and augmented-reality and virtual-reality tools and applications for enhanced interactivity. Digital learning tools do not always need to be connected to the internet ([Council of the European Union, 2021](#), p. 13).

### *Digital literacy*

Digital literacy is about basic computer skills, such as being able to do word-processing or go online. It refers to:

... the skills required to achieve digital competence. It is underpinned by basic skills in ICT and the use of computers to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the Internet (European Commission, 2008, p. 4).

### *Digital media*

An umbrella term often treated as synonymous with new media or computer-mediated communication. A distinction can be made between media which are based on encoded physical qualities such as light or sound waves through the re-encoding of analogue information (e.g. with digital cameras or digital



sound equipment), and media which are based on the re-encoding of previously encoded cultural forms such as writing, mathematics, linear perspective, or the Cartesian coordinate system that is used to represent physical space in [virtual reality](#) applications ([Oxford Reference, 2022](#)).

### *Digital technology*

‘Technology in which data is given numerical value. Computer-based tools and products’ ([UNESCO IITE and European Agency, 2011](#), p. 101).

### *Digital transformation*

Digital transformation is organisational transformation enabled by [digitalisation](#).

Digital transformation covers both the integration of digital technologies by European enterprises and the impact on society of new technologies, such as the Internet of Things (IoT), cloud computing, innovative digital platforms and blockchain technologies ([Negreiro and Madiega, 2019](#), p. 2).

### *Digital violence*

See [‘Cyberbullying’](#).

### *Digitalisation*

‘... the way in which many domains of social life are restructured around digital communication and media infrastructures’ ([Brennen & Kreis, 2016](#), p. 556).

### *Digitisation*

Digitisation refers to ‘the action or process of digitising; the conversion of analogue data (esp. in later use images, video, and text) into digital form’ ([Oxford English Dictionary](#), no date).

### *Distance education*

See [‘Distance learning’](#).

### *Distance learning/remote learning*

Distance learning is defined as learning taking place with the teacher/trainer being separated from the learner by space and/or time, taking into account national circumstances ([Council of the European Union, 2021](#), p. 12).

### *E-learning*

e-learning is about ‘any forms of electronically supported learning and teaching’ ([UNESCO IITE and European Agency, 2011](#), p. 101).



### *E-learning 4.0*

E-learning 4.0 'is characterised by an increasing decoupling of time and place of learning and a stronger individualisation of educational offers' (Fisseler, 2019, p. 236; own translation).

### *Electronic*

'Used to refer to materials that are accessible by a computer or other digital devices. It may include text, images, audio, video or a combination of these' ([European Agency, no date](#)).

### *Emerging technology*

'Emerging technologies are tools, concepts, innovations, and advancements utilized in diverse educational settings to serve varied education-related purposes' They are 'potentially disruptive, not yet fully understood, and not yet fully researched' (International Council for Open and Distance Education, 2010).

### *eSafety*

Safety on the internet.

### *Expert interview*

'Expert interviews are a widely-used qualitative interview method often aiming at gaining information about or exploring a specific field of action' ([Döringer, 2021](#), p. 265).

### *Facial recognition*

'Technology that makes it possible for a computer to recognize a digital image of someone's face' ([Cambridge Dictionary](#), no date).

### *Formal education*

Formal education is defined as education that is institutionalized, intentional, planned through public organizations and recognized private bodies and, in their totality, make up the formal education system of a country. Formal education programmes are thus recognized as such by the relevant national educational authorities or equivalent, e.g. any other institution in co-operation with the national or sub-national educational authorities. Formal education consists mostly of initial education. Vocational education, special needs education and some parts of adult education are often recognized as being part of the formal education system. Qualifications from formal education are by definition recognized and are therefore within the scope of ISCED [International Standard Classification of Education]. Institutionalized education occurs when an organisation provides structured educational arrangements, such as student-teacher relationships and/or interactions, that are specially designed for education and learning (UNESCO, 2011, p. 8, cited by [European Agency, 2016](#), pp. 24–25).



### *Formal learning*

Learning in formal educational settings.

### *Gamification*

'The practice of making activities more like games in order to make them more interesting or enjoyable' ([Cambridge Dictionary](#), no date).

### *Hardware*

'The physical and electronic parts of a computer, rather than the instructions it follows' ([Cambridge Dictionary](#), no date).

