D4.4 Development of Inclusive Digital Education Toolkit

Inclusive Digital Education Toolkit developed within the Atollo project.

30/06/2026 | ATOLLO PROJECT TEAM

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About the Atollo project

The Atollo project aims to empower learners with disabilities and/or special educational needs (SEN) by creating accessible, inclusive and engaging digital educational materials. Through a consortium of partners from Croatia, Bulgaria, Austria, Germany, Iceland, Norway, Ireland and Australia, including an EdTech company, universities, schools for learners with SEN, public authorities and NGOs, the project analyses and compares existing programmes, develops high-quality digital educational content, pilots the materials in schools and improves them on the basis of feedback from learners, teachers and experts. Atollo uses a user-centred design approach to ensure that the materials are accessible, responsive and relevant for learners with different support needs. Its main results include digital educational units, teacher capacity-building activities, parent and guardian education sessions, and this Inclusive Digital Education Toolkit.

The Atollo project Consortium

The Atollo project consortium is an Erasmus Partnership, bringing together 14 partners.

	Partner	Acronym	Country
1	PROFIL KLETT D.O.O.	PK	HR
2	SVEUCILISTE U ZAGREBU	UNIZG ERF	HR
3	UNIVERSITY OF INNLAND NORWAY	INN UNI	NO
4	REGIONALEN TSENTAR ZA PODKREPA NA PROTSESA NA PRIOBSHTAVASHTO OBRAZOVANIE SOFIA GRAD	RCSIE	BG
5	SKOLA ZA ODGOJ I OBRAZOVANJE PULA	STE PULA	HR
6	HASKOLI ISLANDS	UI	IS
7	MATRIX INTERNET APPLICATIONS LIMITED	MATRIX	IE
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No	Associated Partner	Acronym	Country
11	CENTRAL QUEENSLAND UNIVERSITY	CQU	AU
12	NATSIONALNA ASOTSIATSIA NA RESURSNITE UCHITELI	NART	BG
13	DIGITAL TECHNOLOGY SKILLS LIMITED	DTSL	IE
14	TERAWE TECHNOLOGIES LIMITED	TERAWE	IE

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Inclusive Digital Education Toolkit

1. Introduction and Project Context

The Atollo project is introduced at the beginning of this document in the section *About the Atollo Project*. The project is organised into five work packages. Work Package 4, *Piloting and Evaluation of Digital Educational Content & Quality Assurance*, forms the empirical core of the project. Led by Inland Norway University of Applied Sciences (INN UNI) and co-led by the University of Zagreb Faculty of Education and Rehabilitation Sciences (UNIZG ERF), WP4 coordinated the piloting of the digital educational materials in 15 schools across Croatia, Bulgaria and Germany, involving approximately 120 teachers and nearly 500 learners.

During the project, the consortium designed, developed, piloted and optimised 45 digital educational units for learners with disabilities. The units cover the curriculum areas of Mathematics and Information and Communication Technology (ICT) and are available across four programme levels to accommodate diverse learner needs and abilities. Developed using a user-centred and evidence-informed approach, the materials were piloted in authentic classroom settings and subsequently refined based on feedback from teachers, learners and experts. The evidence generated through this iterative process forms the foundation of the recommendations, implementation guidance and good practices presented throughout this Toolkit.

This Toolkit (D4.4) is one of the key outputs of WP4, alongside the pilot evaluation report (D4.1), the evaluation framework (D4.2), the optimised digital educational units (D4.3), and the parent education sessions (D4.5).

The following project deliverables provide the evidence base and practical foundation for this Toolkit:

D4.1 A report summarising the findings of the pilot testing

D4.2 Evaluation procedure and criteria for monitoring and evaluating digital educational content

D4.3 Set of optimised digital education content units, together with guidelines for their use

D4.5 Education sessions for parents and guardians.

1.1 Purpose of the Toolkit

This Toolkit addresses a practical challenge identified during the Atollo project: developing high-quality digital materials is only the first step. The materials also need to be selected, introduced, adapted and supported in ways that make them genuinely usable for learners with SEN.

During the Atollo pilot phase, it became clear that the same digital unit could lead to different outcomes depending on how it was introduced, how the classroom was organised, how prepared the teacher was, and whether the school had reliable digital infrastructure. Teachers reported strong learner engagement and good alignment with curriculum goals, but consistent use depended on conditions that the materials alone could not create.

The purpose of this Toolkit is therefore to translate the evidence gathered during the pilot into practical, transferable guidance for teachers, teaching assistants, school leaders, content developers and policymakers. It extends the Atollo IZZI materials into a broader framework for inclusive digital education that can also be applied beyond the Atollo context.

The Toolkit aims to:

- give teachers and teaching assistants clear, evidence-based guidance on how to implement digital materials effectively with learners with SEN;
- give school leaders and ICT coordinators the institutional framing they need to embed inclusive digital practice at scale;
- give digital content developers the design principles that emerged from real classroom use across three national contexts;
- give policymakers the systemic recommendations needed to create conditions where inclusive digital education can succeed.

1.2 Target groups

This Toolkit has been written with four primary audiences in mind, each of which brings different questions to inclusive digital education. A fifth, secondary audience is also addressed.

Target group	What the Toolkit offers them
Classroom teachers and teaching assistants	Practical guidance on using the IZZI materials with learners with SEN — how to select tasks, adapt pacing, and support independence.
School leaders and ICT coordinators	Institutional framing for embedding inclusive digital practice across the school, including infrastructure and professional development.
Digital content developers and EdTech providers	Evidence-based design principles derived from real classroom piloting across three countries, applicable beyond the Atollo platform.
Educational policymakers and authorities	Systemic recommendations for scaling inclusive digital education, aligned with European accessibility and inclusion standards.
Families and support professionals (secondary)	Practical orientation to the digital materials and how home-based use can extend and reinforce school learning.

In practice, the boundaries between these groups are often blurred. A teacher may also be a coordinator; a policymaker may also be a parent. The Toolkit is structured so that each chapter can be read independently, allowing readers to move directly to the sections most relevant to their role. Chapter 4, for example, is primarily aimed at teachers and teaching assistants. Chapter 6 is aimed at school leaders and policymakers. Chapter 3 will be of particular interest to content developers, and teachers will find it useful too.

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1.3 Methodological basis

The recommendations in this Toolkit are informed by three complementary sources: evidence from the Atollo pilot, practitioner experience gathered across participating schools, and relevant research literature. Together, these sources provide a research-informed and practice-oriented basis for guidance on the design and implementation of inclusive digital materials. The evidence should be interpreted within the scope of the participating schools and the methods described in D4.1, D4.2 and D4.3. The Toolkit therefore presents transferable principles and practical guidance rather than universal prescriptions.

The Toolkit's recommendations rest on three intersecting evidence bases:

Evidence Base 1	Evidence Base 2	Evidence Base 3
Pilot Testing (D4.1)	**Evaluation Framework (D4.2)**	**Optimisation Process (D4.3)**
What was tested?	**How was quality evaluated?**	**How were findings translated into improvements?**
Teacher questionnaires	Evaluation criteria	Pedagogical improvements
Focus groups	Mixed-methods approach	Accessibility improvements
Classroom observations	UDL principles	Interface and navigation improvements
Learning analytics	Ethical procedures	Localisation and implementation readiness

First, systematic pilot testing was conducted across 15 schools in Croatia, Bulgaria, and Germany (February–June 2025). This involved teacher questionnaires administered before and after the use of the digital units, seven focus group interviews involving teachers across all three countries, classroom observations conducted by university researchers in all pilot countries, and engagement data collected through Google Analytics. In total, data were collected from over 400 teacher responses across the three countries (this figure counts individual questionnaire submissions, since the same teacher could pilot several units), covering all four learning levels of the IZZI materials.

Second, the evaluation framework established in D4.2, which defined the procedures, criteria, and ethical standards used throughout the pilot. This framework was grounded in established methodologies for educational research, including Braun and Clarke's six-phase thematic analysis model, Elo and Kyngäs's inductive content analysis approach, and Creswell and Plano Clark's convergent mixed-methods design. It was also informed by the Universal Design for Learning (UDL) principles that underpin the Atollo materials themselves.

Third, the optimisation process documented in D4.3, in which pilot findings were translated into concrete revisions of the digital units across five dimensions: pedagogical design, accessibility and usability, interface and navigation, localisation, and implementation readiness.

The Toolkit also draws on the broader literature on inclusive digital education, Universal Design for Learning, and digital learning environments for learners with SEN. Key theoretical sources are cited throughout and listed in full in the References section. However, the literature is used to contextualise and explain the pilot findings, not to substitute for them.

1.4 How the Toolkit was developed

The Toolkit was developed through a staged process that connects project design, classroom testing and practical guidance.

The development journey began in the early phases of the Atollo project, when partners carried out a cross-country curriculum analysis (WP2) to identify similarities and differences in programmes for learners with disabilities across partner countries. This analysis shaped the choice of subject areas, informed the four-level structure of the materials and highlighted the importance of national adaptation from the beginning.

The digital units themselves were developed iteratively (WP3) through close collaboration between subject authors, inclusion experts, digital designers, translators, editors and proofreaders at Profil Klett, drawing on the curriculum analysis and continuous input from practitioner partners. A Train-the-Trainer programme was also developed to prepare teachers before the pilot began.

The pilot phase (WP4, February–June 2025) placed those materials in real classrooms and systematically collected evidence about what worked, what did not, and what needed to change. University researchers from INN UNI and UNIZG ERF coordinated the data collection, and a collective analysis of findings was conducted at the project's physical partner meeting in Ireland, where all partners contributed to the synthesis of evidence.

Based on that evidence, Profil Klett (PK) led a systematic revision of all 45 digital units (D4.3), addressing the technical, pedagogical, and accessibility issues identified during piloting. The revised units, together with updated teacher guidelines, form the practical backbone of what this Toolkit describes.

This Toolkit (D4.4) is the final synthesis step. It takes the insights generated by the full project cycle — analysis, design, piloting, evaluation and revision — and translates them into transferable principles and practical guidance. It was developed collaboratively across consortium partners, with each chapter drawing on the expertise of the partners best placed to write it. The result is not a single author's view of inclusive digital education, but a collective synthesis informed by researchers, practitioners, and policymakers working across eight countries.

1.5 Connection with pilot testing and optimisation

The foundation of this Toolkit lies in the evidence generated throughout Work Package 4. Pilot testing activities documented in D4.1 provided valuable insights into how learners, teachers and teaching assistants interacted with the digital educational materials in authentic educational settings. Through teacher questionnaires, focus groups, classroom observations and learning analytics, the project gathered evidence on both successful practices and areas requiring further adaptation and support.

The interpretation of these findings was guided by the evaluation framework established in D4.2. This framework defined the procedures, criteria and methodological principles used to assess the quality, accessibility, usability and educational effectiveness of the digital materials. It ensured that observations and recommendations emerging from the pilot phase were analysed consistently and grounded in a transparent evidence-based process.

The findings from the pilot and evaluation activities subsequently informed the optimisation process described in D4.3. Based on the collected evidence, the project partners revised and refined the digital educational materials, improving their pedagogical design, accessibility features, usability, localisation and implementation readiness. D4.3 therefore represents the practical outcome of this iterative development process: 45 revised, ready-to-use digital educational units accompanied by guidance for their implementation in educational settings.

D4.4, this Toolkit, builds upon all these preceding activities. While D4.3 focuses on the use of specific Atollo materials, the Toolkit seeks to identify and articulate the broader principles that emerged through their development, testing, evaluation and optimisation.

In simple terms, D4.3 explains how to use the Atollo materials effectively. D4.4 explores what effective use of digital educational materials means within inclusive education more broadly, why particular design and implementation decisions matter, and how these lessons can inform future practice beyond the Atollo project itself.

The Toolkit therefore moves from project-specific experience to transferable guidance. The Atollo materials and pilot findings serve as concrete illustrations and evidence for the recommendations presented throughout the document. However, the principles themselves are intended to be applicable across a wide range of educational contexts. A teacher using a different digital platform, a developer (author) creating new educational content, or a policymaker designing strategies for inclusive digital education should all be able to benefit from the insights presented here, regardless of whether they use the Atollo materials directly.

While the evidence base for this Toolkit was generated through implementation in Croatia, Bulgaria and Germany, the recommendations have been formulated with adaptability in mind. Throughout the document, the aim is not to prescribe a single model of practice, but rather to provide a framework that can support informed decision-making in diverse educational environments, policy contexts and learner populations.

As such, the Toolkit represents the culmination of the piloting, evaluation, optimisation and implementation activities undertaken throughout Work Package 4, transforming project experience into a practical resource for the wider inclusive education community.

2. Inclusive Digital Education: Principles and Foundations

Inclusive digital education begins with a demanding but practical principle: all learners should have meaningful access to learning, participation and progress. This chapter sets out the conceptual foundation for the Toolkit by explaining what inclusion means in digital learning environments and why digital materials must be designed and implemented with learner diversity in mind from the outset.

The chapter treats inclusive education as a systemic approach to identifying and reducing barriers. In digital settings, access to a device or platform must therefore be distinguished from access to learning. The practical question is whether learners can perceive, understand, use, engage with and benefit from the learning opportunities provided.

The Atollo project is grounded in this understanding and translates it into practical classroom resources. Its digital materials were developed for learners with SEN in special and inclusive settings, but the principles behind them are relevant to a wider group of learners. For practitioners, the key message is that technology becomes inclusive only when accessibility, pedagogy, learner diversity and teacher judgement work together.

2.1 Inclusive education and equal opportunities

Inclusive education is the foundation for this Toolkit. In the work of the European Agency for Special Needs and Inclusive Education, it is understood as a rights-based and systemic commitment to ensuring that all learners have access to meaningful, high-quality educational opportunities in their local communities, alongside their friends and peers (European Agency for Special Needs and Inclusive Education, 2022a, 2024). This moves beyond the idea that inclusion is mainly about placing learners with disabilities in mainstream settings. It requires education systems, schools, teachers, materials and learning environments to identify and reduce barriers to participation, learning and progress.

This distinction matters. Integration often means that learners with disabilities or special educational needs are placed in existing environments while the environment itself remains largely unchanged. The learner is expected to adapt to routines, materials and assessment practices designed for an assumed average learner. Inclusive education goes further: it asks how the learning environment can be redesigned so that a wider range of learners can belong, communicate, understand, contribute and succeed. Presence in a classroom, or access to a digital platform, is not the same as meaningful participation. Learners also need to understand the purpose of the activity, interact with others where appropriate and have a realistic way to demonstrate what they know.

Equal opportunities should be understood in the same way. They do not mean giving every learner the same task, material or support. They mean ensuring that personal, social, linguistic, cognitive, sensory, physical, cultural or economic circumstances do not become barriers to learning. The Agency's work emphasises that inclusive systems must recognise intersecting factors that can marginalise learners, including disability, language, migration, socio-economic status and remoteness (European Agency for Special Needs and Inclusive Education, 2024; UNESCO, 2020). In practice, equal opportunities require flexible and accessible routes into shared learning goals. This includes varying the way content is presented, the way learners respond and the type of adult or technological support available, while keeping the learning purpose clear.

This is particularly important in digital education. Digital tools can support repetition, visual scaffolding, text-to-speech, adjustable display settings, structured feedback and alternative ways of responding. They can make abstract concepts more concrete and give learners more time and more routes to practise. They can also help teachers offer varied levels of challenge and multiple forms of representation. However, technology does not automatically create inclusion. A digital activity may exclude a learner who cannot process fast-moving content, use a drag-and-drop function, read dense text, follow complex navigation, tolerate sensory overload or respond within the expected time. The European Agency's Inclusive Digital Education report makes clear that digital media can support inclusion, but can also create new barriers if design, pedagogy, teacher competence, support and social inequalities are not considered together (European Agency for Special Needs and Inclusive Education, 2022b).

Inclusive digital education therefore requires both accessibility and pedagogy. Accessibility ensures that learners can perceive, navigate and interact with materials across the devices, settings and support arrangements available to them. Pedagogy ensures that the activity is meaningful, appropriately challenging, connected to learning goals and supported by teachers or other adults when needed. Neither is sufficient alone. A technically accessible resource may still be pedagogically weak, while a pedagogically rich resource may still exclude learners if it is not accessible. For teachers, this means that decisions about digital materials should always connect technical access with the learning objective, classroom support and the learner's actual participation.

It also requires a system-level response. The Agency's policy brief argues that inclusive digital education involves learners, teachers, institutions and regional or national governance, and that inclusion, exclusion, digitalisation and the digital divide should be treated as interconnected issues (European Agency for Special Needs and Inclusive Education, 2022c). The quality of inclusive digital learning therefore depends on leadership, infrastructure, teacher education, technical support, procurement, accessibility standards, family support and policy. Without these conditions, the burden of making digital education inclusive falls too heavily on individual teachers and families.

Universal design is central to this approach. Digital materials should be designed from the outset for a wide range of learners rather than created for an imagined average learner and adapted later for those who do not fit. This rationale underpins the Atollo Toolkit and the Atollo IZZI materials. The materials are designed for inclusive and specialised settings, available in six languages, focused on mathematics and digital competencies, and organised across four flexible learning levels so that teachers can select materials according to learners' developmental level, support needs and learning goals rather than relying only on age or diagnosis (Atollo Project, n.d.).

In this Toolkit, inclusive education is therefore treated as the foundation for all design and implementation principles that follow. The key question is not simply whether digital materials can be used with learners with disabilities or SEN. It is whether they are designed and implemented in ways that make learning more accessible, meaningful and participatory. This framing keeps the focus on learning and participation rather than on technology as an end in itself.

2.2 Learners with specialised support needs in digital environments

Learners who require specialised support are at the centre of the Atollo Toolkit. However, inclusive digital education should not begin by listing disability categories or assigning fixed digital solutions to groups of learners. A more useful approach is functional: to ask what a specific design or implementation choice enables or prevents, and for whom. This reflects the European Agency's understanding of barriers as arising from the interaction between the learner, the learning environment, the teaching approach, the available support and the design of materials (European Agency for Special Needs and Inclusive Education, 2022a, 2022b, 2024).

This functional perspective is essential in digital learning environments because the same feature can support one learner and create a barrier for another. Animation may make a mathematical concept more concrete, but may distract or overwhelm learners with attention difficulties or sensory sensitivities. Audio narration may support learners who struggle with reading, but it needs visual alternatives for learners with hearing impairments. Drag-and-drop activities may be motivating for some learners but inaccessible for learners with motor difficulties or those using alternative input methods. The question is therefore not only whether a digital resource is technically accessible, but whether different learners can participate meaningfully in the learning task, with the support and response options they need.

Access to a device, platform or activity is only the starting point. Learners also need to perceive the content, understand the task, manage the interaction, sustain attention, communicate responses and receive support when needed. This requires teachers and developers to look at the full learner pathway, from opening the activity to completing it and moving to the next step. Barriers often appear in small design decisions: the amount of text on screen, the pace of audio or animation, the size of clickable areas, the number of steps in an instruction, the consistency of icons, the need for precise motor control, or the assumption that learners can navigate independently. For learners with SEN, these small obstacles can accumulate quickly and turn an otherwise suitable activity into an inaccessible one. These details may appear minor in design, but in classroom use they often determine whether the learner is engaging with the concept or simply managing the interface.

Learners with intellectual and developmental disabilities may encounter barriers when digital materials rely on abstract language, dense instructions, unfamiliar symbols, rapid progression, weak visual structure or too many choices at once. They may need repetition, predictable routines, concrete examples, clear sequencing, visual scaffolding and opportunities to practise the same concept in slightly varied ways. The Atollo IZZI materials address this through a modular, level-based structure in mathematics and digital competencies, allowing teachers to select tasks according to developmental level, support needs and learning goals rather than chronological age or diagnosis alone (Atollo Project, n.d.).

Learners with physical and motor difficulties may be excluded when tasks require precise dragging, fast clicking, typing, scrolling or selecting small objects. In these cases, the response method can become the barrier, even when the learner understands the concept. Inclusive interaction design therefore requires large and clear interaction areas, predictable response routines, compatibility with assistive technologies and alternatives to motor-demanding actions where possible.

Learners with sensory impairments may be excluded when information is presented through only one sensory channel. Images without meaningful alternatives, low contrast, small fonts, crowded layouts, audio without captions or visual cues, and videos without accessible alternatives can all limit participation. Inclusive digital materials should provide information through more than one route, using combinations of text, image, audio, visual cues and structured layout, in line with Universal Design for Learning (CAST, 2024; European Agency for Special Needs and Inclusive Education, 2022b).

Learners with attention, memory and cognitive processing differences may struggle when digital environments are crowded, inconsistent, too fast or overloaded with simultaneous stimuli. They may benefit from short tasks, repeated routines, clear visual hierarchy, immediate but non-punitive feedback, opportunities to try again and a calm interface that makes the next step obvious. In this context, simplicity is not a weakness in design. It is a condition for participation.

The Atollo materials also show that principles designed for learners who require specialised support can benefit many others, including emerging readers, multilingual learners, learners with low digital confidence, learners who need more processing time and learners who have experienced repeated failure in school. Clear instructions, predictable navigation, multimodal access and flexible levels are not narrow disability adaptations; they are features of better educational design.

The Atollo materials are designed for flexible use in special and inclusive settings. The same unit may be used individually with adult support, in a small group, as part of whole-class teaching, in a support centre, or at home with guidance from parents or caregivers. This flexibility matters because support is shaped not only by the learner, but also by the setting, available adults, teaching goals, technology access and classroom organisation.

At the same time, specialised support should not be made invisible. Universal design and inclusive digital materials can reduce barriers, but some learners will still require individual adaptation, assistive technology, adult mediation, alternative communication, sensory regulation or carefully structured learning situations. Teachers therefore need to know their learners well, observe how each learner responds and decide when additional support is necessary. The aim is not to remove support, but to ensure that support enables the learner to participate rather than replacing the learner's own action. This is why inclusive digital education depends on the relationship between accessible design, pedagogical judgement, learner voice and the support structures around the learner.

For developers and teachers, the practical test is straightforward: can learners understand what to do, access the essential information, operate the task, repeat or try again, receive meaningful feedback and show what they know without unnecessary barriers? If not, the barrier should be addressed in the design, implementation or support plan before the learning expectation is lowered. The Atollo project treats learners who require specialised support not as exceptions to digital education, but as central users whose experiences reveal whether digital materials are genuinely inclusive. Designing for learners who face the greatest barriers can improve learning opportunities for all.

2.3 Universal Design for Learning (UDL)

Universal Design for Learning (UDL) provides the organising framework for the design principles used in this toolkit. UDL starts from an important assumption: learner diversity is normal, predictable and should be planned from the beginning (CAST, 2024; Meyer et al., 2014). In every classroom, learners differ in how they engage with learning, how they understand information, how they communicate what they know, how much support they need, how they use language, how they manage attention, and how they interact physically with learning materials. For learners with disabilities and special educational needs, these differences may be more visible, but they are not exceptional. They are part of the ordinary reality of teaching. UDL is proactive. It asks teachers, schools and content developers to anticipate variation before materials are produced and before teaching begins. This reflects the wider inclusive education principle that participation cannot be increased only by focusing on individual learners;

schools and learning environments must also be responsive to diversity in ways that value learners equally (Booth & Ainscow, 2016; European Agency for Special Needs and Inclusive Education, 2025). A learner may be present in a digital activity but not meaningfully involved in it. Research on participation makes this distinction clearly: attendance or “being there” is necessary, but it is not sufficient for genuine participation; learners also need involvement, engagement, motivation, social connection and meaningful activity (Imms et al., 2016, 2017; Ramberg & Watkins, 2020). Inclusive digital design requires deliberate choices. Accessibility, multimodality, flexible interaction, clear structure and learner choice must be built into the material from the first design stage, not added afterwards as corrections.