### *High technology*

'Scientific technology involving the production or use of advanced or sophisticated devices especially in the fields of electronics and computers' ([Merriam-Webster Dictionary](#), no date).

### *Hologram*

'A special type of photograph or image made with a laser in which the objects shown look solid, as if they are real, rather than flat' ([Cambridge Dictionary](#), no date).

### *Immersive learning environment (ILE)*

Immersive learning environments (ILEs) are learning situations that are constructed using a variety of techniques and software tools, including game-based learning, simulation-based learning and virtual 3D worlds. ILEs are distinguished from other learning methods by their ability to simulate realistic scenarios and environments that give learners the opportunity to practice skills and interact with other learners ([Gartner Information Technology Glossary](#), 2022).

### *Inclusion*

Inclusion is both a principle and a process: 'Inclusion and equity in and through education is the cornerstone of a transformative education agenda [...] No education target should be considered met unless met by all' ([World Education Forum, 2015](#), p. 2).

It can be seen as:

A process consisting of actions and practices that embrace diversity and build a sense of belonging, rooted in the belief that every person has value and potential and should be respected ([UNESCO, 2020](#), p. 419).

The term was often associated with disability, but now extends to wider groups as:

... a response to increasingly complex and diverse societies. It treats diversity as an asset which helps prepare individuals for life and active citizenship in increasingly complex, demanding, multi-cultural and integrated societies ([Soriano, Watkins & Ebersold, 2017](#), p. 7).



### *Individual education plan (IEP)*

‘Written plan setting out a student’s present performance level along with goals and objectives, as well as services and timelines to meet those goals and objectives’ ([UNESCO, 2020](#), p. 420).

Parents and other professionals/specialists may be involved in developing individual education plans.

### *Informal education*

Informal education refers to a lifelong learning process, whereby each individual acquires attitudes, values, skills and knowledge from the educational influences and resources in his or her own environment and from daily experience. People learn from family and neighbours, in the market place, at the library, at art exhibitions, at work and through playing, reading and sports activities. The mass media are a very important medium for informal education, for instance through plays and film, music and songs, televised debates and documentaries. Learning in this way is often unplanned and unstructured ([Council of Europe, 2022](#)).

### *Information and communication technology (ICT)*

ICT ‘covers all technical means used to handle information and aid communication. This includes both computer and network hardware, as well as their software’ ([Eurostat, 2016](#)).

### *Instagram*

‘The name of a social media service for taking, changing, and sharing photographs and video’ ([Cambridge Dictionary](#), no date).

### *Intersectionality*

Intersectionality is the understanding that a person, group of people, organisation or social problem is affected and impacted upon by a number of pressures, forces, levers, discriminations and disadvantages ([European Agency, 2021b](#), p. 6).

### *K–12 setting*

A term that includes primary and secondary education in the US.

### *Learning analytics*

‘Learning analytics can be summarized as the collection, analysis, and application of data accumulated to assess the behavior of educational communities’ (Larsson & White, 2014, p. 1).

### *Learning management system (LMS)*

A software application ‘for the administration, documentation, follow-up, and reporting of educational courses or training programs’ ([Oxford Reference](#), 2022).



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### *Learning platform*

A learning platform is an integrated set of interactive online services that provide teachers, learners, parents and others involved in education with information, tools and resources to support and enhance educational delivery and management. It is not a single 'off the shelf' product but a collection of tools and services designed to support teaching, learning, management and administration (Jewitt, Hadjithoma-Garstka, Clark, Banaji & Selwyn, 2010, p. 4).

### *Low technology*

'Machines, equipment, and methods that are not the most advanced' ([Cambridge Dictionary](#), no date).

### *Machine learning*

'The process of computers changing the way they carry out tasks by learning from new data, without a human being needing to give instructions in the form of a program' ([Cambridge Dictionary](#), no date).

### *Massive open online course (MOOC)*

'A course of study that is made available over the internet and that can be followed by a large number of people' ([Cambridge Dictionary](#), no date).

### *Media*

A channel through which information can be shared. Media usually contains different types of information simultaneously. Examples include electronic documents, online resources and online learning tools ([European Agency, no date](#)).

### *Media literacy*

'Competence in using various media and the ability to think critically about them' ([Oxford Reference](#), 2022).

### *M-learning*

M-learning is a teaching and learning methodology that uses mobile devices that have wireless connectivity, the use of these devices offers the opportunity to learn anytime, anywhere ([Criollo-C, Luján-Mora & Jaramillo-Alcázar, 2018](#), p. 1).

### *Mobile application*

'A software program that runs on a mobile phone' ([Cambridge Dictionary](#), no date).



### *Mobile device*

‘Any piece of electronic equipment such as a mobile phone or small computer that you can use in different places’ ([Cambridge Dictionary](#), no date).

### *Mobile technologies*

Mobiles enable ubiquitous access to information, social networks, tools for learning and productivity, and much more. Mobile devices continue to evolve, but it is the increased access to affordable and reliable networks that is driving this technology now. Mobiles are capable computing devices in their own right — and they are increasingly a user’s first choice for Internet access ([Johnson, Smith, Willis, Levine & Haywood, 2011](#), p. 5).

### *Natural language processing (NLP)*

Natural-language processing (NLP) technology involves the ability to turn text or audio speech into encoded, structured information, based on an appropriate ontology. The structured data may be used simply to classify a document, as in “this report describes a laparoscopic cholecystectomy,” or it may be used to identify findings, procedures [...] and participants ([Gartner Information Technology Glossary](#), 2022).

### *Non-formal education*

Non-formal education refers to planned, structured programmes and processes of personal and social education for young people designed to improve a range of skills and competences, outside the formal educational curriculum. Non-formal education is what happens in places such as youth organisations, sports clubs and drama and community groups where young people meet, for example, to undertake projects together, play games, discuss, go camping, or make music and drama. Non-formal education achievements are usually difficult to certify, even if their social recognition is increasing. Non-formal education should also be:

-  voluntary
-  accessible to everyone (ideally)
-  an organised process with educational objectives
-  participatory
-  learner-centred
-  about learning life skills and preparing for active citizenship
-  based on involving both individual and group learning with a collective approach



- 🌐 holistic and process-oriented
- 🌐 based on experience and action
- 🌐 organised on the basis of the needs of the participants.

Formal, non-formal and informal education are complementary and mutually reinforcing elements of a lifelong learning process ([Council of Europe, 2022](#)).

### *Online learning*

Online learning is defined as learning that takes place using digital technology to connect different devices and to facilitate interaction between the learner and teachers, trainers or other educational staff, or other learners, aimed at obtaining learning content or other information to achieve the objectives of learning programmes ([Council of the European Union, 2021](#), p. 12).

### *Open-access*

'Available for everyone to use' ([Cambridge Dictionary](#), no date).

### *Open educational resource (OER)*

Open Educational Resources (OER) are teaching, learning and research materials in any medium – digital or otherwise – that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions. OER form part of 'Open Solutions', alongside Free and Open Source software (FOSS), Open Access (OA), Open Data (OD) and crowdsourcing platforms ([UNESCO, 2021c](#)).

### *Open-source*

'Open-source software is free to use, and the original program can be changed by anyone' ([Cambridge Dictionary](#), no date).

### *Personal learning network (PLN)*

'A personal learning network (PLN) is a group of people who you connect with to increase your knowledge of a particular subject' ([Lynch, 2017](#)).

### *Personalised learning*

A process of tailoring education to a learner's current situation, characteristics and needs to help achieve the best possible progress and outcomes. Personalised learning can include personalising the curriculum, courses, learning materials and activities, and different forms of learning support. Each learner is provided with education that is tailored to their individual characteristics and needs. They learn in a way that is most suitable for them, resulting in different learning experiences for each learner (Adapted from Seel, 2012 in [UNESCO International Bureau of Education, no date](#)).

Personalisation involves working closely with parents and families to address any support requirements holistically. Personalisation is not 'individualisation of learning', which is



essentially a teacher-driven action. Learner participation and involvement in decision-making is crucial to distinguishing between the two approaches. Personalisation requires learners to reflect in an interactive process – co-creating learning with the teacher but, over time, taking increasing responsibility and managing their own learning (within the framework of the country’s curriculum and standards) ([European Agency, 2012](#)).

### *Professional learning community (PLC)*

A professional learning community, or PLC, is a group of educators that meets regularly, shares expertise, and works collaboratively to improve teaching skills and the academic performance of students. The term is also applied to schools or teaching faculties that use small-group collaboration as a form of professional development (Glossary of Education Reform, 2014).

### *Remote learning*

See '[Distance learning](#)'.