The Atollo project gives a concrete example of this proactive approach. The Atollo IZZI digital materials were designed from the outset for learners who benefit from adapted and differentiated support, particularly learners with learning difficulties and intellectual disabilities. The materials are organised across four learning levels and focus on mathematics and digital competencies, allowing teachers to select activities according to the learner’s developmental level, learning needs and available support rather than relying only on chronological age or formal diagnosis (Atollo Project, n.d.). This structure reflects a UDL logic: the materials assume diversity from the beginning.

UDL is commonly described through three core principles: multiple means of engagement, multiple means of representation, and multiple means of action and expression (CAST, 2024; Meyer et al., 2014). These principles are closely connected. Engagement concerns how learners are motivated and supported to participate. Representation concerns how information is presented and made understandable. Action and expression concern how learners interact with the material and show what they know. Together, they help teachers and developers move from a single-path learning model to a more flexible design that supports participation by a wider range of learners.

Multiple means of engagement refer to the ways learners are invited into learning and supported to stay involved. In classroom reality, engagement is about whether learners understand what they are doing, experience the task as meaningful, feel that success is possible, and receive feedback that helps them continue. Learners with SEN may disengage when a task is too difficult, too fast, too visually crowded, too repetitive without purpose, or too dependent on adult correction. They may also disengage when materials do not connect to familiar experiences or when they cannot predict what will happen next.

The Atollo IZZI materials support engagement through structured, interactive and level-based activities. The resource library describes the materials as including educational games, quizzes, animation videos, visual aids and practical activities that help make abstract mathematical and digital concepts more concrete (Atollo Project, n.d.). These features are important because they allow learners to participate actively rather than only receive information. A learner may select, match, listen, repeat, try again, watch a model, receive feedback or work through a short task with adult support. For many learners with SEN, this kind of structured interaction can make the difference between passive exposure and active participation.

The four-level structure also supports engagement by helping teachers choose an appropriate level of challenge. At Level 1 (L1), learners who need intensive support can engage through simple, highly structured activities with strong visual cues and minimal interaction steps. At higher levels (L2-L4), learners can work with more complex tasks, problem-solving and greater independence. This makes it possible for learners working on the same broad topic, such as numbers and counting or digital literacy, to participate at different levels of complexity.

Multiple means of representation refer to the different ways information is presented so that learners can perceive and understand it. In many classrooms, information is still mainly communicated through spoken explanation or written text. This creates barriers for learners who are emerging readers, learners with language difficulties, learners with hearing or visual impairments, multilingual learners, learners with attention difficulties, and learners who need repeated exposure before they consolidate understanding. UDL asks teachers and developers to avoid relying on one channel only.

The Atollo IZZI materials offer a practical example of multiple means of representation through their multimodal format. The platform includes text, visual aids, interactive activities, educational videos, animation, audio narration, subtitles and adapted text versions (Atollo Project, n.d.). These features make the materials more attractive and give learners different routes into the same learning objective. For example, an emerging reader may access the activity through audio support, images and modelling. Another learner may rely on written text and visual structure. A learner with attention difficulties may benefit from short, predictable steps and repeated visual cues. A learner who needs additional processing time may revisit the same activity more than once.

This multimodal design must be balanced carefully. Too much text, sound, movement or visual information can increase cognitive load and make learning harder. The purpose is to provide meaningful alternatives and complementary supports. In the Atollo materials, the combination of structured modules, visual scaffolding, audio support and interactive elements helps make mathematical and digital concepts more concrete while still allowing teachers to decide how much support each learner needs.

Multiple means of action and expression refer to the different ways learners can navigate learning tasks, respond to activities and demonstrate what they know. This principle is particularly important in digital education because interaction design can create hidden barriers. A learner may understand the content but be unable to show this because the task requires precise dragging, rapid clicking, typing, reading several instructions at once, or navigating independently between screens. In such cases, the problem is not necessarily the learner's understanding. The barrier may lie in the response pathway.

The Atollo IZZI platform supports action and expression through interactive tools and flexible use. Learners may respond by selecting, matching, completing quizzes, using visual supports, engaging with games, working through practical activities, or participating with teacher or assistant mediation. The platform is designed for use in different formats: individual work, small-group activities, whole-class teaching, supported learning in special education settings, and home use with adult assistance (Atollo Project, n.d.). This flexibility matters because learners differ not only in what they know, but also in how they can show what they know.

The resource library also identifies built-in accessibility features such as adjustable font size, dyslexia-friendly text, colour and contrast settings, note-taking features, text-to-speech, interactive exercises and assistive technology compatibility (Atollo Project, n.d.). These features are not minor technical additions. They are part of the learner's opportunity to act within the material. A learner who needs larger text, clearer contrast, audio support or adult-guided navigation should not have to wait for a separate adapted version. The material itself should make these forms of access possible. Using UDL as a design framework does not remove the need for teacher judgement: the teacher still needs to know their learners, select appropriate materials, structure the learning situation, provide emotional and cognitive support, and decide when individual adaptation is necessary. Well-designed digital materials should make participation easier for teachers to organise and more realistic for learners to experience. In the Atollo Toolkit, UDL therefore functions as a bridge between inclusive values and practical design decisions. It connects the commitment to equal opportunities with concrete choices about language, layout, navigation, feedback, accessibility, interaction, differentiation and classroom implementation.

2.4 Accessibility principles

Accessibility is a minimum requirement for inclusive digital education. It should not be treated as an optional enhancement, a technical extra, or something added only when a learner with a diagnosed disability is present. In most European education contexts, particularly in public-sector and publicly funded education, accessibility is both a legal obligation and a professional responsibility. It is also a condition for equal participation. If learners cannot perceive, navigate, understand or interact with digital materials, they do not have real access to learning, even if the material is technically available to them.

The Web Content Accessibility Guidelines (WCAG), developed by the World Wide Web Consortium, provide the most widely used framework for digital accessibility. WCAG is technical in its full form, but its four core principles are highly relevant for teachers and content developers: digital content should be perceivable, operable, understandable and robust (World Wide Web Consortium, 2024). These principles offer a practical way to check whether digital educational materials can be used by a wide range of learners, including learners with disabilities, learners who require specialised support, multilingual learners, emerging readers and learners with limited digital confidence.

The European Agency for Special Needs and Inclusive Education emphasises that accessibility must be understood as part of inclusive digital education, not as a separate technical issue. Digital media can support inclusion, but they can also create or reinforce barriers when accessibility, usability, pedagogy and learner diversity are not considered together (European Agency for Special Needs and Inclusive Education, 2022a, 2024). Accessibility therefore needs to be built into the design, selection and use of digital materials from the beginning.

Perceivable means that learners can access the information presented in the material. For teachers and content developers, this means asking whether essential information is available in more than one form. A learner should not be excluded because content is only presented as small text, only as audio, only through colour, or only through an image without explanation. In practice, perceivable materials include readable text, sufficient colour contrast, captions or subtitles for video, text alternatives for images, audio support where useful, clear visual structure and the possibility to adjust display settings such as font size. For Atollo IZZI materials, this principle is reflected in the use of multimodal presentation, including visual support, audio narration, subtitles and structured digital activities that help learners access mathematical and digital content in different ways (Atollo Project, n.d.).

Operable means that learners can navigate and use the material. In classroom terms, this means that the learner can move through the activity, select answers, repeat instructions, start and finish a task, and interact with the material without being blocked by the interface. Digital activities may fail this principle if they require precise dragging, fast clicking, complex scrolling, small buttons, hidden menus, or keyboard and mouse skills that some learners have not yet developed. Operability is particularly important for learners with physical and motor difficulties, learners using assistive technologies, and learners who need adult support to manage digital routines. For content developers, this means designing large and clear interaction areas, predictable navigation, alternatives to motor-demanding actions, and compatibility with assistive technologies. For teachers, it means observing whether a learner's difficulty lies in the learning goal itself or in the mechanics of using the digital tool.

Understandable means that learners can make sense of the content, instructions and interaction. A digital resource may be technically accessible but still difficult to understand if it uses long sentences, unfamiliar terminology, inconsistent icons, unclear feedback, too many steps, or crowded screens. In practice, understandable materials use clear language, consistent routines, predictable layouts, short instructions, examples, visual cues and feedback that tells learners what to do next. This principle is especially important for learners with intellectual and developmental disabilities, learners with attention or memory difficulties, multilingual learners and emerging readers. In the Atollo IZZI materials, the four-level structure supports understandability by allowing teachers to select activities that match learners' developmental level, learning needs and available support rather than assuming that all learners should work with the same complexity (Atollo Project, n.d.).

Robust means that digital materials work reliably across different devices, browsers, platforms and assistive technologies. For teachers, this principle may seem technical, but it has very practical consequences. If a resource does not work with screen readers, tablets, keyboards, alternative input devices or standard accessibility settings, some learners will be excluded. Robustness also means that materials should remain usable when learners change device, enlarge text, use text-to-speech, adjust contrast or access the material with support from an adult. For content developers, robustness requires attention to technical standards, compatibility and testing with real users. For schools, it means that accessibility should be part of procurement, quality assurance and piloting, not something left to individual teachers to solve after implementation.

Accessibility features often benefit many more learners than the group they were originally designed for. Captions support learners who are deaf or hard of hearing, but they also help learners working in a noisy classroom, multilingual learners and learners who need to see and hear information at the same time. Text-to-speech supports learners with visual impairments or reading difficulties, but it may also help tired learners, emerging readers and learners who need repeated exposure. Clear navigation supports learners with motor difficulties, but it also reduces cognitive loads for all learners. High contrast, large clickable areas, simple language and predictable layouts make digital materials easier and more efficient for everyone.

Accessibility should therefore be understood as the baseline for inclusive digital materials, while Universal Design for Learning builds further on this by considering engagement, representation, action and expression. Accessibility asks whether learners can access and use the material. UDL asks whether they have meaningful routes into learning, participation and expression. Both are necessary. A material that is not accessible cannot be inclusive, but accessibility alone does not guarantee high-quality learning. Inclusive digital education requires accessible design, pedagogical purpose and teacher judgement working together.

The Atollo project reflects this understanding by developing multilingual, structured and differentiated digital materials for learners with SEN in both special and inclusive settings. The Atollo IZZI materials are organised across four flexible learning levels and are intended for use in classrooms, support centres and home-learning contexts with adult guidance where appropriate (Atollo Project, n.d.). This approach connects accessibility with practical implementation: teachers need materials that are not only technically available, but usable, understandable and adaptable in real learning situations.

For teachers and developers, the practical accessibility question is straightforward: can different learners actually use this material to participate in the intended learning? If the answer is no, the barrier should be addressed in the design wherever possible. Accessibility is not about lowering expectations. It is about removing unnecessary barriers so that learners can engage with the learning goal itself.

2.5 Learner diversity

Inclusive digital education begins with a broad understanding of learner diversity. While the Atollo project has a specific focus on learners with disabilities and special educational needs, inclusive design cannot be limited to disability categories alone. Every classroom contains many forms of diversity that influence how learners access, understand and participate in learning. These include linguistic background, socio-economic circumstances, prior knowledge, cultural context, digital literacy, motivation, communication preferences, sensory needs, emotional well-being, family support, access to technology and previous experiences of success or exclusion in school. This wider understanding is important because barriers to learning are rarely caused by one factor only. A learner may have no formally identified disability but may still struggle with digital learning because the language is unfamiliar, the instructions assume prior knowledge, the task depends on home access to technology, or the examples do not connect with the learner's lived experience. Similarly, a learner with a disability may experience very different levels of participation depending on whether the material is meaningful, accessible, culturally familiar and supported by adults and peers. Learner diversity is therefore intersectional: language, disability, socio-economic status, cultural background, digital confidence and emotional security interact in ways that shape participation.

Participation includes active engagement, collaboration and interaction with peers and teachers, a sense of being accepted and valued, opportunities to express views, and the right to participate or not depending on needs, interests and preferences (European Agency for Special Needs and Inclusive Education, 2025). This understanding is consistent with wider participation research, which shows that participation involves more than access or attendance; it also includes involvement, belonging, autonomy, recognition, voice, choice and influence (Anderson et al., 2019; Black-Hawkins, 2010; Booth, 2003; Booth & Ainscow, 2016; Imms et al., 2016, 2017; Ramberg & Watkins, 2020). A digital material becomes inclusive when learners can understand what is expected, interact with the material in meaningful ways, feel recognised, work with others where appropriate, and show what they know through accessible response options. Four interconnected dimensions of participation have been identified: physical participation, engaged participation, socio-emotional participation and decision-making participation (European Agency for Special Needs and Inclusive Education, 2025). These dimensions provide a useful lens for digital learning. Learners need physical and technical access to devices and materials, but they also need tasks that are meaningful, socially supportive and open to learner voice and choice.

The Atollo project responds to this understanding of diversity through a multilingual, multi-country and level-based design. The materials are available in six languages: English, Bulgarian, Croatian, German, Icelandic and Norwegian. They were developed for use across different national contexts and piloted in Croatia, Bulgaria and Germany (Atollo Project, n.d.). This is important as inclusive digital education cannot be designed as if there is one universal classroom. A task that is clear in one language may become confusing in another. An example that is familiar in one country may be less meaningful elsewhere. A digital routine that works well in one special education setting may require different scaffolding in an inclusive classroom, a support centre or a home-learning context. The multilingual development of the Atollo IZZI materials illustrates that translation is not only a technical process but also a pedagogical one. For learners with SEN, translated materials must preserve clarity, simplicity, structure and accessibility. Sentences may need to be short, vocabulary carefully selected, and visual or audio support aligned with the translated content. In this sense, linguistic diversity connects directly with cognitive accessibility. The goal is not only that learners see their language represented, but that the material supports understanding, confidence, independence and participation in that language.

Learner diversity is also addressed through the four learning levels in the Atollo IZZI materials. These levels are flexible rather than fixed. They are intended to help teachers select activities according to learners' support needs, developmental level, learning goals and capacity for independence. Level 1 is designed for learners who require intensive support, highly structured activities, sensory engagement, repetition and often direct adult guidance. Level 2 supports learners who benefit from clear step-by-step instructions, visual support and repeated practice. Level 3 is intended for learners who can engage with more structured tasks and basic concepts, often with some guidance. Level 4 supports learners working closer to lower primary learning outcomes who can often work more independently with clear instructions and structured support (Atollo Project, n.d.). This level-based structure is important because it avoids treating diversity as a problem to be solved through separate materials. Instead, it allows a shared learning focus to be approached through different levels of complexity, representation, interaction and independence. For example, learners may work with the same broad mathematical concept, such as numbers and counting, while using activities at different levels. One learner may focus on recognition and participation with strong visual cues. Another may practise pattern recognition or simple selection. A third may work with comparison or problem-solving. This makes differentiation part of the design rather than an afterthought.

Socio-economic diversity also matters in digital education. Learners do not have equal access to devices, stable internet, quiet workspaces or adult support outside school. The Atollo resource library responds partly to this by making the materials freely available without registration or codes, and by including both a teachers' corner and a parents' corner (Atollo Project, n.d.). This school-home dimension is important because some learners benefit from repetition, familiar routines and adult-supported practice beyond the classroom. At the same time, teachers and schools must be careful not to assume that home access is equal. Home use should extend opportunities where possible, not replace the school's responsibility to provide accessible learning.

Digital literacy is another central dimension of learner diversity. Some learners may be confident using tablets, laptops or interactive platforms, while others need explicit teaching of basic routines: how to start an activity, listen to audio, select an answer, move to the next task, repeat an instruction or ask for help. For learners with SEN, these digital routines cannot be treated as invisible skills. They need to be taught, modelled and practised. The Atollo materials support this through predictable modules, structured activities and recurring interaction formats. Predictability reduces the cognitive effort required to navigate the platform, leaving more capacity for learning the mathematical or digital concept itself.

Cultural diversity should also be considered when developing and implementing digital materials. Images, examples, names, scenarios and assumptions about family life, school routines or everyday experiences may feel familiar to some learners and distant to others. The Atollo project's cross-country development process is therefore significant. Because the materials were produced across partner countries and made available in multiple languages, the project had to consider whether concepts, examples and activities could travel across contexts. This does not mean that all cultural differences can be solved through translation. Teachers still need to contextualise materials, connect them to learners' lives, and decide when an example needs explanation, replacement or extension.

The social and emotional dimensions of learner diversity are equally important. Learners are more likely to participate when they feel safe, recognised and able to contribute. Participation research emphasises that belonging, acceptance, recognition, interaction and collaboration are central dimensions of inclusive education (Black-Hawkins, 2010; Edström et al., 2022; European Agency for Special Needs and Inclusive Education, 2025). Digital materials should therefore support belonging, collaboration and learner voice. The Atollo materials can be used individually, in small groups, in whole-class settings or with adult mediation. This flexibility allows teachers to make pedagogical decisions based on learners' confidence, relationships, communication needs and emotional readiness.

For teachers, recognising learner diversity means using digital materials thoughtfully. The same Atollo IZZI unit may be projected for whole-class discussion, explored in a small group, used individually with adult support, repeated at home, or combined with hands-on activities. The teacher's role is to observe how learners respond and to adjust pacing, grouping, support and follow-up activities accordingly. Inclusive digital education emerges from the relationship between flexible design, teacher judgement, learner voice and the conditions of the learning environment. The Atollo experience shows that attending to learner diversity is the foundation of inclusive digital education. Disability must be understood within the wider reality of diverse classrooms. Truly inclusive digital education is about designing learning environments in which different learners can be present, engaged, understood, connected, and able to express what they know.

2.6 Digital wellbeing basics

Digital wellbeing is an important part of inclusive digital education. It refers to the physical, cognitive, social and emotional conditions that allow learners to use digital materials in ways that support learning without unnecessary fatigue, stress or exclusion. In this toolkit, digital wellbeing is not understood as a warning against technology or as a simple question of "screen time". The evidence on screen time is more nuanced than popular debate often suggests. What matters in education is not only how long learners use a screen, but also what they are doing, why they are doing it, how the activity is structured, whether it supports learning, and whether it is balanced with movement, social interaction, rest and offline experience (World Health Organization, 2020; Santos et al., 2023).

This is consistent with the European Agency's work on inclusive digital education, which stresses that digital technologies must always be considered in relation to pedagogical decisions, learner needs, available support and the wider learning environment (European Agency for Special Needs and Inclusive Education, 2022a). A digital activity may be valuable when it gives a learner access to visual support, audio narration, repetition, feedback or alternative ways of responding. The same activity may become tiring or excluding if it is too long, too fast, visually crowded, physically demanding or poorly integrated into the classroom routine. Digital wellbeing is therefore a design and implementation issue, not an individual learner problem.

A basic principle is that digital learning should be purposeful and paced. Teachers and content developers should avoid long uninterrupted digital sessions, especially for learners who require specialised support. Instead, digital activities should be planned as focused learning episodes with a clear beginning, middle and end. The appropriate length of a session depends on the learner's age, attention profile, support needs, task complexity and classroom context. Some learners may work well in longer independent sessions, while others may need very short digital tasks followed by movement, hands-on activity, adult interaction or rest. The key question is not "how much screen time is allowed?" but "how long can this learner participate meaningfully before fatigue or overload reduces learning?"

Pacing is particularly important for learners with special educational needs. Learners with intellectual or developmental disabilities may need more time to process instructions, repeat steps and understand the purpose of an activity. Learners with attention differences may need shorter tasks, predictable routines and clear visual cues to maintain focus. Learners with sensory sensitivities may become overwhelmed by sound, animation, bright colours or rapid transitions. Learners with motor difficulties may become physically tired if an activity requires repeated clicking, dragging or precise control. For these learners, digital wellbeing depends on reducing unnecessary demands so that energy can be used for learning rather than for managing the interface.

The Atollo IZZI materials can support this approach when used flexibly. Because the materials are organised across four learning levels and include structured activities in mathematics and digital competencies, teachers can select tasks that fit learners' current capacity for attention, independence and support (Atollo Project, n.d.). A learner who needs intensive support may benefit from a short, highly scaffolded activity followed by a concrete offline task using objects, movement or conversation. Another learner may be able to complete a sequence of digital tasks more independently. The same material can therefore be used in different ways depending on learners' wellbeing, attention and energy levels.

Alternating between digital and offline activity is a practical way to support sustainable learning. Digital work may be followed by drawing, building, counting physical objects, movement, peer discussion, teacher-led reflection or practical problem-solving. This is especially important in early and special education settings where learning is embodied, social and relational. Digital materials should not replace hands-on experience or interaction with adults and peers. Rather, they should extend the range of ways learners can access, practise and express understanding. The European Agency's work on inclusive digital education underlines that educational institutions are not only places of instruction but also places of social exchange, and that digital media cannot fully replace direct contact and learning support (European Agency for Special Needs and Inclusive Education, 2022a).

Physical ergonomics also matters. Digital learning should be organised so that learners can sit or stand comfortably, see the screen without strain, reach the device without awkward posture, and use input methods that do not cause unnecessary fatigue. For some learners, this may require a larger screen, an adapted mouse, a touchscreen, a switch, eye-gaze technology, a tablet stand, adjusted seating, or adult support. For others, it may simply mean placing the device at a comfortable height, avoiding glare, allowing movement breaks and preventing long periods of static sitting. The European Agency's think piece on transforming education in a digital world note that interaction with technology may take more time or energy for learners using alternative interaction patterns, and that these differences can become decisive in educational contexts (European Agency for Special Needs and Inclusive Education, 2024).

Digital wellbeing also includes attention regulation. Many digital tools are designed to capture and hold attention, but educational materials should help learners regulate attention rather than compete for it. For learners with SEN, this means avoiding unnecessary animations, background sound, visual clutter, distracting rewards and rapid changes that are not linked to the learning goal. Feedback should be clear and encouraging without being overstimulating. Repetition should be predictable but not monotonous. Choice should be meaningful but not overwhelming. A calm, structured interface often supports learning better than a highly stimulating one.

Fatigue should be taken seriously. Some learners may show fatigue through reduced accuracy, slower responses, frustration, avoidance, restlessness, irritability, physical discomfort or withdrawal. These signs should not automatically be interpreted as lack of motivation. They may indicate that the digital task has become too demanding cognitively, physically, socially or sensorially. Teachers should feel able to pause, shorten, repeat or change the mode of activity. In inclusive digital education, stopping or changing a digital task can be a pedagogical decision, not a failure of implementation.

Psychological wellbeing is also connected to success, autonomy and safety. Digital environments can support confidence when learners can try again without stigma, receive constructive feedback, work at an appropriate level and experience progress. They can undermine confidence when errors are public, feedback is confusing, tasks move too quickly, or learners are repeatedly confronted with activities they cannot complete. For learners who have experienced failure in school, digital materials should be designed and used in ways that create achievable challenge and visible progress. This is particularly relevant in the Atollo project, where materials are intended to support learners with SEN in both special and inclusive settings.

Teachers therefore play a central role in digital wellbeing. They decide when to use digital materials, how long to use them, whether the activity should be individual or shared, how much adult support is needed, and when to shift to offline learning. This requires observation and professional judgement. A digital activity that works well one day may be too demanding another day if the learner is tired, anxious, overstimulated or affected by changes in routine. Inclusive use of digital materials must therefore remain flexible and responsive.

For content developers, digital wellbeing should be considered from the beginning of design. Materials should support short and meaningful learning episodes, clear stopping points, predictable routines, adjustable pace, simple navigation, calm visual design and opportunities for repetition. They should avoid unnecessary cognitive load, excessive stimulation and interaction patterns that create fatigue. Where possible, digital materials should suggest or connect to offline activities so that teachers can create a balanced learning sequence.

Digital wellbeing is therefore not separate from accessibility, Universal Design for Learning or learner diversity. It is part of the same inclusive logic. Learners can only benefit from digital education when they can participate in ways that are physically comfortable, cognitively manageable, emotionally safe and pedagogically meaningful. For learners with SEN, this is especially important because fatigue, overstimulation and attention regulation may directly affect whether they can access and benefit from digital learning. The goal is not more digital activity but better designed and better paced digital learning.