### *Resilience/organisational resilience*

It is the ability of an organization to anticipate, prepare, respond, and adapt to exponential change and sudden interruptions to survive and thrive. It goes beyond risk management, towards a more holistic vision of health and business success ([Vargas-Hernández, Barrios-Vargas & Mercado-Torres, 2019](#), p. 46).

### *Robotics*

'The science of making and using robots (= machines controlled by computers that are used to perform jobs automatically)' ([Cambridge Dictionary](#), no date).

### *Self-assessment*

'A judgment, sometimes for official purposes, that you make about your abilities, qualities, or actions' ([Cambridge Dictionary](#), no date).

### *Smart classroom*

Smart classroom is technology-enhanced classrooms that foster opportunities for teaching and learning by integrating learning technology, such as computers, specialized software, audience response technology, assistive listening devices, networking, and audio/visual capabilities ([Kuppusamy, 2019](#), p. 412).

### *Smartphone*

'A mobile phone that can be used as a small computer and that connects to the internet' ([Cambridge Dictionary](#), no date).



### *Smart speaker*

'A smart speaker is a wireless electronic device that can respond to spoken commands, for example by giving information or playing music' ([Collins Dictionary](#), no date).

### *Smartwatch*

'A watch that has many of the features of a smartphone or a computer' ([Cambridge Dictionary](#), no date).

### *Social media*

'Forms of media that allow people to communicate and share information using the internet or mobile phones' ([Cambridge Dictionary](#), no date).

### *Software*

'The instructions that control what a computer does; computer programs' ([Cambridge Dictionary](#), no date).

### *Special educational needs (SEN)*

SEN is a construct that countries usually define within their legislation. These definitions are then used to identify, assess and make provision for learners with different needs – including recognised disabilities – in different ways (Watkins, Ebersold & Lénárt, 2014). Special or 'additional' needs should not be seen as the result of 'in-child' factors, but rather 'a discrepancy between what a system of schooling ordinarily provides and what the child needs to support their learning' (Rouse, 2008, p. 6, cited by [Soriano, Watkins and Ebersold, 2017](#), p. 22).

### *Speech recognition*

'Computer software that allows a computer to understand spoken words' ([Cambridge Dictionary](#), no date).

### *Stakeholder*

'A person such as an employee, customer, or citizen who is involved with an organization, society, etc. and therefore has responsibilities towards it and an interest in its success' ([Cambridge Dictionary](#), no date).

### *Subtitles*

'Are intended for audiences that do not understand the language used in a dialogue' ([European Agency](#), no date).

### *Tablet/tablet computer*

'A small, flat computer that is controlled by touching the screen or by using a special pen' ([Cambridge Dictionary](#), no date).



### *Tangible augmented reality (TAR)*

TAR interfaces combine the enhanced display possibilities of AR with the intuitive manipulation and interaction of physical objects or Tangible User Interfaces. [...] Tangible AR interfaces are those in which 1) each virtual object is registered to a physical object [...] and 2) the user interacts with virtual objects by manipulating the corresponding tangible objects. In the Tangible AR approach the physical objects and interactions are equally as important as the virtual imagery and provide a very intuitive way to interact with the AR interface (Billinghurst, Kato & Poupyrev, 2008, p. 1).

### *Teachers' self-efficacy*

'Perceived self-efficacy refers to people's beliefs about their capabilities to exercise control over their own activities' ([Cambridge Dictionary](#), no date).

### *Technology*

Technology is:

... often used as another word for ICT, although strictly speaking 'technology' can mean almost any type of tool or applied knowledge. For example, pencil and paper, slates, blackboards and whiteboards are all types of writing technology ([UNESCO and Microsoft, 2011](#), p. 92).

### *Technology-based leadership/Technological leadership*

This is the act of commitment to the provision of technology facilities and enabling environment that can support their application in classroom instruction to promote learning among students. It entails the enhancement of the instructional roles of lecturers through the provision of technological facilities and coordinating their utilization for the achievement of instructional goals ([Akegwu, 2015](#), p. 360).

### *Telepresence*

'The use of various technologies to create the effect of being at a different or imaginary place, or to operate equipment from a different place' ([Cambridge Dictionary](#), no date).

### *Twitter*

A social media service that allows users to publish short remarks or pieces of information.

### *Universal design*

'Design of products, environments, programmes and services to be usable by all to the greatest extent possible, with no need for adaptation or specialised design' ([UNESCO, 2020](#), p. 420).