2.7 Benefits and limitations of digital learning

Digital learning can support inclusive education, but it should not be presented as a simple solution to complex educational challenges. Digital tools can extend access, provide flexible routes into learning, support multimodal presentation, increase opportunities for practice and feedback, and offer accessibility features that are difficult to provide in printed materials. They can also help teachers organise differentiated practice within the same broad learning focus. At the same time, they can reinforce inequalities, increase cognitive load, distract from learning goals and create new forms of exclusion when poorly designed, poorly selected or implemented without adequate support (European Agency for Special Needs and Inclusive Education, 2022a, 2024).

The main benefit of digital learning, particularly for diverse inclusive classrooms, is flexibility. Digital materials can be used individually, in small groups, in whole-class teaching, in specialised support settings and, where appropriate, at home with adult guidance. They allow learners to repeat tasks, work at a suitable pace, revisit instructions and receive immediate feedback. The Atollo IZZI materials reflect this principle through four flexible learning levels, which allow teachers to select activities according to learners' developmental level, learning goals and support needs rather than relying only on chronological age or diagnosis (Atollo Project, n.d.).

A second benefit is multimodality. Digital materials can combine text, images, audio, video, animation, interactive exercises and structured visual cues. This can support learners who do not access information easily through written text alone, including learners with reading difficulties, intellectual disabilities, language barriers, attention differences or sensory needs. When well designed, multimodal materials make abstract concepts more concrete and provide several routes into the same learning objective, while allowing teachers to select the channel or combination of channels that best suits the learner. The value of multimodality lies in meaningful alternatives and complementary supports, not in presenting every possible medium at once.

Digital tools can also support engagement and accessibility. Interactive tasks, educational games, quizzes, visual feedback and short structured activities can help learners become active participants rather than passive recipients of information. Features such as text-to-speech, captions, adjustable text size, contrast settings, visual supports, alternative response formats and assistive technology compatibility can reduce unnecessary barriers. These features are essential for many learners with disabilities and often improve usability for a much wider group of learners, including emerging readers, multilingual learners, learners working in noisy environments and those who need repeated access to information. This is one reason why accessibility should be treated as a quality standard rather than as a specialist add-on.

However, these benefits are not automatic. Unequal infrastructure remains a major limitation: learners and schools do not have equal access to devices, stable internet, technical support, accessible platforms or quiet learning spaces. Cognitive overload is another risk when materials include too much information, too many instructions, unnecessary animation, background sound, unclear navigation or competing elements on the screen. Distraction is also a concern when digital environments use rewards, sounds, pop-ups, rapid transitions or excessive choice in ways that pull attention away from the learning goal. In these cases, engagement may be superficial rather than educationally meaningful.

A further limitation is over-reliance on technology. Digital tools cannot replace human pedagogy, relationships, professional judgement or the social life of the classroom. For learners who require specialised support, the teacher, teaching assistant, peer group or family member may be decisive in making the activity meaningful. Learners may need help to understand the purpose of the task, regulate attention, connect the activity to prior knowledge, communicate a response or transfer learning to an offline situation.

The Atollo project illustrates this balanced understanding. The IZZI materials provide accessible, multilingual and differentiated resources for learners with SEN, but they do not remove the need for teacher judgement. Teachers still need to decide which level is appropriate, how long the activity should last, whether learners need adult support, when to repeat or pause, and how to connect digital learning with hands-on practice, discussion, collaboration and everyday application. A counting activity, for example, may be used digitally for matching or feedback and then extended through physical objects, peer discussion or a classroom routine so that the concept is transferred beyond the screen.

The key message is therefore straightforward: digital materials are most effective when embedded in sound pedagogical design, with clear objectives, appropriate pacing, accessible interaction and opportunities to connect digital practice with real communication and activity. They should make inclusive teaching easier to realise, not replace the human and professional work that makes inclusion possible in classrooms, support settings and home-supported learning.

3. Principles for Developing Inclusive Digital Educational Materials

Designing inclusive digital educational materials requires more than transferring curriculum content onto a digital platform. It involves making careful decisions about how learners encounter information, how they interact with tasks, how much cognitive effort the design demands, and how different learners can participate meaningfully in the same learning environment. This chapter translates the conceptual foundations of Chapter 2 into practical design principles for anyone creating, selecting or adapting digital materials for learners with special educational needs. The starting point is learner-centred design. Inclusive digital materials should be designed around the real learner, not around an imagined average user or around the technical possibilities of a platform. For learners with SEN, small design choices can have significant consequences. A long instruction, a crowded screen, a small clickable area, an inconsistent icon or an unclear transition may become a barrier to participation. Conversely, clear structure, predictable navigation, simple language, multimodal presentation and accessible interaction can support independence, confidence and engagement.

The Atollo project provides a practical basis for these principles. The Atollo IZZI materials were developed, piloted and revised through an iterative process in which feedback from teachers, learners, experts and classroom observations informed concrete improvements to the digital units. This process showed that inclusive design is not achieved by one single feature, such as audio support or adjustable font size. Rather, it emerges from the combination of pedagogical clarity, accessibility, usability, differentiation and responsiveness to real learner experience.

This chapter, therefore, focuses on the design decisions that make digital materials more usable and meaningful for diverse learners. It begins with learner-centred design and then addresses cognitive load, readability and language simplicity, visual design, multimodal learning, interaction design, navigation and usability, embedded accessibility features, differentiation and adaptability, and learner engagement. The chapter closes by showing how pilot experience was translated into design principles through the Atollo optimisation process. The central argument of the chapter is that inclusive digital materials must be designed intentionally from the beginning. Accessibility and differentiation should not be added afterwards as corrections for learners who struggle with standard materials. They should be built into the structure, language, layout, interaction and pedagogical logic of the material itself. In this way, digital design becomes part of inclusive pedagogy: it helps remove unnecessary barriers so that learners can focus their energy on learning, participation and progress.

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3.1 Learner-centred design

One of the fundamental principles of the Atollo project is the development of digital educational materials that start from the needs of the learner, rather than from technological possibilities or the content requirements of teaching units. This approach derives from the concept of learner-centred design, according to which the user experience shapes the development, implementation, and evaluation of educational content. Norman (2013) emphasises that the success of a digital product depends on how well it is adapted to real users and their ways of using it, and not solely on its functionalities.

For learners with special educational needs, this approach has added value because it takes into account differences in cognitive, communicative, motor, and sensory abilities. In line with the principles of universal design for learning (Meyer, Rose, and Gordon, 2014; 2025), the quality of a digital educational material is reflected in its ability to provide the learner with an independent, comprehensible, and motivating learning experience.

Piloting the digital materials within the Atollo project showed that learners respond best to simple, visually clear, and predictable activities, while complex instructions, multiple demands, and technically demanding interactions reduce the success of independent work.

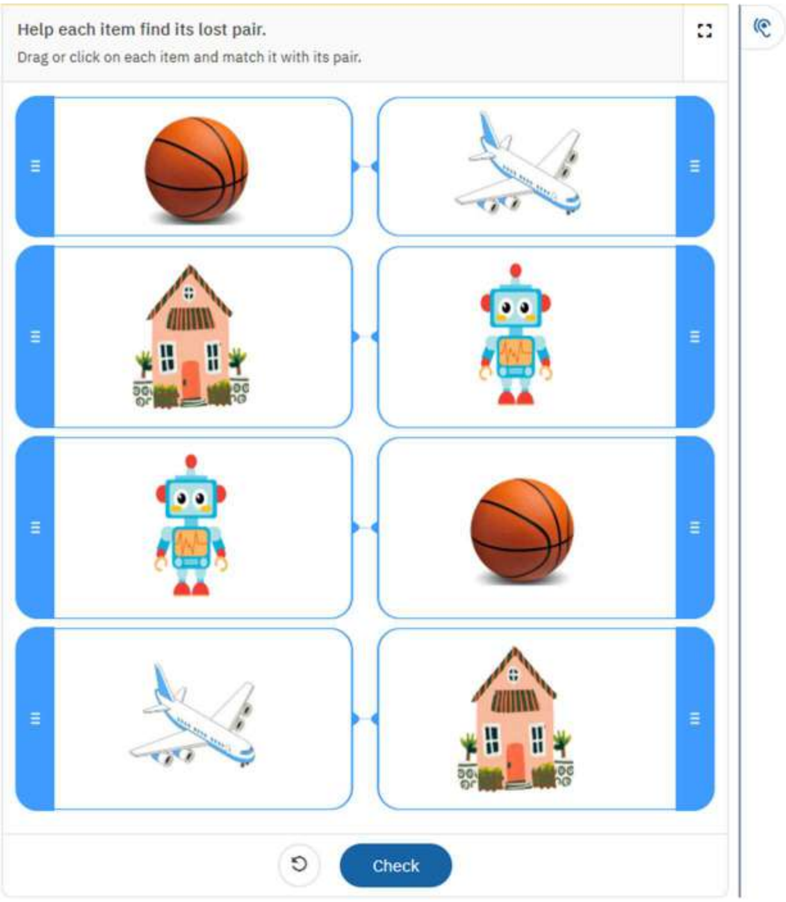
Simplicity and Clarity

Digital content has a clearly defined structure in which each task encompasses one educational goal and one activity. Such organisation reduces the load on working memory and facilitates information processing, which is also confirmed by research in the field of universal design for learning (Meyer et al., 2014).

Experiences from piloting show that breaking down complex activities into smaller steps increases understanding of the task and enables greater learner independence.

Example

A positive example of good practice is the task "Find a pair for each object," in which each activity encompasses one educational goal and one action - matching identical objects. The review pointed out that complex, multi-step tasks (e.g. "find -> drag -> match identical -> match similar" within a single task) represent an excessive burden for learners with intellectual disabilities. By breaking them down into separate steps, where each has one clear instruction and one activity, the load on working memory is reduced and the learner is enabled to work independently.



Example of a matching task with one clear goal (Level 1 - Same and Different).

Visual Consistency

Visual representations are characterised by simplicity, a consistent graphic style, and a focus on information relevant to solving the task. Decorative elements and varied illustration styles draw attention away and make it harder to recognise the key features of the content.

Evaluation of the materials showed that learners more easily acquire new concepts when these are presented through familiar everyday situations and when the same objects are depicted in a consistent manner. Such visual consistency reduces cognitive load and supports effective learning.

Example

A good example of adaptation is visible in the task of sorting objects into groups of equal quantities, where the same concept is presented consistently - identical balls, identical teddy bears. When the objects to be compared are depicted in a uniform graphic style, without unnecessary decorative differences, the learner more easily recognises the key feature of the task - quantity, rather than differences in appearance. This reduces cognitive load and supports effective acquisition of the concept.

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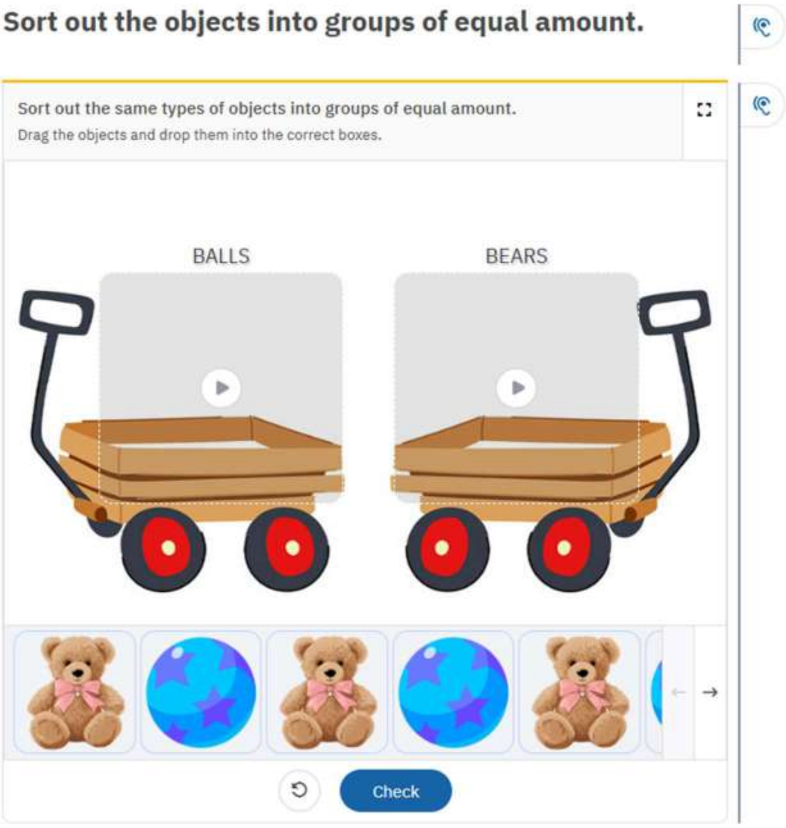


Sorting the same types of objects into groups of equal quantities (Level 1 - More, Less, Equal).

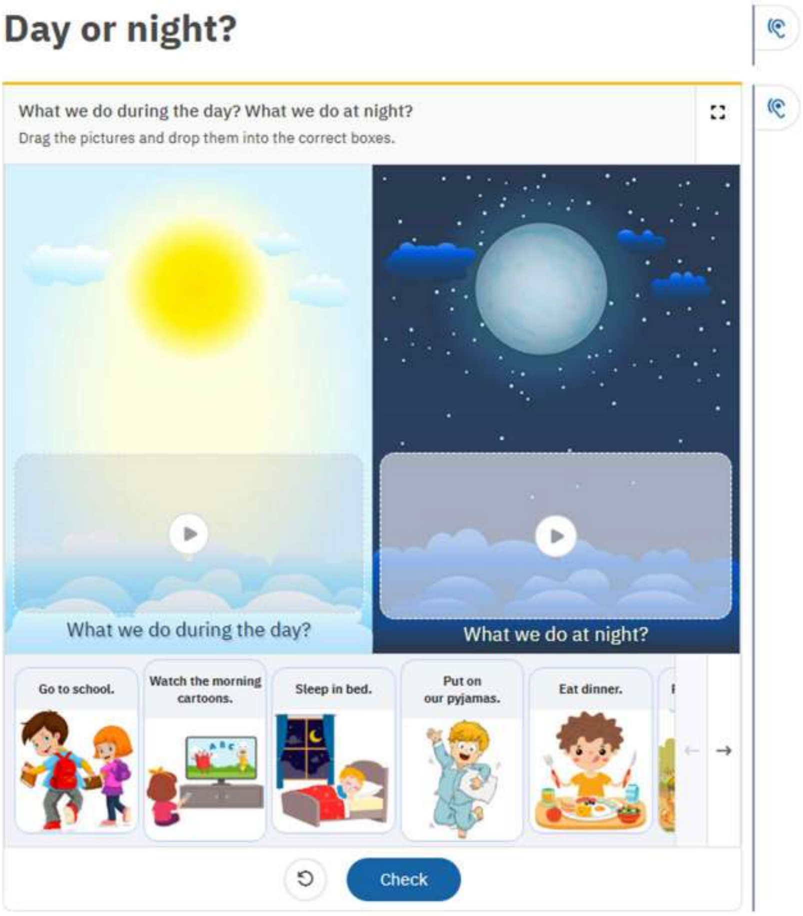
Accessibility of Interaction

Interactions in the digital content are simple, intuitive, and adapted to the varied motor abilities of learners. Active areas are sufficiently large, the areas for placing objects are clearly defined, and the possibility of error is reduced through technical solutions that make it easier for the user to complete the task.

Piloting showed that complex manipulation of objects often represents a greater obstacle than the teaching content itself, which is why the accessibility of the user interface directly contributes to learning success.

Example

A positive example of accessible interaction is the sorting task "What do we do during the day? What do we do at night?" with large, clearly delineated drop areas (day/night) and images of sufficient size. The review emphasises that such clearly defined drop areas, together with a "drag and drop" mechanic instead of frame sliding that gets stuck, directly facilitate work for learners with motor difficulties and reduce the possibility of error.



Sorting by dragging into large, clearly delineated fields (Level 1 - Measurement).

Multichannel Presentation of Information

The digital content combines visual, auditory, and interactive ways of presenting information, thereby supporting different learning styles. UDL principles emphasise the importance of multiple means of representing content so that information is accessible to the widest possible range of learners (Meyer, Rose, and Gordon, 2025).

During piloting, the option of listening to instructions proved particularly useful, as it increases the independence of learners with difficulties in reading or understanding written text. Animations and demonstrations further facilitate understanding when they are functional and focused on the educational goal.

Example

Good practice in multichannel presentation is illustrated by a task in which the same content - the place value of a number - is offered simultaneously through video, a short-written explanation, and an interactive matching task. Information is available via video and sound to a learner who has difficulty reading, while text and interactive matching support those who learn visually and through activity. Such a combination of visual, auditory, and interactive channels makes the content accessible to a wider range of learners.

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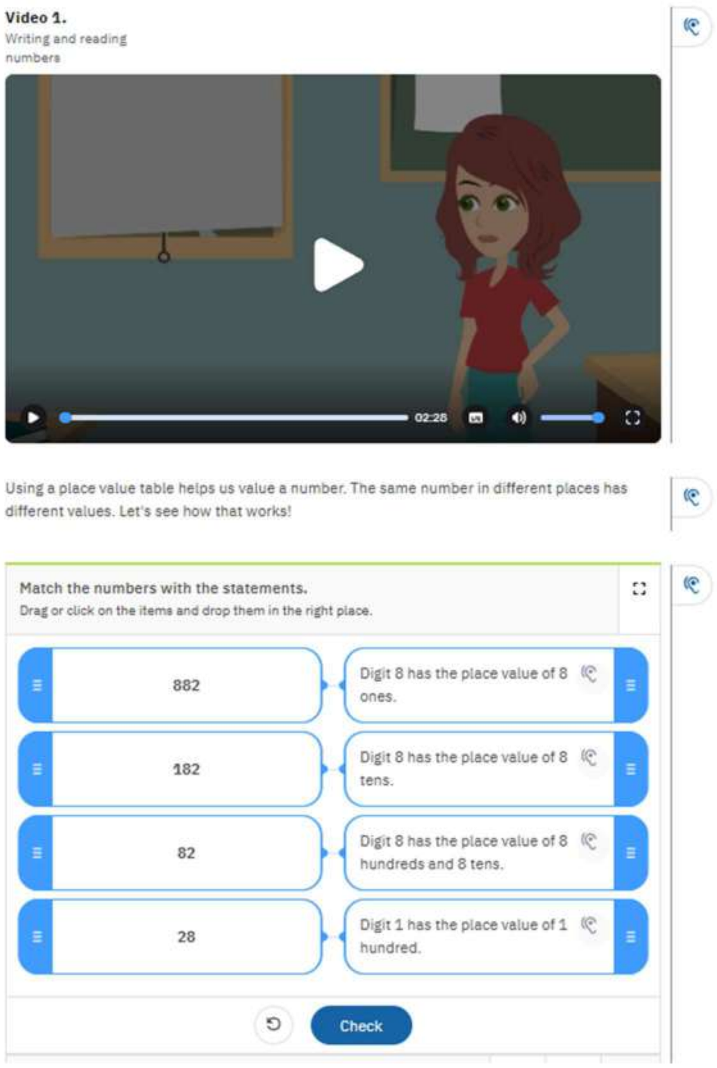


The same content presented through video, text, and interactive matching (Level 4 - Numbers).

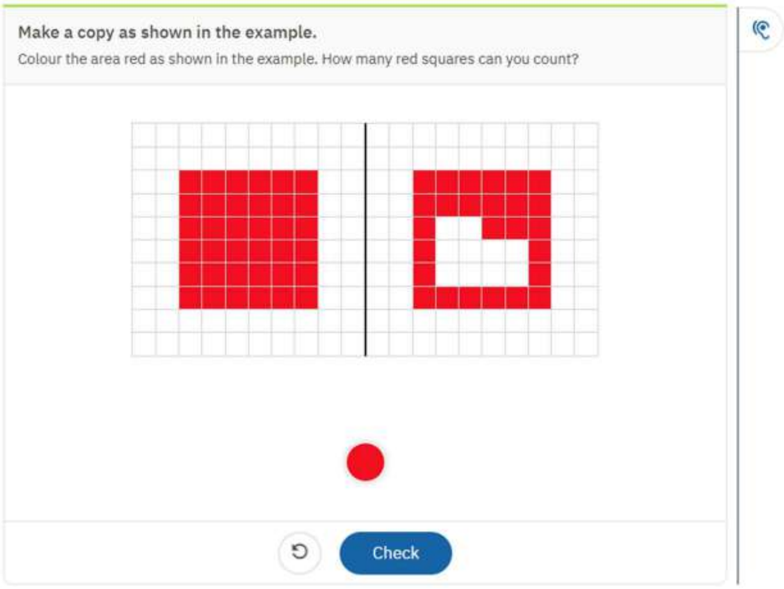
Predictability and a Sense of Security

The digital materials have a stable organisation, a uniform layout of elements, and consistent navigation. Such a structure provides learners with a sense of security and allows them to direct their attention to the content rather than to changes in the user interface.

Experiences from the project showed that changes in the layout of elements or unexpected scrolling of the screen create additional cognitive load and disrupt the learner's concentration.

Example

A positive example of predictability is the task "Copy the displayed example," in which the grid of squares, the example to be coloured, and the "Check" button have a stable and uniform layout. Reviewers warned in several places that the unexpected scrolling of the screen when moving to the next task or when zooming in creates additional cognitive load. A task with a fixed, clearly structured grid and a consistent position of elements allows the learner to direct their attention to the content rather than to changes in the user interface.



A stable and clear layout of the grid and controls (Level 4 - Measurement).

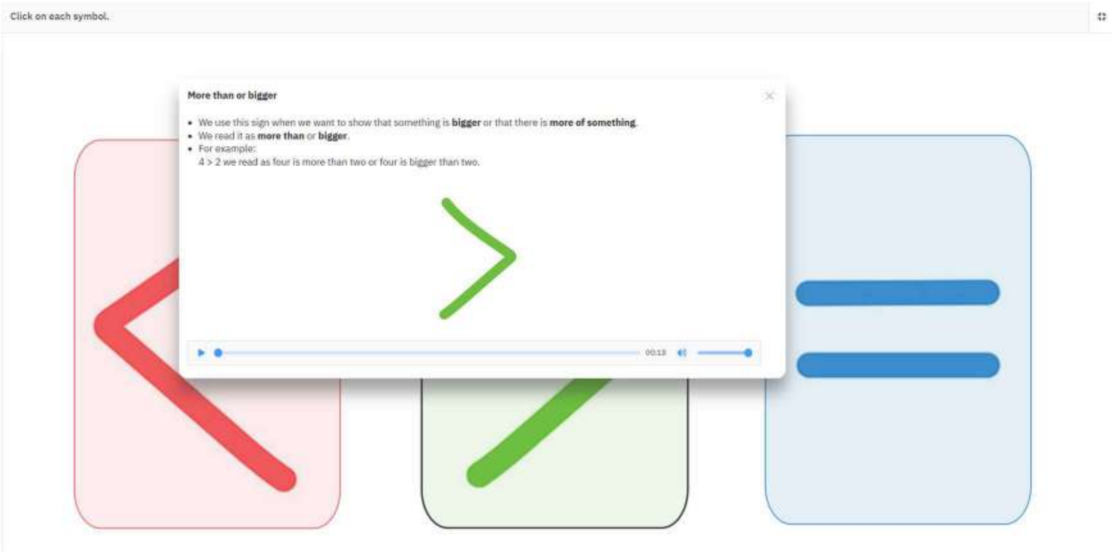
Design Based on Real User Experience

A particular value of the Atollo project arises from the development of digital materials through continuous piloting and evaluation in real classrooms. Feedback from teachers, expert associates, and learners made it possible to identify obstacles that were not visible during the development phase itself.

Such an iterative approach corresponds to contemporary models of instructional design, such as the ADDIE model (Branch, 2009), in which user analysis and evaluation form integral parts of the development process. Research on the application of UDL in digital environments also confirms that the continuous involvement of users increases the usability and educational effectiveness of the system (Montes, Herrera, and Crisol, 2024).

Example

A positive example of an adaptation arising from user experience is the interactive glossary of mathematical symbols "Click on each symbol." When the learner clicks on the "greater than" sign, a simple explanation opens with a definition and an example from everyday logic (4 > 2 is read as "four is greater than two"). It was precisely the continuous piloting in real classrooms that showed that abstract symbols become comprehensible to learners when accompanied by a short explanation and a concrete example; the reviewer’s note here was only a minor refinement (that the full sign be displayed as in the example with the equals sign), through which an otherwise well-designed solution is further improved.



Interactive glossary of the "greater than" sign with a definition and an everyday example (Level 1 - Comparing Numbers).

Principles of Learner-Centred Design

The experiences of the Atollo project show that high-quality inclusive digital educational materials are characterised by:

- the learner and their needs as the starting point of the design process,
- a clearly defined goal for each activity,
- simple and visually consistent elements,
- intuitive and accessible interactions,
- multichannel presentation of information,
- encouragement of learner independence,
- a stable and predictable user experience,
- continuous improvement based on experiences from the real educational environment.

Such an approach is in line with the principles of universal design for learning (Rose and Meyer, 2002; Meyer et al., 2025) and differentiated instruction (Tomlinson, 2017), according to which educational content is adapted to the varied abilities of learners in order to ensure their active and equal participation in the learning process. The application of these principles contributes to the development of digital materials that are simultaneously accessible, pedagogically effective, and inclusive.

Example

A consolidated example of the application of all the principles is the task "Select the images that show more objects," with a clear note that there are two correct answers. The task is visually simple and consistent, has a clearly defined goal and an accessible interaction (selection by ticking), and encourages independence because the learner is informed in advance to expect more than one solution. In this way, simplicity, clarity of goal, and encouragement of independence are achieved at the same time, and the learner is not left with the impression of being unable to solve the task.

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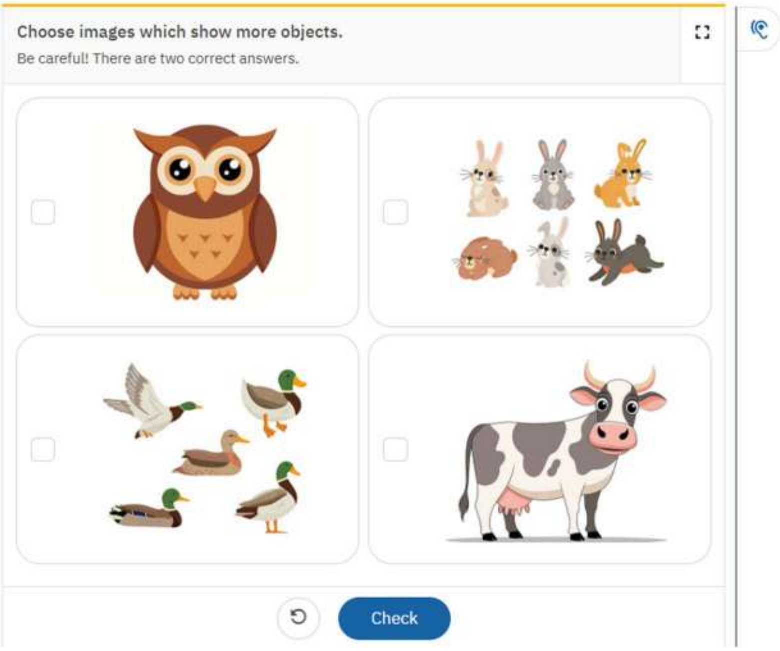


Selecting images with a note about two correct answers (Level 1 - More, Less, Equal).

3.2. Cognitive Load Considerations

Every digital learning activity asks two things of a learner at once. The first is to engage with the actual content - to count, to compare, to recognise a shape, to read a number. The second, often invisible to designers, is to operate the activity itself: to work out where to click, to interpret an instruction, to find the relevant element among everything else on the screen, and to remember what to do next. Both demands draw on the same limited pool of mental resources. When the second demand grows, less capacity remains for the first. This is the practical heart of cognitive load theory, which holds that working memory is severely limited and that learning suffers when the demands placed on it exceed its capacity (Sweller, 1988). For the Atollo project it is best understood not as an academic framework but as a design discipline: a way of deciding what to put on the screen, and, more importantly, what to leave off.

For learners with special educational needs, this balance is especially delicate. These learners frequently have a smaller margin of working-memory capacity to begin with, which means that complexity which a typically developing child might absorb without noticing can, for them, consume the resources that the learning itself requires. The implication for design is direct. Complexity that does not serve the learning goal is not neutral; it actively competes with learning. A cluttered layout, an instruction that contains more words than necessary, a navigation step that moves unpredictably - each of these spends a portion of the learner's attention that can no longer be spent on the mathematics.

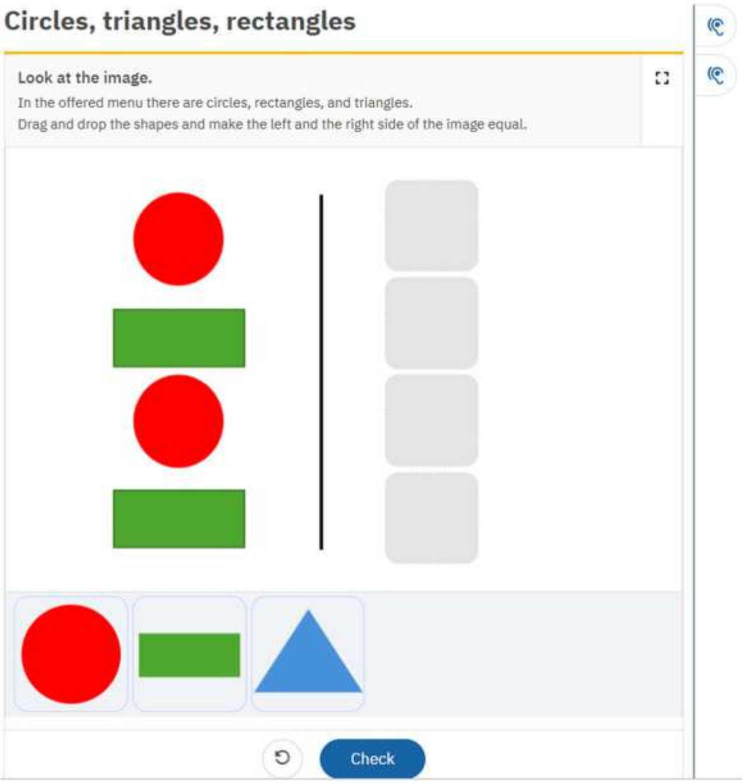
It is useful to distinguish between the load that belongs to the task and the load that the design adds on top of it. Some difficulty is intrinsic: comparing two quantities or grasping place value is genuinely demanding, and that difficulty is the point of the activity. Other difficulty is extraneous: it comes from how the task is presented rather than from the task itself, and it carries no educational benefit. This distinction between intrinsic and extraneous load, and the principle that instructional design should minimise the extraneous portion, is central to later formulations of the theory (Sweller, van Merriënboer, & Paas, 1998). The goal of good inclusive design is not to remove all difficulty - that would empty the activity of its purpose - but to remove the extraneous portion so that the learner's limited resources are spent where they matter. The revision work carried out in deliverable D4.3, in which text load was consistently reduced and visual layouts were simplified on the basis of pilot feedback, is in effect a sustained exercise in stripping away extraneous load.

Visual clutter competes with attention

The most immediate source of extraneous load is the visual field itself. When a screen presents many elements of similar prominence, the learner must first search and filter before any thinking about the content can begin. Decorative details, inconsistent illustration styles, items packed closely together, and visual structures that have to be parsed (such as a dividing line that separates two halves of a task) all add to this search cost. During piloting, teachers repeatedly reported that learners hesitated or disengaged not because the underlying concept was beyond them, but because the screen gave them too much to take in at once. The recommended remedy was consistent across units: fewer items, more space between them, a calmer and more uniform visual style, and a layout that follows the direction in which children are used to working.

Example

In the comparison task shown below, learners are asked to drag shapes so that the left and right sides match. The activity stacks several figures vertically, separates them with a dividing line, and adds a separate tray of draggable shapes at the bottom - so before any comparison is made, the learner must scan a dense field and hold several relationships in mind at once. Pilot feedback recommended reducing the number of figures to no more than three in a row and arranging them horizontally, from left to right, the direction in which children are accustomed to working on paper. The simplified version lowers the search cost and frees attention for the comparison itself, which is the actual learning goal.



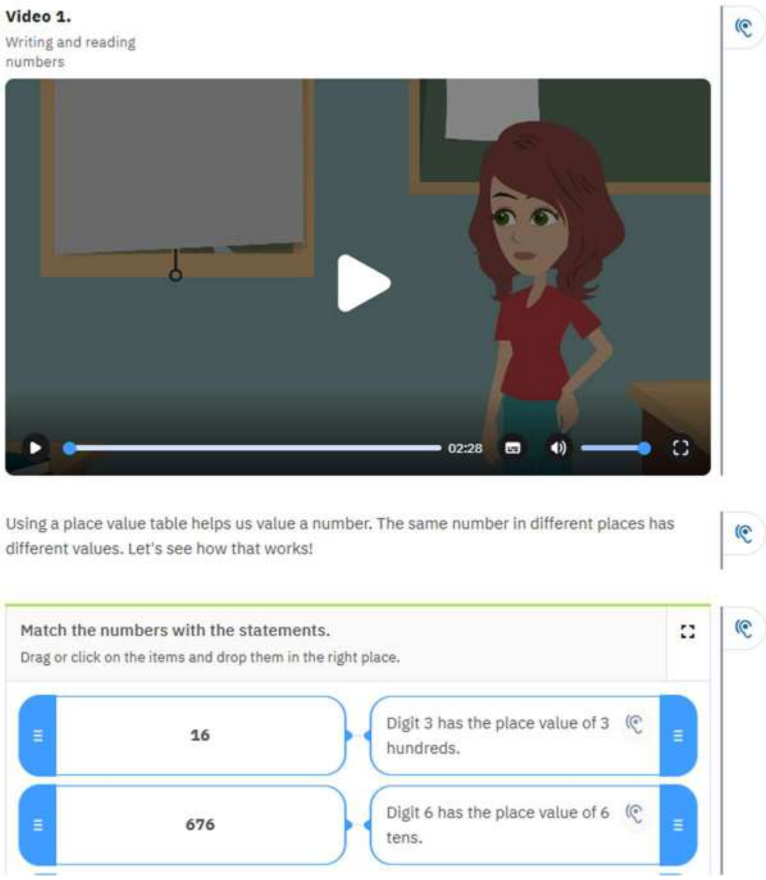
A visually dense comparison task; pilot feedback recommended fewer figures and a horizontal layout (Level 1 - Comparing Numbers).

Text load and the cost of decoding instructions

A second, easily overlooked source of load is language. Every word in an instruction or answer option must be decoded before it can be used, and for learners who read slowly, or who do not yet read independently, this decoding can consume most of the available capacity before the mathematics is even reached. Long instructions, answer options phrased as full sentences, and wording that does not match the picture all raise the cost of simply understanding what is being asked. The principle that emerged from the pilot is to reduce text to the minimum the task genuinely needs, to phrase what remains as plainly as possible, and - wherever feasible - to offer the same information through an additional channel, such as an audio reading of the instruction, so that decoding the text is not the only route into the task. This echoes research on multimedia learning, which finds that presenting information through complementary verbal and visual channels can support understanding more effectively than words alone (Mayer, 2009), and the Universal Design for Learning principle of providing multiple means of representation (CAST, 2018).

Example

The place-value matching task below illustrates the cost of text load. Learners must connect each number to a sentence describing the place value of its digits, and the answer options are themselves full sentences containing several near-identical phrases. Pilot feedback noted that the volume of text made the relationships hard to grasp and that learners struggled when the same digit appeared across more than one option. Pairing the task with a short video and a brief plain-language explanation, and trimming the wording of the options, lowers the decoding cost so that the learner's attention reaches the underlying idea of place value.



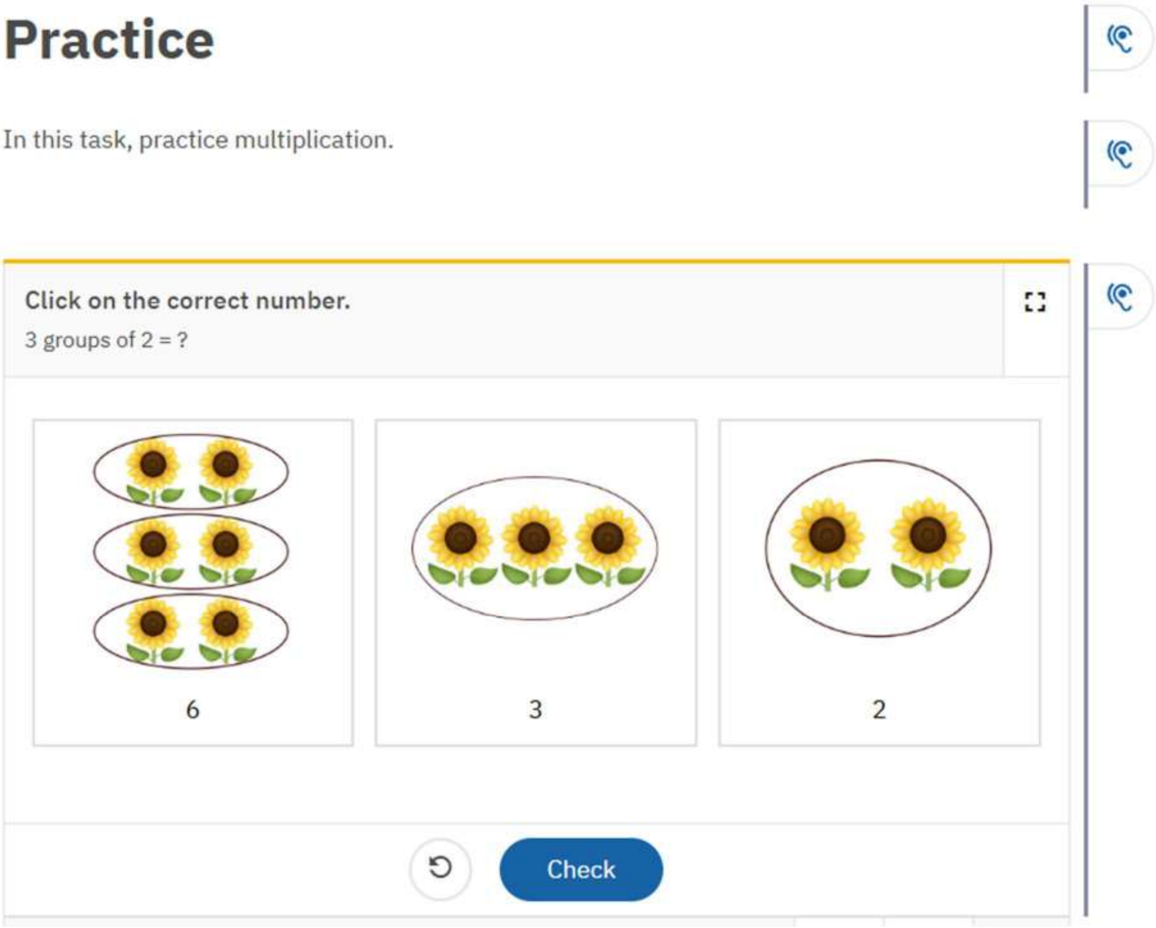
A text-heavy matching task supported by video and a short explanation to reduce decoding load (Level 4 - Numbers).

Managing the difficulty that belongs to the task

Not all load can or should be removed. The difficulty inherent in a concept - recognising that three groups of two make six, for example - is the substance of the activity, and the designer's task is to manage it rather than eliminate it; in cognitive load terms this intrinsic load is determined by the complexity of the material itself and the learner's prior knowledge (Sweller, van Merriënboer, & Paas, 1998). The most effective way to do this is to keep everything around the core idea as simple as possible, so that the only real demand the activity makes is the demand the learning requires. Clear, uniform pictures, generous spacing, a small number of options, and the removal of any visual element that does not carry meaning all serve this purpose. When the presentation is calm and predictable, the intrinsic difficulty of the concept stands on its own and becomes something the learner can work through.

Example

In the multiplication practice task below, learners click the option that shows the correct total for "three groups of two." The concept itself carries real difficulty, so the presentation is kept deliberately plain: the same simple sunflower image is repeated, the three options are clearly separated, and there is nothing decorative to distract from the count. Pilot feedback on similar tasks recommended exactly this - smaller, uniform pictures with clear spacing - so that the only demand on the learner is the one the activity is designed to teach. Here the design manages intrinsic load instead of adding to it.



A multiplication task that keeps presentation simple so that intrinsic difficulty stands alone (Level 1 - Multiplication and Division).

Practical takeaways

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For teachers and content developers, cognitive load is most useful as a short set of questions to ask of any activity before it reaches a learner. Each question targets a form of load that the Atollo pilot showed to be common and avoidable:

- Visual load: Is every element on the screen necessary? Could anything be removed, enlarged, or given more space without losing meaning?
- Text load: Is the instruction as short and plain as it can be? Are answer options phrased simply, and is the same information available through audio or images for learners who do not read independently?
- Navigation load: Does the activity stay still and behave predictably, so that the learner never has to spend attention re-finding their place?
- Intrinsic load: Is the genuine difficulty of the concept clearly visible, rather than buried under presentation that competes with it?

Used together, these questions turn cognitive load theory into an everyday design habit. The consistent direction of the D4.3 revisions - less text, simpler layouts, calmer screens - is the practical expression of a single idea: that the resources a learner brings to an activity are finite, and that good inclusive design spends them on learning rather than on decoding the design itself.

3.3 Readability and language simplicity

Sentence Structure and Vocabulary Control
Sentences should be short and carry one idea each. Research confirms that sentence density is one of the strongest negative predictors of comprehension for learners with cognitive and language difficulties: the more propositions a learner must hold in memory simultaneously, the harder it becomes to draw connections between them (González-Leiva et al., 2012). Vocabulary choice matters equally — an eye-tracking study found that high-frequency words improved reading speed and shorter words improved comprehension in learners with dyslexia, while no such effects were observed in the control group (Rello et al., 2013). In practice, this means choosing common, everyday words wherever possible; when technical terms are unavoidable, they must be defined immediately. Metaphors and idioms should be avoided, particularly given the six-language scope of the Atollo materials, where expressions transparent in one language may become unclear or misleading in translation.

Consistency in Terminology
Once a term is chosen for a specific concept, it should be used consistently throughout the material. Switching between synonyms creates unnecessary confusion for learners with SEN, who may not readily recognise that two different words refer to the same thing. Consistency makes materials easier to follow and helps many learners with SEN feel more confident when engaging with the content.

Active Voice and Cross-Linguistic Clarity
Active voice constructions make the actor and action explicit, reducing effort for learners with language processing or cognitive difficulties. This is especially important in a multilingual project such as Atollo, where passive constructions may be interpreted differently across languages or sound unnatural in translation. Using active voice helps learners understand content more easily and supports consistency across language versions.

3.4 Visual design principles

In educational contexts, visual design is often mischaracterised as merely cosmetic. However, for learners with Special Educational Needs (SEN), visual adaptations are essential for comprehension. Cognitive, neurodivergent, and sensory differences affect how information is processed. Therefore, structured visual adaptation is necessary for learners with diverse learning needs. All learning materials, both printed and digital, must be adapted to be accessible to all learners. Visual adaptations required for learners with SEN may also benefit other learners. This is why universal design is frequently discussed in relation to accessibility. Although each learner with SEN has different visual needs, some basic principles support understanding of visual content for everyone. In this chapter, we explain the most common principles.

Size is crucial for recognising different visual elements (symbols, icons, pictures, etc.). For a neurotypical learner, a small button may be a minor inconvenience. However, for a learner with visual impairment, it can significantly affect their ability to see and recognise content. Additionally, for learners with physical or processing challenges, clicking a small target may be impossible. Therefore, all content must be large enough, or, in the case of web content, it must be possible to increase the size of that content.

Contrast is the foundational mechanism that enables a learner to distinguish figure from background. For individuals with decreased contrast sensitivity (such as those with low vision, colour vision deficiencies, or processing differences including dyslexia and cerebral visual impairment), low contrast causes visual fatigue and an inability to recognise content. Furthermore, using high contrast strategically draws immediate attention to critical data points, keywords, or instruction blocks. Thus, it supports learners with attention disorders and/or intellectual disabilities. Conversely, poor contrast forces the brain to expend excessive energy on basic visual decoding, leaving fewer cognitive resources available for comprehension and working memory tasks. Inclusive design requires a high contrast ratio between text and its background.

Colour may be used to increase contrast, but also to enhance the recognition of small details. Additionally, colour can highlight important points in the content and attract attention to them. Colour can also be used to separate or connect different concepts throughout the text, making it easier to follow and comprehend.

Visual crowding, that is, a cluttered visual scene, is exceptionally difficult to comprehend for learners with ADHD, autism spectrum conditions, and processing disorders such as cerebral visual impairment. Therefore, increasing line spacing, letter spacing, and paragraph margins prevents text blocks from overlapping. Generous margins and padding around interactive elements or distinct sections isolate information, allowing the eyes to navigate the page without tracking errors. Intentionally embedded blank space can effectively reduce peripheral distractions and allow the learner to focus on one discrete task at a time.

Many learners with SEN often struggle with executive functioning, particularly in prioritising information and determining where to begin a task. **Visual hierarchy** provides an intuitive, self-explanatory roadmap of the page. Through systematic use of size, weight, and structural positioning, a clear hierarchy immediately indicates what is most important.

As many SEN learners benefit from routines, they require predictability, which fosters autonomy. **Consistency** across layouts – such as instructional icons, navigation buttons, and page numbers – minimises the need for contextual adaptation.

When providing visual hierarchy and highlighting important content, many authors use different fonts, font sizes, and other features. However, it is important to remember that some fonts are easier to read than others. For example, a dyslexia-friendly **font** will be easier for learners with dyslexia, while serif fonts may be impossible to read for learners with visual impairment. Additionally, italic and underlined letters are difficult to read for learners with visual impairment. Therefore, **bold letters** are preferred for emphasis (Alimović, 2023). Some authors use circles or boxes around content, but as with underlined letters, this can reduce the ability to recognise the content if the frame is too close. Thus, frame lines must be far enough from the content for the learner to recognise it.

When visual design is treated as a core pedagogical tool, it enables access to the learning environment. By rigorously applying size, contrast, colours, spacing, hierarchy, consistency, and easy-to-read fonts and styles, design directly counteracts barriers to executive functioning and sensory processing.

3.5 Multimodal learning approaches

Multimodal design for learning involves the intentional integration of text, audio, video, images, and interactive elements, and is central to inclusive digital education, particularly for children with complex educational needs. Learners with diverse neurodivergent profiles, sensory processing differences, or cognitive disabilities do not interact with digital content in the same way. Years of using Learning Media Assessment in practice indicate that learners use different sensory channels for different tasks. For example, a learner may use vision as the primary sensory channel for one task and hearing for another. Furthermore, even learners with low vision may primarily use vision rather than hearing or touch for certain tasks. Multimodality acknowledges that learners process information differently and have varying accessibility needs. Multiple pathways allow learners to access information through their most reliable and comfortable processing channels, thereby supporting comprehension.

However, regarding accessibility and learning, the true effectiveness of multimodal learning depends not on the number of media used, but on the strategic balance and pairing of those channels with the specific educational content. As the human brain processes visual and auditory information through separate streams that integrate in the brain, a digital module that combines text, audio recordings, video demonstrations, and interactive activities creates a robust framework for deeper understanding. This combination ensures that, whether a learner relies on vision or auditory processing, the core learning objective remains fully accessible. For children with complex educational needs, combining text with high-quality audio recordings and descriptive videos creates a layered learning experience. A child who struggles to decode written language can rely on a synchronised audio track, while a learner with auditory processing delays can anchor their understanding in visual animations and video modelling.