The Center for Universal Design at North Carolina State University conceived and developed the seven principles of Universal Design: equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, and size



and space for approach and use. It is copyrighted material ([The Center for Universal Design, 1997](#)).

### *Universal Design for Learning (UDL)*

This stems from the general term ‘universal design’. However, it focuses on improving and optimising teaching and learning for all to ensure learners’ success and well-being. The Center for Applied Special Technology (CAST) owns the copyright for the term and the three principles for curriculum development based on a UDL approach:

1. Provide information through multiple means of representation (present information and content in different ways)
2. Provide multiple means of action and expression (differentiate the ways that learners can express what they know)
3. Provide multiple means of engagement (stimulate interest and motivation for learning).

UDL provides a blueprint for creating instructional goals, methods, materials and assessments that work for everyone. It does not involve a single, one-size-fits-all solution, but rather flexible approaches that can be customised and adjusted to individual needs.

UDL is an approach to addressing the diversity of learner needs by suggesting flexible goals, methods, materials, and assessment processes that support educators to meet varied needs. Curricula created using UDL are designed from the outset to meet the needs of all learners. A UDL framework incorporates flexible design of learning situations with customisable options, which allow all learners to progress from their own, individual starting points ([European Agency, no date](#); [CAST, 2022](#)).

### *Usability*

‘Extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use’ ([International Organization for Standardization, 1998](#)).

### *User interface*

Software that is designed to allow a computer user to interact with the operating system of a machine or system (such as by selecting presented options or entering text commands) ([Merriam-Webster Dictionary, no date](#)).

### *User-centred design*

Design of products, systems, etc., ‘based on the ways that people will use them and what they will do with them’ ([Cambridge Dictionary, no date](#)).



### *Virtual learning environment (VLE)*

VLEs are [learning platforms](#) including resources, tools and interactive communication possibilities for teachers and learners:

... providing learning experiences and content management. The term 'learning platform' also includes the personal learning environment (PLE) that helps learners to keep control and manage their own learning by personalizing the content and process ([UNESCO IITE, 2011](#), p. 1).

Other terms used to describe this concept are [learning management system](#) (LMS), course management system (CMS) and learning content management system (LCMS) ([European Agency, no date](#)).

### *Virtual presence*

'The sensation of being in an interactive computer-generated simulation of an environment, associated with virtual reality technologies' ([Oxford Reference](#), 2022).

### *Virtual reality*

Virtual reality (VR) provides a computer-generated 3D environment (including both computer graphics and 360-degree video) that surrounds a user and responds to an individual's actions in a natural way, usually through immersive head-mounted displays. Gesture recognition or handheld controllers provide hand and body tracking, and haptic (or touch-sensitive) feedback may be incorporated. Room-based systems provide a 3D experience while moving around large areas, or they can be used with multiple participants ([Gartner Information Technology Glossary](#), 2022).

### *Voice assistant*

A computer program that can hold a conversation with somebody and complete particular tasks by responding to instructions or to information that it gathers from that person's digital device ([Oxford Learner's Dictionary](#), 2022).

### *Web-based learning*

Web-based learning refers to the type of learning that uses the Internet as an instructional delivery tool to carry out various learning activities. It can take the form of (1) a pure online learning in which the curriculum and learning are implemented online without face-to-face meeting between the instructor and the students, or (2) a hybrid in which the instructor meets the students half of the time online and half of the time in the classroom, depending on the needs and requirement of the curriculum. Web-based learning can be integrated into a curriculum that turns into a full-blown course or as a supplement to traditional courses ([Zheng, 2008](#)).



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### *Web Content Accessibility Guidelines (WCAG)*

Web Content Accessibility Guidelines (WCAG) is developed through the [W3C](#) [World Wide Web Consortium] process in cooperation with individuals and organizations around the world, with a goal of providing a single shared standard for web content accessibility that meets the needs of individuals, organizations, and governments internationally ([World Wide Web Consortium, 2012](#)).

### *Workplace learning*

'Lessons or training that people receive while they are at work and that are paid for by their employer' ([Cambridge Dictionary](#), no date).

### *World Wide Web Consortium (W3C)*

W3C is:

... an international community where Member organizations, a full-time staff, and the public work together to develop Web standards. Led by Web inventor and Director Tim Berners-Lee and CEO Jeffrey Jaffe, W3C's mission is to lead the Web to its full potential ([World Wide Web Consortium, 2015](#)).



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