However, designing for learners with complex educational needs requires balance. Not every media channel suits every type of content, and over-stimulation may be a risk for these learners. For them, content must be presented in the clearest possible modality. The choice of media must respect the learner's energy limits, ensuring that the technology accommodates the child rather than requiring the child to adapt to the technology.

Learners with complex educational needs usually experience fatigue much earlier than their typical peers. To avoid over-stimulation and fatigue when creating multimodal content, we must balance useful redundancy and cognitive overload. Useful redundancy occurs when channels support one another, for example, when a clear visual icon is paired with a clearly spoken word. This reinforces meaning without overwhelming the brain. Cognitive overload, on the other hand, occurs when many stimuli compete for attention. Attracting a child’s focus to multiple elements – such as an active video, text, moving background animations, and an audio track simultaneously – can trigger sensory overload, leading to distress and reduced ability to learn. Therefore, multimodal design must prioritise simplicity and intent: media channels must work together to clarify a single concept, eliminating any unnecessary noise that threatens the learner’s path to successful learning.

3.6 Interaction design

Predictability and Consistency

Interactive elements, such as navigation and action buttons, must appear in consistent positions and behave predictably throughout a module. Consistency helps learners focus on learning instead of searching for controls or working out what to do next. In the Atollo IZZI platform, for example, the "Check" button is consistently placed at the bottom of the task area, providing a reliable anchor for learners to finalise their activities.

Reducing Physical and Interpretive Demand

Inclusive interaction design requires offering alternative pathways for task completion and avoiding unnecessary physical or time-based pressure. Actions that require sustained physical input, such as drag-and-drop, can be difficult for learners with motor difficulties. In the Atollo materials, a click-based alternative allows the same task to be completed using simple clicks instead of continuous dragging. Similarly, time-constrained tasks should be avoided, as they can create pressure and disadvantage learners with slower processing speed or those using assistive technology. Providing a pressure-free environment allows learners with SEN to engage with content at their own pace. All interactions should also be operable through multiple input methods, including mouse, touchscreen, and keyboard.

Clear and Descriptive Labelling

Every clickable element should carry a specific, descriptive label — such as "Check" or "Listen" — rather than a generic "Click here". Clear labels, combined with the immediate result provided by the "Check" button, help learners with SEN understand the purpose of an interaction and verify their work independently, which is crucial for fostering autonomy in digital environments.

3.7 Navigation and usability

Accessible navigation and a high level of usability in digital content are fundamental components of inclusive education for learners with disabilities. Flexible navigation and usability provide several benefits, such as enhancing learners' engagement, improving their performance, and reducing cognitive demands, all of which are important for learners with disabilities.

Contemporary literature and the development of various digital contents focus on applying the principles of Universal Design. Since the early 2000s, the Design for All approach has influenced the development of accessible and inclusive digital environments created today. Predictable, clear navigation, as a form of cognitive scaffolding, is also grounded in the principles of Universal Design. Usability refers to the effectiveness, efficiency, and satisfaction experienced with the content. When navigating digital content, learners with disabilities should be able to achieve their goals easily, complete tasks with minimal effort, and be satisfied with the experience.

When applying the idea of Design for All, the structure of learning pages should be consistent, multiple navigation options should be available, and the presentation of content should be adaptable. In the context of Universal Design for Learning, navigation and usability are integral to its framework, which emphasises multiple means of content representation, varying levels of engagement, and diverse ways of acting. Learners with intellectual disabilities benefit from content with a simple structure, predictable navigation, clear instructions, and well-organised material. The World Wide Web Consortium (WCAG) is based on principles that support accessibility, navigation, and usability. In practice, when navigation and usability are appropriately addressed, learners should be able to access content in various formats, understand tasks and instructions, navigate smoothly through content, and engage with learning through multiple options. Taking all these aspects into consideration within Atollo digital content will reduce anxiety and increase learners' autonomy.

Effective digital learning environments provide clear navigation, intuitive interfaces, compatibility with assistive technologies, and flexible ways to access and interact with content. By applying all mentioned principles of Universal Design, Universal Design for Learning authors can create digital learning environments that support accessibility, equal participation, and meaningful learning opportunities for all learners.

3.8 Accessibility features in digital materials

Accessibility features should be embedded in digital materials from the earliest design stage rather than added retrospectively. Each feature should respond to a clearly identified barrier and should support learners in perceiving, understanding, navigating and interacting with the material. Accessibility is therefore not a separate technical layer. It is part of the pedagogical and functional quality of the resource.

Text and visual content should remain readable when enlarged and should use sufficient contrast, clear spacing and a consistent visual hierarchy. Information should not be communicated through colour alone. Meaningful images should include alternative text that communicates their educational purpose, while images that are purely decorative should be marked as decorative. Visual elements should support the learning objective rather than compete for attention.

Audio and video should be under the user's control. Learners should be able to start, pause, repeat and stop media content. Spoken information should be accompanied by accurate captions or a transcript where appropriate, while important visual information in video should be explained through narration or an alternative description. Audio support can reduce dependence on written decoding, but it should complement rather than unnecessarily duplicate or overload the visual content.

Interaction should be possible without unnecessary demands on speed, memory or fine motor precision. Buttons and other interactive targets should be sufficiently large, clearly labelled and placed consistently. Alternatives should be provided for interaction patterns such as drag-and-drop where these may create motor barriers. Tasks should avoid unnecessary time limits, and feedback should explain what has happened and what the learner can do next. Keyboard access and compatibility with commonly used assistive technologies should be considered and tested wherever technically applicable.

Accessibility features should also remain flexible. A feature that supports one learner may distract or disadvantage another. Audio, animation and visual supports should therefore be adjustable, and teachers should be able to select or activate the options that match the learner's needs. The aim is not to use every available feature simultaneously, but to offer appropriate routes into the same learning objective.

The Atollo IZZI materials illustrate this approach through structured layouts, adjustable display options, audio support, clear interaction controls, differentiated learning levels and teacher-mediated use. These features are most effective when combined with professional judgement. Teachers still need to preview the material, select an appropriate level, adjust settings and observe whether the learner's difficulty relates to the learning objective or to the way in which the task is presented.

Accessibility testing should form part of regular quality assurance. Automated tools can identify some technical problems, but they cannot determine whether instructions are understandable, whether feedback is meaningful or whether a learner can complete a task successfully. Review by developers, accessibility specialists, teachers and users therefore provides the strongest basis for identifying and removing barriers.

3.9 Differentiation and adaptability

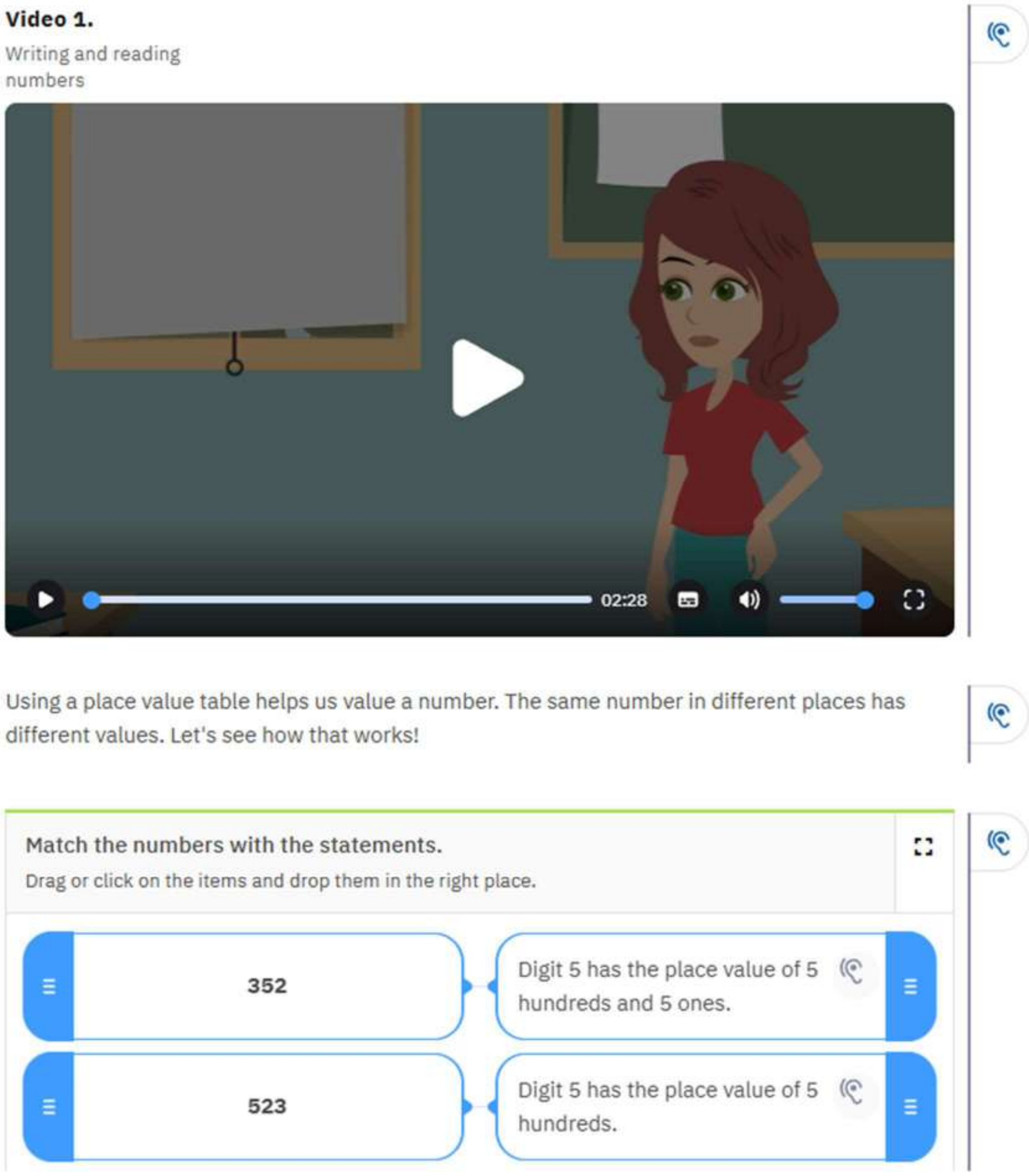
A single kind of learner rarely uses a single set of digital materials. In inclusive classrooms, the same unit may be opened by a student who reads fluently and by one who does not read at all, by a learner who grasps a concept after one example and by one who needs the same idea presented several times in slightly different ways, and by children whose sensory or motor profiles shape how they can interact with a screen at all. Differentiation is the structural principle that allows one set of materials to serve this heterogeneity without fragmenting into a separate product for every learner. In Tomlinson's account, differentiation means proactively adjusting content, process, and product in response to learners' readiness, interests, and learning profiles, rather than treating a single version of a task as adequate for everyone (Tomlinson, 2017). It is therefore not an add-on or a special-case feature; it is a property of how the materials are organised, and it has to be planned from the outset.

In the Atollo model, differentiation is built in through three connected mechanisms. The first is a progression of four learning levels, so that the same mathematical domain is available at different degrees of complexity and a teacher can place a learner at the level that matches their current understanding rather than their age or grade. The second is flexible activity selection: within a level, individual activities can be chosen, reordered, or skipped, so the path through a unit is not fixed. The third is the possibility of partial use - a teacher need not use a whole unit to benefit from it but can draw on a single activity or a short sequence that fits the lesson and the learner in front of them. Together these mechanisms turn a fixed body of content into something a teacher can shape.

The principle generalises well beyond Atollo. Any digital educational materials project that intends to be inclusive needs a comparable structure: graded levels of difficulty so that content is not all-or-nothing, modular activities that can be recombined, and the freedom to use parts rather than wholes. What follows sets out the specific design choices that make such a structure work for the groups of learners who are most often underserved - non-readers and emerging readers, learners with complex cognitive support needs, learners with sensory or attention differences, and learners with fine-motor or interaction difficulties - and the assistive-technology features that underpin all of them. The framework that most directly informs this approach is Universal Design for Learning, which calls for multiple means of representation, engagement, and action and expression so that variability among learners is anticipated in the design rather than retrofitted afterwards (CAST, 2018; Rose & Meyer, 2002).

Example

The four-level structure is the backbone of differentiation in Atollo. The same domain - for example, number and place value - appears at Level 1 as simple, image-led recognition and, several levels higher, as the more demanding place-value matching shown below at Level 4. Because the levels are explicit and selectable, a teacher can keep two learners working on the same underlying topic at the degree of complexity each can manage, rather than forcing a single version of the activity onto both. The same content, pitched at the right level, is what allows one set of materials to serve a wide spread of abilities.



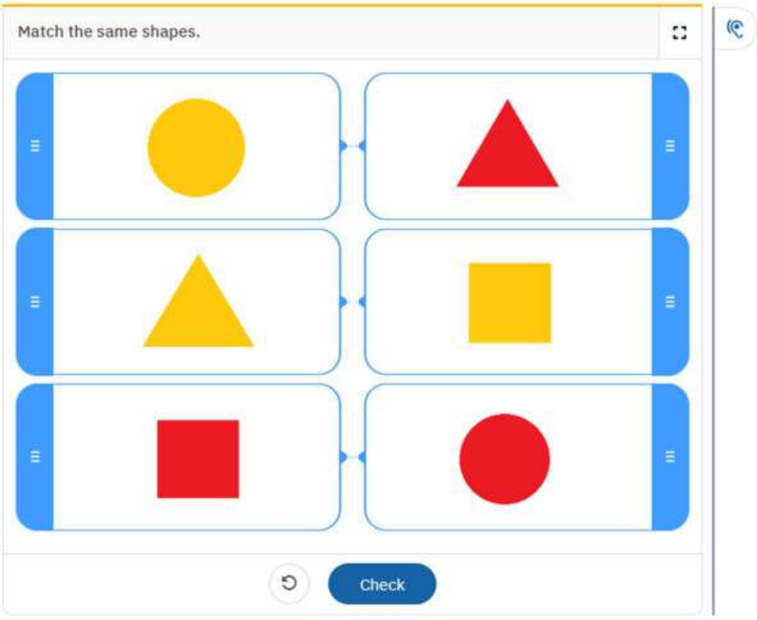
A more advanced level of the same number domain, selectable for learners ready for greater complexity (Level 4 - Numbers).

Non-readers and emerging readers

For learners who do not yet read, or who read slowly and with effort, written text is a barrier rather than a route into the task. The design response is to ensure that no activity depends on reading alone. Instructions and content should be available as audio, through a read-aloud function that voices the text on demand; icons and consistent symbols should carry meaning that would otherwise sit in words; and any text that remains should be short, plain, and predictable in its phrasing. Where a concept can be presented through a picture or a recognisable symbol rather than a sentence, it should be. This reflects the UDL principle of offering multiple means of representation, including alternatives to text such as audio and graphics, so that the mode of presentation does not itself become the barrier (CAST, 2018). The aim is that a learner who cannot read the instruction can still understand what the task asks and complete it independently.

Example

The shape-matching task below carries almost no reading demand. Beyond a short, repeatable instruction, the entire task is expressed through icons - the learner matches a shape on the left to the same shape on the right - so a non-reader can grasp and complete it without decoding any sentence. Pairing such visual tasks with a read-aloud function for the instruction, and using the same consistent symbols throughout, ensures that emerging readers are not excluded from content they are otherwise fully able to do.



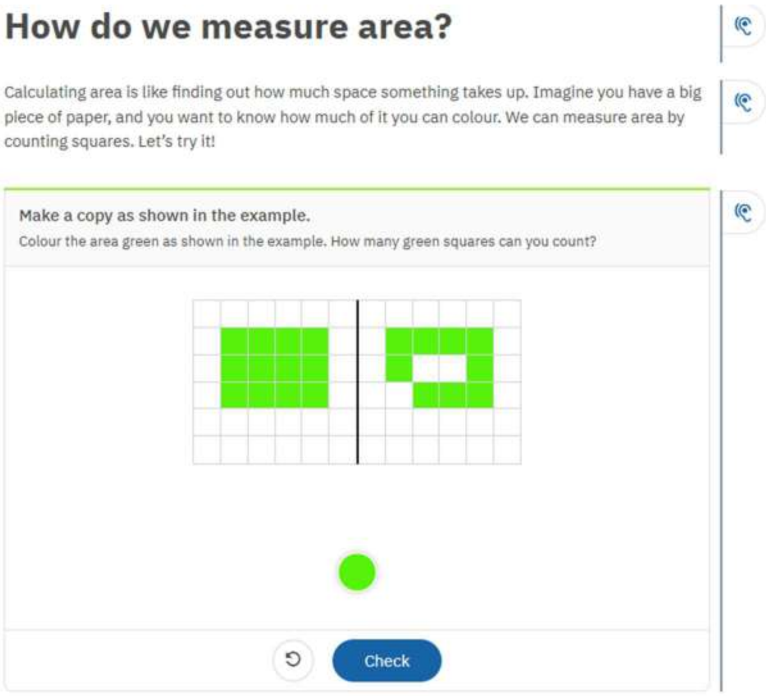
An icon-based matching task that does not depend on reading (Level 1 – I solve problems).

Learners with cognitive and developmental difficulties

Learners with complex cognitive support needs benefit most from activities that are broken into small, clearly bounded steps, that repeat a pattern so it can become familiar, and that present a stable and predictable structure from one task to the next. Visual clutter is particularly costly for this group, because effort spent interpreting the layout is effort taken from the concept itself. The design response is to give each activity one clear step at a time, to reuse the same structure across activities so that learning the interface is a one-time cost, and to remove anything on the screen that does not directly serve the task. Predictability here is not a stylistic preference but a support: when the structure is known, the learner can devote attention to the new content rather than to the activity's mechanics.

Example

The area task below shows a predictable, repeatable structure: a clearly bounded grid, a worked example to copy, and a single "Check" button always in the same place. The activity asks for one thing - reproduce the coloured pattern - and presents it without decorative distraction. Because this same layout recurs across the unit, a learner who has done one such task already knows how the next one works and can spend their effort on the area concept rather than on relearning the interface each time.



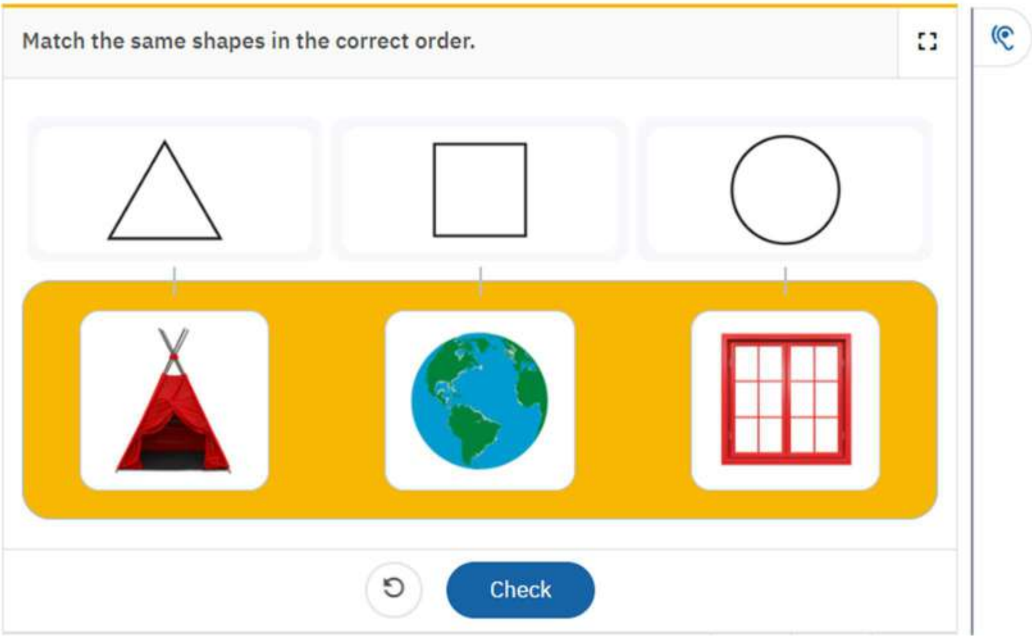
A clearly bounded, repeatable task structure that supports learners who need predictability (Level 4 - Measurement).

Sensory and attention considerations

Some learners are easily overloaded by sensory input or find it hard to sustain attention in a busy visual field. For them, design choices that other learners might not notice become decisive. Distractions should be limited, so that the screen holds only what the task needs; pacing should be adjustable, so that nothing moves or advances faster than the learner can follow; contrasts should be clear, so that the relevant elements stand out distinctly from the background and from one another; and overload - too many colours, too much movement, sound that serves no purpose - should be avoided. During piloting, learners were observed to disengage when colours were too similar to be told apart, or when unnecessary sound prompted them to cover their ears. The corrective is consistent: a calmer screen, stronger contrast, and control over pace. These choices also align with established web-accessibility standards, which set out testable requirements for sufficient colour contrast and for giving users control over moving or time-based content (W3C, 2018).

Example

The shape-recognition task below uses strong, deliberate contrast: clear black outlines for the abstract shapes and a saturated background tray that sets the real-world images distinctly apart from the shapes they match. The field is uncluttered - three shapes, three images, nothing extraneous - so a learner who is easily overloaded is not asked to filter noise before working. Keeping contrast clear and the visual field sparse is precisely the adjustment that makes such a task accessible to learners with sensory or attention differences.



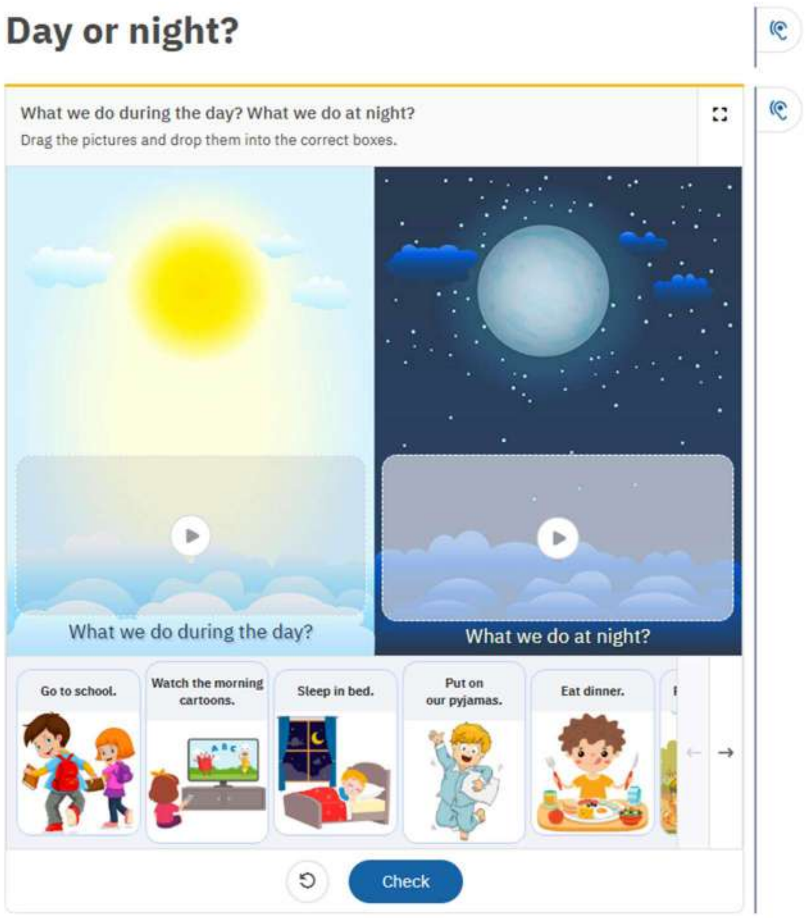
Clear contrast and an uncluttered field reduce sensory load (Level 1 - Geometry).

Fine-motor and interaction challenges

For learners with fine-motor difficulties, the physical act of interacting with the activity can be a greater obstacle than the content. Small targets, precise dragging, and interactions that punish slight inaccuracy all raise this barrier. The design response is to make clickable and draggable areas large and forgiving, to provide drop zones that are big and clearly delineated rather than pixel-precise, and to support alternatives to fine pointer control - including keyboard navigation, so that an activity can be completed without a mouse, and other input methods where available. When the interaction itself is undemanding, the learner's effort goes into the task rather than into fighting the interface.

Example

The day-and-night sorting task below is built around large, forgiving interaction. The two drop zones occupy a substantial part of the screen and are clearly delineated, so a learner does not need pixel-precise control to place an item correctly, and the draggable images are themselves large. This is exactly the adjustment that helps learners with fine-motor difficulties: generous targets and clearly bounded drop areas, ideally complemented by keyboard or alternative-input routes so that the activity does not depend on precise dragging alone.



Large, clearly delineated drop zones lower the motor demand of the interaction (Level 1 - Measurement).

Assistive technologies and accessibility features

The differentiation choices above are most effective when they are underpinned by a layer of assistive-technology support and verified through testing. The features below correspond closely to the requirements of recognised accessibility standards, which call for text alternatives, captions for audio and video, full keyboard operability, and compatibility with assistive technologies (W3C, 2018). Several features matter across all the groups discussed:

- Screen readers: content and controls should be structured and labelled so that a screen reader can convey them accurately to a learner who is blind or has low vision.
- Speech-to-text: where a learner is asked to produce input, a speech-to-text option allows those who cannot type easily to respond by voice.
- Captions: any audio or video should be captioned, so that learners who are deaf or hard of hearing have full access to the same information.
- Keyboard-only navigation: every activity should be completable using the keyboard alone, without reliance on a mouse or precise pointer control.
- Compatibility testing: accessibility should be verified in practice - across the devices, browsers, and assistive tools that learners use - rather than assumed from the design.

Taken together, levels and flexible selection, group-specific design choices, and a foundation of assistive technology turn a single set of materials into something genuinely adaptable. The lesson from the Atollo pilot is that adaptability is not achieved by building many versions of an activity, but by designing one activity that bends to the learner - through the level it is pitched at, the channels it offers, the size of its targets, and the assistive tools it supports. Differentiation, designed in from the start, is what lets inclusive digital materials reach the full range of learners they are meant to serve.

3.10 Learner engagement strategies

In the field of special education and digital instructional design, engagement is often misinterpreted as an intrinsic personality trait. However, within inclusive digital learning, learner engagement is more accurately achieved as a deliberate design outcome. For learners with complex educational needs, engagement is rarely spontaneous; they must be systematically encouraged to interact with the digital materials. Therefore, teachers must create environments that capture attention. The use of motivating materials and evidence-based strategies can stimulate curiosity and sustain motivation. This proactive design is demonstrated by empirical data from the recent Atollo pilot study, where the intentional implementation of IZZI digital materials consistently generated high levels of learner motivation and curiosity, even among learners with complex educational needs.

To make engagement a predictable outcome, digital materials must first establish an appropriate challenge level, in accordance with the "Zone of Proximal Development" (Vygotsky, 1978). For learners with complex educational needs, materials must break down complex tasks into smaller units that offer a high probability of success while gradually increasing complexity. When the challenge level matches the learner's current cognitive or physical capacity, it triggers a state of flow, reducing the task-avoidance behaviours that often arise when a learner feels overwhelmed or under-stimulated. Therefore, materials must be designed to keep the learner in the optimal biobehavioural state for learning (Nelson et al., 2002). Digital materials must provide real-time, multisensory reinforcement. For learners with complex educational needs, delayed feedback loses its pedagogical value. Hence, materials must integrate meaningful, immediate feedback loops. Meaningful feedback should be informative, gently guiding the learner towards the correct response through visual or auditory cues.

Furthermore, introducing structured opportunities for choice within the digital environment gives these learners a sense of autonomy. Complex educational needs can often leave learners feeling a lack of control over their physical and educational environments. Allowing a learner to select their own learning path, choose a theme, or decide whether to engage with a concept using an audio track or an interactive game fosters intrinsic motivation. Autonomy counteracts learned helplessness, which is common in learners with complex educational needs, by transforming passive consumption of media into an active, self-directed educational experience.

To ensure these choices feel purposeful, the content must be relevant, motivating, and meaningful to the learner. Abstract concepts should be anchored in familiar, real-world contexts, such as daily routines, community spaces, or highly specific personal interests common among learners. When digital content introduces familiar scenarios, the cognitive load required to understand the context is minimised, allowing the child to dedicate their full cognitive energy to learning and mastering the tasks.

Finally, results from the Atollo pilot reveal the value of reasonable use of gamification elements. Inclusive gamification embedded in the learning task increases learners' motivation and supports the learning process. Progress bars, motivating visual elements, and interactive problem-solving narratives serve the educational objective rather than distract from it. As evidenced by the IZZI materials in the Atollo pilot, when gamification is applied with restraint and purpose, it does not merely entertain; it sparks a learner's curiosity.

The Atollo pilot corroborates the existing literature and demonstrates that combining calibrated challenges, autonomous choices, real-world relevance, and immediate feedback successfully construct an environment that increases learners' engagement and provides the foundation for active learning.

3.11 Translating pilot experience into design principles

This closing section brings the theoretical design into direct contact with the evidence gathered during the Atollo pilot. The development of the Atollo materials did not occur in isolation; rather, it relied on a rigorous, iterative feedback cycle: pilot – evaluate – revise – finalise. By analysing how learners with complex educational needs interacted with the initial digital content, the project team identified challenges and implemented concrete, data-driven modifications. Furthermore, this alignment was evaluated against the theoretical principles of education for learners with complex educational need.

As one of the principles for encouraging learning is the use of **learner-centred design**, the digital material was created accordingly. The Atollo pilot confirmed that the content motivated learners to engage actively. Most learners were independent in solving the tasks; however, some learners with most complex educational needs required additional support from the teacher. Nevertheless, even with teacher support, learners interacted with the digital content.

When creating the content, **cognitive load** was a key consideration, especially because the material was designed for learners with complex educational needs. The pilot showed that it was too difficult for some learners to use an entire digital unit at once. Therefore, teachers used one task at a time. When teachers noticed that some videos were too long for a learner to watch attentively, they used only selected parts of the videos. In this way, they reduced cognitive overload for the learner, in accordance with their learning abilities.

The **language** used in the digital units had to be simple and easy to read. As learners with complex educational needs struggle with longer words and abstract sentences, during the pilot phase teachers recommended using shorter phrases and even simpler language. Therefore, some words and sentences were changed after the pilot phase.

As **visual design** is essential for comprehension, much attention was given to it during the creation phase. Nevertheless, during the pilot phase teachers noticed that some pictures were cluttered, containing unnecessary details. Therefore, those pictures had to be replaced with simpler ones, featuring bright colours and high contrast.

According to testimonials from the pilot phase, learners benefited from the **multimodal approach**, which combined visual and auditory channels. Although some learners had difficulty with sensory integration and comprehending more than one sensory channel at once, it was decided after further revision to keep multimodality in the digital units, since teachers can exclude some features and use only one modality when operating the units.

The pilot phase revealed that learners faced the most challenges with **interaction design**. Although the content was easy to use, many learners had fine motor skills problems. Therefore, some interaction types, especially dragging or precise selecting, were difficult for some learners. Some teachers noticed that it was easier for these learners to use a touch screen on a tablet than to use a mouse with a laptop.

Since **accessibility** features were embedded in all digital unit content, during the pilot phase no issues with accessibility were found.

The created digital content has proved to be flexible, meaning the content is suitable for **differentiation and adaptability**. Teachers adapted the content to each learner individually, in accordance with their learning abilities, as well as their sensory, communication, and motor abilities, and their overall functioning. Therefore, they used only some parts of the units with certain learners, provided additional support, and used different digital devices, etc.

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Evaluation of the digital content revealed that learners were **engaged**, very active, and motivated while using the Atollo digital content. This shows that the digital units used good strategies to engage learners through different games, interactive tasks, real-life examples, etc.

4. Implementing Digital Materials in Educational Practice

Inclusive digital materials only become meaningful when they are used well in practice. Even the most carefully designed resource can have very different effects depending on how it is introduced, how the classroom is organised, how learners are supported, and how teachers connect the digital activity to broader learning goals. This chapter therefore moves from the design principles presented in Chapter 3 to the practical conditions that shape implementation in real classrooms. The focus of the chapter is on the everyday pedagogical decisions that teachers, teaching assistants, support staff and families make when working with digital materials for learners with special educational needs. These decisions include how to select an appropriate learning setting, how much adult support to provide, how to organise learners individually or in groups, how to combine digital and non-digital activities, and how to respond when learners show signs of fatigue, overload or disengagement. In inclusive digital education, implementation is not a technical afterthought. It is part of the pedagogy.

The Atollo pilot showed that the same digital unit could be used successfully in different ways: projected for whole-class introduction, explored in small groups, used in one-to-one adult-mediated learning, or offered as semi-independent practice. This flexibility is one of the strengths of digital materials, but it also requires professional judgement. Teachers need to consider the learning objective, the learner's support needs, the level of independence expected, the available devices, the classroom environment and the role of adults before deciding how to use a digital resource.

This chapter therefore addresses the main conditions that support effective implementation. It begins by outlining different classroom implementation settings and then discusses the roles of key actors, including teachers, teaching assistants, support staff and families. It continues with guidance on supporting learner autonomy, using blended learning approaches, managing attention and cognitive load, considering screen time and ergonomics, and organising the classroom so that learners can engage with digital materials in a predictable and accessible way. The central argument of this chapter is that inclusive digital education depends on the relationship between materials, learners and pedagogical support. Digital tools should not be used as standalone interventions or as substitutes for human interaction. They work best when they are embedded in clear routines, meaningful learning sequences, responsive adult support and inclusive classroom organisation. When these conditions are in place, digital materials can support access, engagement, independence and participation for learners with SEN. When they are absent, even high-quality materials may fail to reach their potential.

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4.1 Classroom implementation settings

Digital material advocates claim that digital materials have potentially transformative features, such as enhanced interactivity, customisation, and adaptive assessment (Choppin & Borys, 2017). Digital materials can be implemented in a variety of classroom organisational formats. The most appropriate setting depends on the learning objectives, learners' profiles (especially the type and intensity of Special Educational Needs – SEN), as well as the level of available professional or peer support. Accurately identifying the needs of learners is essential to developing effective teaching strategies that adequately address the particularities of each student (Duque et al., 2024). Selecting the right format is crucial for ensuring both accessibility and meaningful engagement. An analysis of teaching approaches and learning styles is an essential process for the teacher who wishes to develop an inclusive classroom (Marvin, 2002).

This section outlines four key classroom scenarios and describes when and how each can be used most effectively in inclusive digital education. These formats should not be seen as fixed categories, but as part of a continuum of support. Learners may move progressively from adult-mediated or small-group settings toward more independent use as their confidence and competence develop.

Whole-Class Projection
The whole-class teaching model has long been dominating global classrooms. This way of applying digital materials is best suited to learning and teaching situations where we want to introduce new concepts or terms. It is also useful when we need to build a common understanding before proceeding with task differentiation. To ensure that no learners get excluded from work, teacher must ensure that their work is valued as important part of the whole class result and that everyone is aware of the purpose of the activity and the intended outcome (Marvin, 2002). For this setting to be effective, it is necessary to take care of the satisfaction of several key conditions. First, the teacher should provide verbal explanations alongside visual input (supporting multimodal learning). It is necessary to provide opportunities for the interaction of all learners (e.g., questions, pauses, physical responses) to maintain engagement.

Possible risks of this scenario include passive engagement or cognitive overload.

Although this format ensures structure and predictability, depending on the specifics of individual learners, it will be necessary to provide additional support in the form of the use of breaks in work, repetition, the use of easy-to-understand language, visual communication symbols and other forms of visual support, support for motivation, independence in work and enabling different ways of participating in activities. The digital educational content created within the Atollo project is effective for use in this setting since it is visually clear, uncluttered, and accessible from a distance. In short, this environment requires a low level of individual support and is most effective in introducing a particular topic.

Small-Group Supported Work
In this form of work, learners work in small groups, most often with the support of a teacher or teaching assistant. The focus is on collaboration and guided practice. In a differentiated classroom, the goal is to have learners work consistently with a wide variety of peers and with tasks thoughtfully designed not only to draw on the strengths of all members of a group but also to shore up those learners' areas of need (Tomlinson, 2017, as cited in Strogilos & alt., 2023). The range of small groups commonly developed in classrooms, as classified by Galton and Williamson (1992) includes:

- seating groups, where learners sit together but are engaged in separate tasks and produce separate and often quite different outcomes;

- working groups, where learners tackle similar tasks resulting in similar outcomes, but their work is independent;
- co-operative groups, where learners have separate but related tasks resulting in a joint outcome;
- collaborative groups, where learners have the same task and work together towards a joint outcome.

This setting is most suitable for practicing skills with support, peer-assisted learning and social interaction, differentiated activities tailored to group needs and learners who benefit from shared problem-solving.

Possible risk includes dominant peers limiting participation of the demurer learners.

For this environment to be functional and efficient, it is necessary to consider some prerequisites. Roles and tasks in the group should be clearly defined and divided, so that each student has the opportunity to participate and succeed. Adult guidance should be active, but not overly directive. It is very important to enable the development of independence, provide opportunities for decision-making and negotiation in the group without excessive interference from an adult. Digital materials created within the Atollo project allow flexibility during work in small groups through adjustable pace, different levels of difficulty and feedback.

This format is particularly valuable for learners who need structured support but also benefit from peer interaction. It allows for immediate feedback, modelling, and encouragement. However, group size and composition must be managed to avoid overstimulation or imbalance in participation. This setting requires a moderate level of support and works best in the practice phase of learning.

One-to-One Adult-Mediated Learning

The accessible design of digital learning resources should ensure that no user be unduly deprived of benefiting from the resource use simply due to their needs or preferences of access (Ribeiro et al., 2011). This environment is the most common choice for teaching learners with significant or complex SEN, in situations where it is necessary to build student's confidence and reduce anxiety in learning, in targeted interventions such as strengthening communication skills or the use of assistive technology and in other situations that require high levels of individualisation. Working with individual learners should enable teachers to match their teaching as accurately as possible to each student needs (Marvin, 2002).

For this teaching scenario to be effective, it is necessary, as before, to satisfy certain prerequisites. It is essential that the adult providing support is familiar with both the digital tool and the learner's specific needs. Activities should be highly personalised in pace, content, and support level. The environment should minimise distractions and immediate feedback and encouragement are essential. It should be noted that organising the classroom to facilitate individual teaching usually involves more than one adult.

This is often the most supportive and adaptable setting. It enables scaffolding, repetition, and alternative communication methods (e.g., AAC tools, visual supports). However, it is resource-intensive and should be used strategically where the greatest impact is needed. This scenario is associated with a high level of support and is best for implementing interventions.

Semi-Independent Individual Use

This teaching method is most suitable in situations where we want to achieve reinforcement and practice of previously learned skills in learners. It is also useful when we want to develop autonomy and self-regulation or with learners who are ready for more independent engagement. It is ideal when we want to achieve differentiated learning pathways within the same classroom.

This format promotes independence but may not be suitable for all learners without prior scaffolding. The necessary prerequisites for achieving the effectiveness of this setting include instructions that are clear and available in multiple formats (visual, audio, simplified text). However, the materials created within the Atollo project meet the requirements of semi-independent individual use, as they are intuitive, accessible and user-friendly in structure. Built-in feedback and guidance support independent progress.

It must be taken into consideration that learners with executive functioning difficulties, reading challenges, or attention needs may require modified interfaces, assistive tools, or periodic adult check-ins. This scenario requires low to moderate levels of support and is useful in the reinforcement phase.

Each implementation setting offers distinct advantages and challenges. In inclusive digital education, flexibility is key: teachers should combine and adapt these formats based on learner needs, task complexity, and available support. Effective practice often involves transitioning between formats — for example, introducing content through whole-class projection, practicing in small groups, and consolidating learning through individual use.

Across all settings, the role of the adult is not only to facilitate access to digital materials but to actively mediate learning—adjusting input, prompting engagement, and monitoring understanding in real time.

The approach, of course, is not limited to choosing just one of these four scenarios. Quality teaching can also take place in a hybrid mode. For example, a lesson may begin with whole-class projection, followed by small-group practice, targeted one-to-one support for specific learners, and conclude with semi-independent digital activities.

A responsive and inclusive classroom ensures that digital materials are not only accessible, but are used in ways that maximise participation, engagement, and learning outcomes for all learners, particularly those with SEN. The pilot evidence from the Atollo project consistently showed that the same unit could work well in multiple formats and teaching scenarios.

These implementation scenarios align with the principles of Universal Design for Learning (UDL), which emphasise providing multiple means of engagement, presentation and expression. UDL applies not only to learners with SEN, rather it was conceived in order to make education accessible for learners with disabilities, but it provides learning opportunities for all learners, guiding educators in finding innovative ways to make the curriculum accessible and appropriate for learners with different learning paths, styles and learning abilities and disabilities, in different learning settings (Rose & Meyer, 2002, as cited in Ribeiro et al. 2011). Different classroom formats naturally support different UDL dimensions, helping ensure that all learners can access and participate in learning.

4.2 Roles of key actors in implementation

Effective implementation of inclusive digital materials does not depend solely on the quality of the resources themselves. It relies fundamentally on the people who use, mediate, and support these materials in different learning contexts. For learners with Special Educational Needs (SEN), success is shaped by coordinated collaboration between educators, support staff, and families. Communication encourages collaborative practices, problem-solving, active engagement in the IEP process, and promotes the sharing of best practices among professionals and families (Anderson-Butcher & Ashton, 2004).

Each group brings a distinct but complementary role. When these roles are clearly understood and effectively enacted, digital materials can become powerful tools for inclusion. But, when they are unclear or disconnected, even well-designed resources may fail to have meaningful impact.

Classroom Teachers

Teachers are key figures in the process of ensuring the effective organization of inclusive education (Shevchenko et al., 2020). Classroom teachers are the primary facilitators of learning and play a central role in embedding digital materials into everyday teaching practice. The role of teachers has changed and continues to change from being an instructor to becoming a constructor, facilitator, coach, and creator of learning environments (Amin, 2016). Their main role is to effectively integrate digital materials into lessons, aligned with learning objectives.

Other roles include the application of inclusive pedagogical approaches, such as Universal Design for Learning (UDL), by offering multiple means of representation, engagement, and expression; differentiation of the use of digital materials according to learners' needs, including pacing, level of support, and modes of interaction; monitoring of the learner engagement and progress, and adaptation of the instruction in real time and collaboration with the support staff and families to ensure continuity of learning.

However, the important role of the teacher is also to ensure that all the necessary equipment and digital resources are available to the student and that, in addition to the pedagogical, the material conditions for the efficient implementation of digital materials are met. This is why the development of digital literacy among teachers is extremely important. The reviews in this field strongly agree on the need to integrate approaches to develop digital literacy in both teacher education and teacher professional development to prepare teachers for the use of digital materials (Wohlfart & Wagner, 2023). Tondeur et al. (2012) recommend the development and maintenance of a technology plan for teacher education that considers both technical and instructional circumstances, with the goal of empowering end users.

Specific support which teachers provide consists of selecting appropriate digital tools and adapting them for accessibility; structuring tasks (e.g., breaking content into smaller steps, using visual supports); encouraging active participation and reducing barriers to access and guiding learners in developing independence in using digital materials.

Teachers have specific position in creating a safe and meaningful environment for learners with disabilities (Bjekić et al., 2014). They must apply new teaching elements and roles (active facilitation, coordination, management, tutoring, technical support, assessment and others) and become well acquainted with new technologies and the approaches that accompany them.

Teaching Assistants and Learning Support Staff

The involvement of teaching assistants (TA) in providing support to learners most often involves one of two models: TAs are either employed 'for the whole class', as a general aide or are deployed to support the inclusion of a specific pupil with SEN (Vogt et al., 2021). The role of the TA has undergone something of a transformation from the time when classroom assistants were seen as 'an extra pair of hands' in the classroom to the present day where they are perceived to have a more professional role (Groom & Rose, 2005). This has been recognised through the provision of a range of new accredited training initiatives and qualifications.

In the implementation of digital inclusive education teaching assistants (TAs) and learning support staff provide targeted support that enables learners with SEN to access and benefit from digital materials. Their role is crucial in bridging the gap between the learner and the resource.

Their engagement includes supporting learners during digital activities through prompting, modelling, and clarification, facilitating (not replacing) learner interaction with digital materials, working closely with teachers to understand learning objectives and adapt support, accordingly, encouraging independence by gradually reducing support when appropriate and providing feedback to teachers about learner progress and challenges.

Specific support they provide can also include helping learners navigate digital interfaces and use accessibility features; reinforcing instructions using alternative communication methods (visuals, gestures, AAC tools) and supporting attention, motivation, and task completion.

It is important to note here that TA is not an independent carrier of the educational process nor a substitute for comprehensive support for learners. As with teachers, it is important to create conditions for the development of digital literacy with teaching assistants. Professional development of teaching assistants is an important issue and one of the pillars of inclusive education. It is of great importance that teaching assistants in this segment are not left to their own devices since such structural negligence could easily result in negative consequences not only for learners but also for all other subjects in inclusive education.

Families and Caregivers
Families and caregivers are essential partners in inclusive digital education, particularly for learners who benefit from repetition, routine, and consolidation outside the classroom. However, teachers play a significant role in parents' decisions to become involved in their children's education (Collier et al., 2015). Parents' self-efficacy regarding digital resources is a crucial factor in encouraging their children to use digital resources effectively and accurately (Bassi et al., 2020). Piloting digital materials created within the Atollo project has shown that their implementation at home can not only serve to further develop and practice the skills of learners with SEN, but sometimes also as a joint activity for multiple members of the family, who in this way build cohesion and spend quality time together.

Effective engagement of parents / caregivers and other family members at home can serve to support learners in accessing and using digital materials at home in a consistent and structured way. The reinforcement of key concepts and skills introduced in school can happen through repetition and practice at home, as well as providing encouragement and emotional support, helping build confidence and motivation.

As always, it is of great importance for parents and caregivers to communicate regularly with teachers about progress, difficulties, and successes of their child.

Specific support that can happen at home is the establishment of routines for home learning (e.g., short, regular sessions) and generalisation of skills to everyday contexts. Parents / caregivers together with other members of household (especially siblings) can assist with technical aspects of device use where needed.

Strengthening the Home–School Connection
For learners with SEN, the connection between school and home is particularly important. Digital materials offer a unique opportunity to extend learning beyond the classroom, but only if this connection is actively supported. That is why schools must make sure to provide clear, accessible guidance for families (e.g., short instructions, video demonstrations) on how to use digital materials at home. It is important to ensure that digital platforms are user-friendly and accessible outside school.

Teachers' responsibilities also include sharing specific goals, so families understand what to reinforce, and to encourage regular, manageable engagement rather than overwhelming expectations.

In effective practice teachers design and guide learning, teaching assistants and support staff scaffold access and engagement, and families reinforce and extend learning.

The implementation of inclusive digital materials is a collaborative process. Each group—teachers, support staff, and families—plays a vital role in ensuring that learners with SEN can access, engage with, and benefit from digital education.

When roles are clearly defined, communication is strong, and support is coordinated, digital materials can move beyond being useful tools to becoming powerful enablers of inclusion. Without this shared effort, however, even the most carefully designed resources may fall short of their potential.

The Atollo project highlights that strengthening the involvement of families, alongside effective classroom practice, is key to achieving sustained and meaningful learning outcomes for learners with SEN.

4.3 Supporting learner autonomy

In the context of inclusive education, one of the main objectives is to facilitate student independence, both in academic, social and daily life aspects (Ariyani et al., 2025).

Guided by this premise, one of the central goals of the Atollo project is to support learners with SEN in developing greater autonomy in their learning. In the context of inclusive digital education, autonomy should not be understood as complete independence from adult support. In this process adults have the strategic role as facilitators and motivators. Independence therefore refers to the gradual development of learners' capacity to engage meaningfully with digital materials within a structured, supportive, and predictable environment.

This includes the ability to navigate digital content, make choices, attempt tasks, and reflect on progress, with decreasing levels of adult mediation over time. For many learners with SEN, achieving autonomy is a progressive and scaffolded process, requiring deliberate instructional strategies and consistent support. Holistic and collaborative approach, as well as individualized strategies, are key in maximising student potential (Atsnan et al., 2024).

Scaffolding is essential in supporting learners as they move from supported participation toward more independent engagement. Scaffolding means include providing advice or feedback information, asking questions, demonstrating the process of behaviour, and explaining reasons in the context of classroom (van de Pol et al., 2010).

The activities provided in scaffolding instruction are just beyond the level of what the learner can do alone (Olson & Platt, 2000). In digital learning, scaffolding should be intentional, visible, and gradually reduced over time.

Key scaffolding strategies in the implementation of Atollo digital resources include direct or explicit instructions, modelled navigation and thinking, gradual release of responsibility and the use of metacognitive prompts.

Direct or Explicit Instructions
Learners with SEN often require direct teaching of how to use digital materials, rather than being expected to "figure it out by themselves". Clear directions reduce student's confusion and clarify the purpose of certain task or work in whole. Effective explicit instructions include clearly explaining the purpose of the task ("This assignment is about your personal information. We will review what information you are allowed to share online and what you are not allowed to share"), demonstrating how to start, navigate and complete activities ("Click on the card. When the card is turned over you will be able to check your answer") and using simple, accessible language, supported by visuals or symbols.

Modelled Navigation and Thinking
Modelling instruction consists of teacher demonstration and student imitation (Dickey, 1992). Modelling of navigation consist in demonstrating how to navigate through tasks step by step. Modelling the student's thought processes can include verbalising decisions (e.g., "I will click here because…") and modelling problem-solving

strategies when difficulties arise („This answer is incorrect. What can you do next? “). This approach supports learners in understanding not just what to do, but how to think when interacting with digital materials.

Gradual Release of Responsibility

A key principle in building autonomy is the progressive shift from adult-led to learner-led engagement. The gradual release of responsibility model of instruction requires that the teacher shift from assuming all the responsibility for performing a task to a situation in which the learners assume all of the responsibility (Duke & Pearson, 2002).The framework of gradual release of responsibility consists of four interrelated components: focused instruction (teacher models the behaviour), guided instruction (teachers prompt, question, facilitate, or lead learners through tasks that increase their understanding of the content), collaborative learning (learners practice and apply their learning while interacting with their peers) and independent learning (provides learners practice with applying information in new ways) (Fisher & Frey, 2021).

In the implementation of Atollo digital materials, the gradual release of responsibility can be structured through following stages:

- full support – adult (teacher or parent/guardian) guides the learner step by step
- shared control – learner participates with prompts and cues
- supported independence – learner works more independently with occasional check-ins
- increased independence – learner manages tasks with minimal support
- full independence

Atollo digital materials are particularly well suited to this process, as they allow repetition, consistency, and adjustable levels of support.

Use of Metacognitive Prompts

The use of metacognitive prompting to support self-regulated learning is a well-established area of research in education. In general, prompts can be seen as specific external support tools, usually in the form of hints or questions that act as strategy activators. Prompts do not provide new information, but rather stimulate the use of known cognitive, metacognitive, motivational and resource management strategies during the learning process. The main goal of prompts is to activate strategies or skills that learners have acquired but do not use spontaneously (Juhanak et al., 2025).

Simple metacognitive prompts can be embedded in the activity or provided by adults, such as:

“What do I need to do first?”, “Am I finished, or do I need to check something?”, “What can I do if I get stuck?” or “Did I do this correctly?”. These prompts help learners develop self-monitoring and self-regulation skills, even at a basic level.

Supporting learner autonomy is a gradual, scaffolded process that lies at the heart of inclusive digital education. For learners with SEN, autonomy is not defined by independence from support, but by the increasing ability to engage, make choices, and regulate their learning within a structured environment. The role of adults (teachers, teaching assistants and/or parents / guardians) should consider maintaining the balance between providing enough support to enable success and allowing enough space for learners to take initiative.

Digital materials, when designed and implemented effectively, provide a powerful platform for this development. Through explicit instruction, modelling, gradual release of responsibility, and metacognitive support, educators can help learners move from supported participation toward greater independence.

The Atollo project underscores that strengthening autonomy is not an optional goal, but a central outcome of inclusive practice—enabling learners with SEN to become more confident, capable, and active participants in their own learning.

4.4 Blended learning approaches

The digital materials developed within the Atollo project are designed as complementary resources within a blended learning approach. They are not intended to present the standalone curricula for any of the subjects. Their effectiveness depends not only on their design, but on how they are integrated into broader teaching and learning processes. When creating them, care was taken to ensure that they were designed in such a way that they could fit into different national curricula. For learners with SEN, this integration is particularly important. Many benefit from multimodal input, repeated exposure, and learning across different contexts. Blended learning provides a structured way to combine these elements and enhance accessibility, engagement, and retention.

Blended learning refers to the systematic integration of digital (online) and face-to-face (offline) engagement and learning experiences to support and enhance meaningful interaction between learners, teachers and resources (Garrison & Kanuka, 2004). Blended learning may also allow teachers to spend less time giving whole-class lessons, and more time meeting and interacting with learners with special educational needs individually or in small groups to help them with specific concepts, skills, questions, or learning problems (Zavaraki & Schneider, 2019). In that sense, blended learning in inclusive education can include digital activities, teacher-led explanations and modelling, hands-on activities, printed or physical resources, verbal interaction (with or without visual support) and offline practice and reinforcement.

Digital materials are most effective when they are embedded into a broader instructional sequence, rather than used in isolation. Examples of a blended learning implementation strategy might look like this:

The concepts are introduced through teacher explanation and then followed by digital practice. Teacher can use Atollo IZZI digital materials to reinforce different hand-on activities, like matching or sorting. Digital exercises can also be linked with real-world or practical applications (e.g. ICT lessons or Measurements lesson). This combination strengthens understanding by allowing learners to process information in multiple ways and contexts.

Many learners with SEN benefit from frequent repetition and consistent reinforcement, which digital tools can support effectively. The materials created within the Atollo project are specifically focused on the gradual generalisation of skills beyond a single context.

A major strength identified in the Atollo project is the potential for continuity between school and home learning. Digital materials can serve as a bridge, allowing learners to revisit and consolidate learning outside the classroom. The same digital materials can be used in both settings so the learning can be reinforced through repetition in a familiar surroundings and format. The important advance of this mode of practicing and working on assignments is the opportunity for practice in less pressured environment. Classroom sessions can be dedicated to advanced interactive experiences, while the online components are used for research, homework and guided practice activities (Vintila, 2025).

There are several ways in which schools can support families for blended learning to extend effectively into student homes. Active support includes simple accessible guidance (short instructions for parents/guardians, short webinars or videos) and the clarification of the purpose of activities and expected outcomes.

Blended learning can also include elements of a flipped classroom model, where initial exposure to content happens through digital materials outside the classroom, and in-class time is used for guided practice. The flipped classroom inverts traditional teaching methods, delivering lecture instruction outside class (Altemueller & Lindquist, 2017). When applied appropriately, flipped elements can increase continuity between home and school learning. But for blended learning to be effective there must be consistency and coherence across home and school settings. This usually includes consistent use of language, symbols and formats across digital and non-digital materials and across different settings. For learners with SEN, continuity reduces confusion and supports the transfer of skills across environments.

Although the positive aspects of blended instruction are validated by SEN teachers, there are several pitfalls that must be taken into account. The most commons include lack of guidance for families, cognitive overload for learners and the premature assumption of independence, without adequate scaffolding. Addressing these risks requires careful planning and coordination.

4.5 Managing attention and cognitive load in practice

The concept of cognitive load has direct and practical implications for how digital learning is designed and implemented in inclusive classrooms. Cognitive Load Theory (CLT) relates to the situation where a person learning complex cognitive tasks is overloaded by several elements of information and the interactions between them which must all be processed simultaneously (Leppink et al. 2014). For learners with SEN, who may experience difficulties with attention, memory, processing speed, or executive functioning, managing cognitive load is essential for ensuring that learning remains accessible and meaningful.

Cognitive overload is a state in which a learning task is too difficult for a learner's cognitive ability and working memory. It tends to develop when a person is performing a demanding or complex task, and the information load involved creates mental stress (Bishara, 2022). Cognitive overload, especially the one connected to digital resources is not something specific only to learners with SEN. The rapid inflation in information and in its applications in the digital age is posing a challenge to humanity – a multitude of channels of communication is forcing a stream of information on the individual that is greater than the individual's processing capacity (Edmunds and Morris 2000). However, SEN learners experience higher cognitive load than learners without learning disabilities (Bishara, 2022).

For learners with SEN, cognitive overload can occur when too much information is presented at once, when instructions are unclear or overly complex, when tasks require managing multiple steps simultaneously or when the digital interface itself demands attention (e.g., navigation, buttons or layout). Digital resources can provide captivating and immersive learning experiences. However, educators need to consider the cognitive challenges that these resources methods may pose, especially for learners with cognitive impairments or attention difficulties (Kwon, 2019).

Managing cognitive load is therefore not about simplifying content excessively, but about presenting it in a structured, accessible, and manageable way.

Cognitive overload is often visible through changes in learner behaviour and engagement. Teachers and teaching assistants should be attentive to early signs, which may include:

- loss of focus or attention (e.g., looking away, disengaging from the task)
- task avoidance or refusal
- increased errors, especially in tasks the learner has previously managed

- slow response or hesitation, indicating processing difficulties
- frustration or anxiety, sometimes expressed verbally or through behaviour
- repeated requests for help, even for simple steps
- random or impulsive clicking in digital environments.

For some learners (e.g., those with autism or anxiety), overload may also lead to withdrawal or reduced communication rather than visible frustration.

The length and intensity of digital learning sessions are key factors in managing cognitive load for learners with SEN. This means that sessions should be structured keeping in mind the appropriate length and intensity for the student or group of learners. Lessons should be kept short and purposeful, especially for younger learners and/or those with attention difficulties. As mentioned before, it is useful to alternate tasks and activities between digital and non-digital ones. Long, uninterrupted periods of screen-based work should be avoided. For some learners, even 5–10 minutes of focused digital engagement may be more effective than longer sessions.

Breaking tasks into smaller, manageable parts is one of the most effective ways to reduce cognitive load. This means presenting one step at a time rather than multiple instructions at once and using clear visual or verbal cues to indicate progression.

Planned breaks are not interruptions to learning—they are essential for maintaining engagement and processing. It is good to introduce short, regular pauses between tasks or steps of the activity. Especially in working with learners with attention deficit disorder, it is important to plan the opportunities for movement or sensory regulation breaks.

Learners with SEN often require adjusted pacing to process information effectively. This means allowing extended time for task completion and monitoring learner responses and adapting the speed of instruction. When needed, opportunities for repetition must be provided.

One often overlooked aspect of cognitive load is the effort required to navigate and understand the learning environment itself. Familiar routines and consistent structures significantly reduce this burden. In the implementation of digital materials from Atollo project, these routines may include the consistent use of lesson structure, repetition of similar task formats across sessions and the consistent use of visual support symbols.

By recognising signs of overload and applying practical strategies—such as task chunking, adjusted session length, planned breaks, flexible pacing, and consistent routines—educators can create digital learning experiences that are accessible, engaging, and sustainable. Teachers must possess the expertise and abilities to choose, modify, and support technology-based learning activities that correspond with the varied requirements and educational objectives of their learners (Khasawneh & Khasawneh, 2024).

The Atollo project emphasises that inclusive digital materials achieve their full potential only when they are used in ways that respect learners' cognitive capacities, allowing them to participate confidently and make meaningful progress.

4.6 Screen time and ergonomic considerations

Digital materials play an important role in supporting inclusive education, particularly for learners with SEN. The use of ICT may result in many positive gains for learners, as it may deliver educational content in a dynamic and engaging manner and may tailor learning methods to the individual needs of learners (Lidström & Hemmingsson, 2014). When used thoughtfully, they can enhance access, engagement, and independence. At the same time, their effectiveness depends on how they are used in practice, including session duration, physical conditions, and the individual needs of learners.

This section provides practical, evidence-informed guidance on establishing healthy and sustainable patterns of digital use. Rather than prescribing rigid rules, it emphasises responsive, context-sensitive decision-making based on learners' needs and reactions.

Session Lengths
There is no single "correct" duration for digital learning sessions. For learners with SEN, appropriate session length depends on factors such as attention span, fatigue, type of task (passive or active interaction), sensory and cognitive load and the level of scaffolding provided.

For many learners with SEN, sessions of 5–20 minutes of active digital engagement are often effective, especially when embedded in a broader teaching sequence.

Breaks and Movement
Breaks are a critical part of healthy digital use, particularly for learners who experience attention difficulties, sensory sensitivities, or physical fatigue. However, structured movement during breaks between tasks is beneficial not only because it helps learners with self-regulation. Children with special educational needs are significantly less active than their mainstream counterparts. One strategy to increase physical activity levels in child populations is through classroom activity breaks (McMinn et al., 2011).

When planning a session in advance, it is necessary to plan regular short breaks between tasks. Breaks based on movement, such as walking, stretching and other simple physical activities, are especially useful.

Ergonomic Considerations
The physical setup of digital learning environments can significantly affect comfort, focus, and accessibility. Ergonomics is the process of making the work environment more efficient by reducing human fatigue and restlessness and maximising safety (Eldho & Muthukumar, 2022). General ergonomic principles include the following adaptations: the screen should be positioned at a comfortable viewing height (approximately eye level), learners should be seated with adequate back support and feet supported where possible, devices should be used at an appropriate distance from the eyes and lighting should minimise glare and reflections.

When interactive boards are used in the classroom, it is recommended to take care of visibility for all learners, including those with specific difficulties in motor skills and visual perception. When using a laptop, if necessary, ensure the use of external keyboards or stands. If tablets are used in work, encourage use on a stable surface rather than prolonged handheld use.

For learners with physical disabilities, adaptations may include alternative input devices as switches and adapted keyboards, individualized seating arrangements and positioning support such as stands and mounting systems.

Sensory Considerations
Many learners with SEN, particularly those with autism or sensory processing differences, may be sensitive to visual, auditory, or tactile stimulation. Evidence suggests the unpredictable multi-sensory nature of school can elicit sensory distress, adversely affecting behaviour and learning (Price & Romualdez, 2025).

A calm and controlled digital environment helps reduce sensory overload and supports sustained engagement. Some practical strategies can include uncluttered design, reduction of animations and sound effect, and allowing learners to assess the appropriate volume, pace and progression for themselves. It is also useful for learners to be able to use headphones or muted audio.

Accessibility for Learners with Physical Disabilities
Information and communication technologies represent a significant part of the educational process for learners with physical disabilities (Brčakova, 2025). Key considerations for use of digital materials include the ease of navigation (e.g., large buttons, simple interfaces), compatibility with assistive technologies (e.g., screen readers, switches, eye-tracking tools), alternative modes of input and response and the avoidance of tasks that rely solely on fine motor precision. The Atollo project highlights that when digital tools are used in a thoughtful, adaptive, and learner-centred way, they can support not only access to learning, but also wellbeing, engagement, and long-term independence.

4.7 Practical classroom organisation

The logistical aspects of digital learning—such as device setup, classroom organisation, grouping, and transitions—are often overlooked in guidance materials. However, in practice, they have a significant impact on learning outcomes, particularly for learners with SEN, who benefit from predictability, clarity, and structured routines. Effective digital learning begins before learners enter the activity. Preparation reduces uncertainty, saves time, and supports smoother engagement.

Preparation of the environment
To ensure that the start of the activity goes smoothly, it is necessary to take care of the preparation of some key elements. First, it is important to ensure that all devices that are planned to be used are charged and turned on (unless the predicted outcome for the day involves turning on the device). Accessibility settings (e.g., text size, contrast, audio) must be adjusted in advance. Seating should be arranged to support visibility, movement, and supervision. Strategies for working with learners with SEN dictate that it is advisable to avoid multiple steps (e.g., logging in, searching, navigating) at the start. It is very useful to reduce visual and auditory distractions in the environment. In a word, learners should begin the session ready to focus on learning—not on managing technology.

Structuring the physical environment
The location and grouping of learners in the classroom can have a significant impact on their learning. Minimising clutter and competing visual stimuli are beneficial for all learners with SEN. When considering how to group learners, it is important to remain flexible. Whether learners work individually, in pairs, in small or large groups depends, first and foremost, on the characteristics, preferences and needs of the learners, as well as the requirements of the individual task.

Defining expectations
Before starting the digital activity, learners should be clearly guided on what will happen, what is expected, and what support is available. For this purpose, it is advisable to use visual schedules and other forms of support/visual support. It is particularly important for learners with SEN to clarify expectations in order to motivate them to start and persist with the task and to increase the likelihood of successfully completing the tasks. In addition to visual layouts and instructions, it is useful to use easy-to-understand language and unambiguous, task-oriented instructions. Clear expectations and clear instructions reduce anxiety and support independent engagement.

Transitions Between Activities
Transitions are often the most challenging part of a lesson for learners with SEN. Moving between digital and non-digital tasks requires explicit structure and support. Due to perseveration, learners with SEN often have difficulty in disengaging from preferred digital tasks, which can easily lead to the emergence of challenging behaviours in the classroom. Also, learners may be confused in determining the next step in completing the task. They can also show increased off-task behaviour during unstructured time. Effective transition strategies include the use of

visual and auditory cues, such as timers, signals, and schedules. Clear instructions about the beginning and end of a particular activity are especially important for learners with difficulties in executive functions. It is advisable to keep transitions short and highly structured, and to use repeated routines so learners know what to expect.

Supporting Engagement During the Session
During the session, ongoing teacher presence and responsiveness are essential. Support strategies in this segment include offering scaffolding without taking over, keeping in mind that one of the expected outcomes for each student is the development of independence in a particular area. In addition, it is important to regularly check for understanding, in ways that will not negatively highlight the student. Understanding should therefore be checked in subtle ways and by observation rather than by directly calling out individual learners. During the work, it is important that the teacher and teaching assistant permanently check for signs of cognitive overload or disengagement.

Consolidation and Reflection
The end of a digital session is an important opportunity to reinforce learning and create closure. Effective closure can include a brief recap of what was learned, as well as highlighting key successes or achievements. By asking simple reflection questions (e.g., "What did you find easy or difficult?"), the teacher can determine whether the student's progress is in line with expectations. Digital or analogue output cards can also be used for this purpose. Linking the activity to future work or home practice will support student motivation and enable the functionality of the acquired skills.

During the piloting of Atollo digital materials in schools in Croatia, Bulgaria and Germany, it was shown that the organisation of digital learning sessions is a critical—but often underestimated—factor in inclusive education. For learners with SEN, predictable routines, clear structures, and well-managed transitions create the foundation for successful engagement with digital materials.

The Atollo project highlights that effective implementation depends not only on the materials or devices used, but also on how the learning environment is organised. When logistical elements are carefully planned, digital learning becomes more accessible, focused, and meaningful for all learners. The piloting showed that the success of teaching can be hindered by controllable technical difficulties, such as devices that are not charged in time or set to the appropriate settings. This leads to interruptions and waste of time, which can lead to disengagement or reduced motivation of learners. Instructions that are not adapted to the needs of learners also have an impact on how successful a lesson will be.

The instructions in the Atollo digital materials themselves will not always be appropriate for each individual student. In that case, they will serve as instructions for the teacher who, knowing the specificities of their learners, will adapt or modify them. Tasks that are too complex for individual learners can and should also be modified by the teacher. The teacher is the one who knows the characteristics and specific educational needs of their group and each of its individual members. Atollo digital educational content is adapted to learners with SEN in general, however, the specific adaptations, breadth and depth must be determined by an expert who knows the individual learner, their strengths and needs.

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5. Lessons Learned from the Atollo Pilot Phase

The Atollo pilot phase generated the evidence base for this Toolkit. Conducted in Croatia, Bulgaria and Germany, it tested how the digital educational units functioned in real classrooms, with learners requiring different levels of support and teachers working in different organisational and technical conditions.

Evidence was collected through teacher questionnaires, focus groups, classroom observations and usage analytics. This mixed-methods approach made it possible to compare reported experience with observed practice and to identify both the strengths of the materials and the conditions required for effective implementation.

5.1 Pilot overview

The pilot was conducted in 15 schools across Croatia, Bulgaria and Germany. Participating settings included special schools, inclusive classrooms and resource or support environments for learners with cognitive, communication, sensory, motor and other support needs.

Approximately 120 teachers and teaching staff used the materials during the pilot, with nearly 500 learners taking part. This provided a broad evidence base across different school types, learner profiles and implementation conditions.

Teachers reported that the Atollo materials supported differentiated instruction, learner engagement and curriculum-related practice. Classroom observations confirmed that visually supported, low-threshold response formats helped many learners participate more actively.

The pilot also showed that digital materials do not work independently of context. Teacher mediation, classroom organisation, technical readiness and appropriate support were decisive for successful implementation.

5.2 Methodology of piloting

The pilot used a mixed-methods evaluation design combining pre- and post-implementation questionnaires, focus group interviews, classroom observations and technical usage data.

Questionnaires gathered evidence on teachers' experience, perceived learner engagement, curricular alignment, usability and suggestions for improvement. Focus groups added qualitative detail about classroom use, barriers and successful practices.

Classroom observations captured how learners interacted with the digital materials, how much support they needed and how teachers adapted activities in practice. Usage analytics provided an additional source of evidence on navigation and engagement patterns.

These methods supported triangulation and strengthened the reliability of the findings. Ethical procedures, including GDPR-compliant data management and informed consent, were applied throughout the pilot.

5.3 Key findings

The pilot findings point to four main conclusions relevant for future inclusive digital education practice.

First, teachers valued the clarity, multimodal design and curriculum relevance of the materials. Interactive tasks, visual supports, audio elements and repeated practice contributed to learner engagement, especially when activities were well matched to the learner's current level of support.

Second, adult mediation remained essential. Learners often benefited from modelling, prompting, encouragement, pacing support and help with navigation. Teacher and assistant roles should therefore be considered part of the implementation model, not an optional add-on.

Third, implementation was affected by infrastructure and usability conditions. Device availability, internet stability, screen size, classroom layout, sound, and familiarity with the platform influenced how smoothly the materials could be used.

Fourth, localisation and pedagogical adaptation mattered. The materials were developed from a shared cross-country framework, but teachers still needed to connect activities to their own curriculum, language, classroom routines and individual learner profiles.

Overall, the pilot confirmed the value of inclusive digital educational materials while also showing that effective use depends on preparation, support, accessibility, classroom organisation and continuous improvement.

5.4 Implementation challenges findings

The pilot findings are valuable precisely because they include challenges as well as successes. The following issues should be read as implementation lessons for future users and developers, not as weaknesses of the Atollo materials alone.

Infrastructure and technical conditions
Schools differed in the availability of appropriate devices, stable internet connections, large screens, tablets, smartboards, headphones and technical support. These differences affected lesson flow and the extent to which learners could use the materials independently or in groups.

Educator confidence and digital competence
Teachers entered the pilot with different levels of confidence in using digital materials. Some needed more time to preview the platform, understand the structure of units, adjust accessibility options and plan how to integrate activities into lessons.

Accessibility and usability
The pilot helped identify where instructions, task sequences, response formats or interface elements could be simplified or better scaffolded. Many of these issues were addressed during optimisation, but the broader lesson remains: accessibility must be tested with real users and revised continuously.

Classroom organisation and learner support

Some learners required one-to-one support, repeated modelling, additional time, adapted communication or a calm learning environment. Digital materials therefore need to be embedded in flexible classroom routines rather than treated as stand-alone resources.

Localisation and curriculum fit

Atollo materials were developed from a common cross-country framework. For classroom use, teachers still need to connect the materials to local curricula, language, cultural references and individual education plans. This is a normal part of inclusive implementation rather than a defect of international materials.

Limitations and transferability

The pilot was conducted in three countries and involved different numbers of schools and learners in each context. Findings relied strongly on teacher assessment and mediated learner feedback, and there was no control group. The results therefore provide strong practice-based guidance, but they should not be treated as universal proof of impact in every setting.

5.5 Optimisation and revision process

The optimisation process translated pilot evidence and user feedback into concrete improvements of the Atollo digital educational units. This process is documented in D4.3 and provides an important model for future development of inclusive digital educational content.

Feedback from teachers, learners, support staff, researchers and technical users was reviewed and prioritised according to five optimisation dimensions: pedagogical design, accessibility and usability, interface and navigation, localisation, and implementation readiness.

The revision focused on five dimensions:

1. **Pedagogical design:** learning objectives, instructions and task sequences were clarified where needed, and scaffolding was strengthened to reduce unnecessary complexity.
2. **Accessibility and usability**: barriers connected to text load, audio support, visual clarity, response formats and learner independence were reviewed and addressed where possible.
3. **Interface and navigation:** navigation paths, task access, visibility of controls and teacher guidance were improved so that learners could focus more on the learning objective and less on operating the platform.
4. **Localisation:** language, examples and guidance were reviewed to support use across partner contexts while preserving the shared cross-country framework of the project.
5. **Implementation readiness**: teacher guidance, technical preparation and classroom-use recommendations were strengthened to support practical use after the pilot.

The optimisation process shows that inclusive digital materials should be treated as living resources. Testing, feedback, revision and continued maintenance are necessary if materials are to remain accessible, usable and educationally relevant.

5.6 Successful practices across countries

Across the participating countries, several practices consistently supported successful implementation. These practices are directly relevant for teachers and schools using the Atollo materials or developing similar inclusive digital resources.

Link digital activities to clear learning goals
Teachers used the materials most effectively when each activity had a defined role in the lesson: introducing a concept, modelling a skill, practising a target outcome, checking understanding or supporting repetition.

Select the level through learner need, not age alone
The four-level structure was most useful when teachers selected tasks according to the learner's current understanding, communication, independence and support needs. Moving between levels should be flexible and based on observation.

Use adult mediation to build independence
Successful classrooms used modelling, prompting and encouragement without taking over the task. Support was gradually reduced where learners became more confident.

Prepare the technical and physical environment
Effective implementation depended on simple preparation: testing links and devices, checking sound and display, planning grouping, reducing distractions and ensuring that learners had enough time and support to complete the activity.

Connect digital and offline learning
Digital tasks were strongest when followed by discussion, hands-on activity, repetition with concrete objects, peer interaction or transfer to everyday situations. This helped learners move from screen-based practice to broader understanding.

The pilot confirmed that digital educational materials are most effective when teachers use them selectively rather than mechanically. Successful implementation depended on matching the level, format and support to the learner, rather than completing units in full or using the same pathway for all learners.

6. Policy Recommendations and Sustainability

Inclusive digital education will not become sustainable through individual teacher effort alone. It requires accessible materials, prepared staff, reliable infrastructure, leadership support and policy conditions that make inclusive practice possible in everyday school life.

The Atollo project demonstrates that digital educational materials can support engagement and participation for learners with disabilities when they are carefully designed, implemented in authentic classroom settings, evaluated and refined. It also shows that the availability of digital resources is only the starting point. Their impact depends on how schools organise access, how teachers are supported, how families are involved and how systems recognise inclusive digital education as part of quality education.

This chapter translates the Atollo experience into recommendations for schools, policymakers, teacher education providers, digital content developers and other stakeholders responsible for scaling inclusive digital education. The focus is practical: what needs to be in place so that inclusive digital materials can be used well, maintained over time and adapted responsibly in different educational contexts.

6.1 Recommendations for schools

Schools are the level at which inclusive digital education becomes real or remains only an aspiration. Effective use of digital materials requires a whole-school approach rather than reliance on individual enthusiastic teachers. School leaders should therefore treat inclusive digital education as part of school development, accessibility planning and professional learning.

- **Define minimum implementation conditions.** Before digital materials are introduced, schools should check that learners have access to suitable devices, stable internet, appropriate display and input options, assistive technologies where needed, and adult support arrangements. Teachers should not be expected to overcome technical barriers while simultaneously supporting learners with complex needs.
- **Use accessibility as a procurement and selection criterion.** When choosing platforms, devices or digital resources, schools should consider readability, navigation, compatibility with assistive technologies, audio and visual alternatives, adjustable display options, data protection and ease of use for both learners and staff.
- **Create shared routines for classroom use.** Digital materials should be embedded in predictable lesson routines: preparation, modelling, guided practice, independent or supported work, reflection and follow-up. These routines reduce cognitive load for learners and make implementation easier for staff.

- **Plan flexible organisation of time and support.** Learners with disabilities may need additional time to process instructions, repeat activities, use alternative response methods or move between digital and offline tasks. Timetables and classroom organisation should allow this flexibility.
- **Invest in teacher collaboration**. Schools should provide time for teachers, teaching assistants, SEN specialists and ICT coordinators to plan together, review learner responses, share effective practices and identify barriers in the use of digital materials.
- **Involve parents and guardians as partners**. Families should receive clear, accessible information on the purpose of digital materials, how they may be used at home and what type of support is helpful. Home use should extend learning opportunities where possible, but it should not replace the school's responsibility to provide accessible learning in school.

A practical school-level standard is simple: digital materials should only be considered successfully implemented when learners can access them, understand the task, participate meaningfully and receive the support they need. Usage alone is not evidence of inclusion.

6.2 Recommendations for policymakers

Inclusive digital education should be treated as a system-level priority, not as a short-term innovation project. Policy determines whether schools have the resources, standards, training and support required to use digital materials in ways that promote participation and equal opportunities.

- **Establish quality criteria for inclusive digital educational resources**. National and regional authorities should define clear criteria for accessibility, pedagogical quality, differentiation, language clarity, usability, data protection and evidence of testing with relevant user groups. This would help schools identify high-quality resources in a crowded digital environment.
- **Embed inclusive digital pedagogy in teacher competence frameworks**. Digital competence frameworks should explicitly include accessibility, Universal Design for Learning, assistive technology, differentiated digital tasks, blended learning and the use of digital tools with learners requiring specialised support.
- **Move from project-based funding to sustainable investment.** Schools need predictable funding for devices, internet access, assistive technologies, accessible platforms, technical support, staff training and content maintenance. Short-term funding can stimulate innovation, but it cannot sustain inclusive digital practice at scale.
- **Align education, social policy, health and digital infrastructure.** Learners with disabilities often require support that crosses institutional boundaries. Policy should therefore promote cooperation between ministries, agencies, schools, families, rehabilitation professionals and technology providers.
- **Include inclusive digital education in monitoring and accountability.** Evaluation should look beyond the number of devices or resources used. It should consider accessibility, learner participation, teacher confidence, family engagement and whether digital materials contribute to meaningful learning.

For policymakers, the central question is not whether digital education is expanding. It is whether digitalisation is reducing barriers for learners who have historically been underserved. If this is not measured, it will not be managed.

6.3 Teacher education and professional development

Teachers are the key mediators between digital materials and learner participation. Professional development should therefore connect digital competence with inclusive pedagogy. One-off technical training is not enough. Teachers need sustained opportunities to practise, reflect, adapt and receive support in real classroom conditions.

Teacher education and continuing professional development should cover the following competence areas:

- **Digital confidence and technical use:** operating platforms, devices, accessibility settings and assistive technologies with confidence.
- **Accessibility and cognitive accessibility:** recognising barriers linked to text density, visual design, audio, navigation, interaction, sensory load and language complexity.
- **Universal Design for Learning:** planning multiple means of engagement, representation, action and expression.
- **Differentiation and level selection**: choosing appropriate levels of challenge, adapting pacing and combining digital and offline activities.
- **Blended lesson design:** integrating digital materials with teacher explanation, hands-on activities, peer interaction and practical application.
- **Evaluation and reflection:** observing learner responses, collecting feedback and adjusting implementation based on evidence.

The most effective professional development formats are practice-based. They include coaching, peer observation, professional learning communities, short targeted modules, lesson study, action research and opportunities for teachers to adapt materials together. Training should also include teaching assistants, support staff, ICT coordinators and school leaders, because inclusive digital education depends on coordinated adult support around the learner.

A useful professional development principle is: do not train teachers only to use a platform; train them to make pedagogical decisions with the platform. This shifts the focus from technical operation to inclusive teaching quality.

6.4 Guidance for digital content developers

Digital content developers shape the conditions for inclusion before a resource reaches the classroom. Decisions about language, layout, interaction, feedback, technical reliability and localisation can either remove barriers or create additional demands for learners and teachers.

- Start with the learning objective, not the digital feature. Every activity should have a clear pedagogical purpose. Developers should distinguish between the educational challenge of the task and unnecessary barriers created by the interface.
- Build accessibility into templates and workflows. Accessibility should be part of design, authoring, editing, translation, testing and publication. It should not be added only at the end of production.
- Use plain and structured language. Instructions should be short, concrete and consistent. Key information should be easy to find and supported visually or auditorily where appropriate.
- Make multimodality purposeful. Text, image, audio, animation and interaction should reinforce the same learning goal. Adding several media channels at once is not automatically inclusive if it increases cognitive load.

- Design interaction for diverse learners. Clickable areas should be clear; navigation should be predictable; feedback should be understandable; tasks should not depend unnecessarily on speed, precise motor control or independent reading.
- Design differentiation into the resource. Materials should include different levels of complexity, optional supports, opportunities for repetition and varied ways for learners to respond.
- Test with real users. Automated accessibility checks are useful but insufficient. Teachers, learners, support professionals and accessibility experts should review materials in realistic use situations.
- Maintain materials after publication. Developers should use version control, review dates, issue-reporting processes and clear responsibility for fixing broken links, compatibility problems, accessibility barriers and outdated content.

Developers should avoid claiming that a resource is fully accessible unless this has been systematically tested and documented. A stronger and more responsible claim is that the material has been designed according to accessibility and inclusion principles, tested with users and improved through feedback.

6.5 Scaling inclusive digital education across systems

The experiences gained through the Atollo project demonstrate that the successful implementation of inclusive digital education extends beyond the development of high-quality digital materials. While pilot initiatives play an important role in testing innovative approaches, achieving long-term impact requires the integration of inclusive digital practices into broader systems. Scaling should therefore be understood as a process of systemic change rather than simply increasing the number of users or institutions involved.

Scaling also requires coherent digital education ecosystems. OECD (2023) stresses that effective digital transformation depends not only on technology, but also on governance arrangements, interoperability, professional competencies, procurement frameworks and continuous evaluation mechanisms. Sustainable implementation therefore requires coordinated action across different sectors and levels of governance.

From the perspective of social inclusion, scaling inclusive digital education requires particular attention to the needs of learners with disabilities and those requiring additional support.

A key prerequisite for scaling is the continuous development of professional competencies. Effective digital inclusion depends on the capacity of teachers to select, adapt and implement accessible digital resources in ways that respond to individual learning needs. Strengthening these competencies should be supported through initial education, continuous professional development and the integration of digital inclusion competencies into occupational standards, qualification standards and professional competence frameworks.

Successful scaling further requires strong leadership, organisational readiness and collaboration among professionals. Comparative research conducted across European inclusive schools highlights the importance of institutional digital capacity, leadership commitment and professional collaboration in achieving sustainable implementation of digital technologies (Bešić et al., 2025).

Monitoring and evaluation mechanisms should accompany all scaling efforts. Beyond measuring the uptake and use of digital resources, evaluation frameworks should assess participation, accessibility, learner engagement and inclusion outcomes. Such evidence can support continuous improvement and help ensure that digital innovation contributes to reducing, rather than reinforcing, existing inequalities.

From a content-development perspective, scaling also depends on modular and maintainable design. Reusable templates, consistent interaction patterns, documented accessibility criteria and controlled translation workflows make it possible to extend resources to new units, languages and contexts without rebuilding them from the beginning. Scaling should not weaken quality assurance: the accessibility, editorial and user-testing requirements applied during piloting should remain in place whenever new content or platform functionality is introduced.

As highlighted by the Atollo project, meaningful digital inclusion cannot be achieved by educational institutions alone. It requires a broader ecosystem in which accessibility, participation and support are shared responsibilities across multiple sectors.

The Atollo project model, developed through multilingual, multi-context and evidence-based collaboration, provides a practical framework that can be adapted and implemented in different national contexts. Its future value lies not only in the digital materials produced, but also in demonstrating how inclusive digital education can be scaled through partnership, professional capacity-building and coordinated system-level support.

6.6 Sustainability strategies

The long-term value of inclusive digital education depends not only on the quality of the resources developed, but also on the capacity of systems to maintain, update and continuously improve them after individual projects have ended. Sustainability therefore extends beyond the lifespan of a specific initiative and requires long-term commitment from institutions, professionals and policymakers.

UNESCO (2023) emphasises that technology should support educational goals and be introduced only when it demonstrably adds value, is equitable, scalable and sustainable, and serves the best interests of learners. This principle is particularly relevant in the context of inclusive digital education, where technological solutions should support participation and accessibility rather than create new barriers or inequalities.

From a social policy perspective, sustainable digital inclusion contributes to broader objectives of social participation, independent living and equal opportunities for persons with disabilities. Investments in accessible digital learning environments therefore generate benefits that extend beyond educational outcomes and support inclusion across the life course, including future participation in community life, employment and lifelong learning.

Sustainability also requires an explicit content maintenance cycle. Each resource should have an identified owner, version number and review date, together with a process for reporting and resolving broken links, browser incompatibilities, accessibility barriers and outdated content. Changes made in one language version should be assessed across all relevant versions, and user feedback should remain part of continuing quality assurance. Without assigned responsibility for maintenance, even well-designed digital resources may gradually become less reliable or accessible.

Finally, long-term sustainability should be guided by the principle of “Nothing About Us Without Us”. The active participation of persons with disabilities and their families in the development, evaluation and improvement of digital learning solutions is essential for ensuring that future developments remain relevant, accessible and responsive to users’ needs.

6.7 Open access and long-term use

Open access is an important means of extending the educational and social value of project results. The Atollo digital materials and supporting resources are publicly available through the project’s online Resource Library. At the time of publication, the materials can be accessed free of charge, without user registration, in Bulgarian, Croatian, English, German, Icelandic and Norwegian (Atollo Project, n.d.-a). This reduces practical barriers for teachers, schools, families and support professionals who wish to use the materials.

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Public availability should, however, be distinguished from open licensing. The ability to view or use a resource online does not automatically include permission to copy, modify, translate or redistribute it. These permissions are governed by the copyright notice or licence accompanying the individual resource. Unless a separate open licence is explicitly stated, copyright remains with the identified rights holder, and users should obtain permission for uses that extend beyond the conditions specified with the resource.

Where reuse or adaptation is permitted, users should provide appropriate attribution, identify any changes made and retain the relevant rights or licence information. Adapted versions should not be presented as having been formally approved by the Atollo Consortium unless such approval has been granted. Materials containing third-party images, audio, video, fonts or other protected content may also be subject to separate conditions that differ from those applying to the Toolkit as a whole.

A recommended citation for the present deliverable is:

Atollo Consortium. (2026). D4.4 Development of Inclusive Digital Education Toolkit. Atollo Project, project no. 101132759.

Long-term use also depends on technical and organisational continuity. Resources should be published through stable web addresses, include clear version and publication information and remain available in accessible formats. Responsibility should be assigned for maintaining links, responding to reported accessibility or technical issues, updating outdated information and preserving archived versions where substantial revisions are made.

Schools and teacher education institutions can support long-term use by incorporating the resources into professional development, shared repositories and communities of practice rather than relying on individual teachers to rediscover them. The materials should be used flexibly and critically, with adaptations to pacing, support and classroom organisation based on the learner and the local educational context.

Open and sustainable access is therefore more than the act of placing a resource online. It requires transparent rights information, accessible publication, reliable maintenance and clear guidance on responsible use.

7. Practical Tools and Checklists

This chapter translates the principles and evidence presented in earlier chapters into practical tools for classroom use, school planning and content development. The tools are designed to be used selectively: readers should choose the checklist or decision guide that matches their role and immediate task.

The checklists are intended to support professional judgement rather than replace it. They are not diagnostic instruments or formal compliance audits. Users may mark each item Yes, No or Not applicable, record any required action and adapt the tool to the learner, institution and national context.

List of checklists:

1. Checklist A. Teacher implementation: before, during and after the session
2. Checklist B. Classroom readiness
3. Checklist C. Learner support plan
4. Selecting the level of challenge and support
5. Five-step inclusive digital lesson routine
6. Checklist D. Rapid material selection and accessibility review
7. Checklist E. Content development, testing and publication quality assurance
8. Checklist F. Rapid practitioner response card

Primary user	Recommended route through Chapter 7
Teachers, teaching assistants and support staff	Use Checklists A–C for planning and implementation; use Checklist D before introducing an unfamiliar resource; keep Checklist F available during the session.
School leaders and ICT coordinators	Use Checklist B for infrastructure and logistics, and the technical, privacy and maintenance criteria in Checklist E.
Content authors, editors and developers	Use Checklist E from concept to publication; test prototypes against Checklists A–C to ensure that the material works in real teaching conditions.
Families and other practitioners	Use the relevant parts of Checklists C and F, in coordination with the learner's teacher or support team.

Six non-negotiable conditions for inclusive digital implementation

- Learning comes before technology: every digital activity needs a clear educational purpose.
- The task is matched to the learner's current goal and support needs, not to chronological age or diagnosis alone.
- An interface barrier is addressed before the learning objective is lowered.
- Accessibility settings, devices, the environment and adult roles are prepared before the learner begins.
- Digital work is used flexibly and combined with explanation, interaction, practical activity and off-screen transfer.
- Educators and developers observe real use, distinguish the source of barriers and revise the next step accordingly.

7.1 Educator implementation tools

Checklist A. Teacher implementation: before, during and after the session

Use one copy per lesson or digital learning session. The sequence is chronological so it can function as a genuine planning and reflection tool.

Priority	Criterion	Status Yes / No / N/A	Action / notes
Essential	The learning objective is specific, meaningful and observable.		
Essential	The digital activity has a defined role in the lesson: introduction, modelling, practice, consolidation, review, assessment or transfer.		
Essential	The activity, complexity level and expected response are selected according to the learner's current goal, prior knowledge, communication, attention, sensory and motor needs, and available support—not age or diagnosis alone.		
Essential	The full learner pathway has been previewed, including instructions, media, interaction, feedback, navigation, exit and transition.		
Good practice	Only the tasks, screens or video segments needed for this session have been selected; a complete unit is not used by default.		
Essential	The intended session length, stopping point and evidence of learning have been planned.		
Good practice	The digital activity is embedded in a blended sequence that may include explanation, demonstration, objects, movement, discussion, collaboration or an off-screen transfer task.		
Essential	The use format and adult roles are clear: whole class, small group, paired, individual, home-supported, teacher-led, assistant-supported or peer-supported.		
Essential	At the start, the learner is told or shown the purpose, the first step and how the activity will end.		
Good practice	An unfamiliar interaction is modelled before independent or semi-independent use is expected.		
Essential	Instructions are presented one manageable step at a time and are rephrased, demonstrated or supported visually when needed.		
Essential	Before changing the task level, the educator checks whether difficulty comes from the concept, the language, the interaction, the navigation or the environment.		
Good practice	Pace, repetition, task length and modality are adjusted in response to the learner rather than fixed in advance.		
Essential	Support enables the learner to act; the adult does not complete the interaction or thinking on the learner's behalf.		
Good practice	Prompts are reduced when possible so that the learner can assume more control over time.		

Priority	Criterion	Status Yes / No / N/A	Action / notes
Essential	Feedback is used to clarify what happened and what to do next, and the learner has a meaningful opportunity to try again.		
Essential	The educator monitors signs of overload or loss of access, including hesitation, repeated errors, random clicking, withdrawal, frustration, fatigue, sensory distress or task refusal.		
Good practice	The activity is linked to communication, physical materials, real-life action, peers or off-screen reflection where this strengthens the learning goal.		
Essential	The end of the activity and transition to the next task are clearly signalled and predictable.		
Essential	After the session, the educator records what the learner understood, practised or demonstrated—not only whether the task was completed.		
Good practice	The appropriateness of the selected task, level, length, settings and support is reviewed.		
Essential	Any barrier is recorded by source: content, language, visual presentation, interaction, navigation, environment, support or technical performance.		
Good practice	The learner's level of independence and the next opportunity to reduce or change support are noted.		
Good practice	A follow-up, repetition or off-screen transfer activity is planned, and any technical or content problem is reported with enough detail to reproduce it.		

Checklist B. Classroom readiness

Complete before learners begin. School leaders and ICT coordinators may use this checklist as a shared readiness standard.

Priority	Criterion	Status Yes / No / N/A	Action / notes
Essential	Each device is available, charged, functioning and suitable for the intended input method and screen size.		
Essential	The link, platform, browser, account or access route has been tested on the actual device to be used.		
Essential	Internet stability and the loading of videos, audio and interactive elements have been checked; a non-digital backup is ready if access fails.		
Essential	Sound, headphones, speakers, projection and volume have been tested and are appropriate for the learner and setting.		
Essential	Required accessibility and personalisation settings—such as zoom, text size, contrast, captions, audio or a dyslexia-friendly display—have been prepared in advance.		
Essential	Any required assistive technology or alternative input method has been tested with the material.		
Essential	Seating, screen height, viewing distance, glare, posture, reach and movement space support safe and comfortable use.		
Good practice	Visual and auditory distractions have been reduced, while supervision and peer interaction remain possible.		
Good practice	A visual schedule, timer, cue or familiar routine makes the beginning, duration and ending of the activity predictable.		
Essential	Teachers, assistants, ICT staff or other adults know who will provide pedagogical, communication, physical and technical support.		
Essential	Personal information, passwords or confidential learner data will not be exposed on a projected or shared screen.		
Good practice	The planned transition to the next digital or non-digital activity can be completed without leaving learners waiting while technology is reorganised.		

Checklist C. Learner support plan

Use when preparing for an individual learner or a group with diverse support needs. The focus is access to the intended learning, not a diagnostic judgement.

Priority	Criterion	Status Yes / No / N/A	Action / notes
Essential	The learning goal is connected to the learner's current educational priorities and, where possible, to familiar contexts or interests.		
Essential	The learner has an accessible way to understand and communicate "start", "help", "repeat", "pause", "finished" and "stop".		
Essential	Language and instructions are accessible without removing the intended conceptual challenge.		
Essential	The activity is divided into manageable steps with a clear beginning, sequence and ending.		
Essential	Visual, auditory and sensory settings are matched to the learner; features are activated because they remove a barrier, not simply because they are available.		
Essential	The learner can see, reach and operate the response method, or an alternative response route has been planned.		
Essential	The initial support level is agreed: full support, shared control, supported independence, minimal support or independent use.		
Good practice	A prompt hierarchy is planned, beginning with the least intrusive support likely to be effective.		
Good practice	The learner has meaningful opportunities to choose, repeat, pause, ask for help and attempt the task before support is increased.		
Essential	Known signs of fatigue, anxiety, sensory overload, frustration or withdrawal have been considered, with an agreed pause or regulation response.		
Essential	Feedback, correction and success are communicated respectfully and without public embarrassment.		
Essential	An alternative way to participate or demonstrate the same learning objective is available if the interface becomes a barrier.		
Good practice	The plan includes a next step for increasing autonomy, transferring the skill or generalising it beyond the digital task.		

Atollo-specific application note

• The four Atollo learning levels are flexible guidance, not fixed learner categories. Activities from different levels may be combined within one learning sequence.

• Teachers may use a single assignment or only the relevant part of a video; completing an entire unit is not required.

• Learners using Levels 1 and 2 will often need continuous or shared adult mediation. Learners using Levels 3 and 4 may work more independently, but monitoring remains important.

• Before the session, review audio support, display and dyslexia-friendly options. Increase visibility where needed and use an available click–click alternative when dragging creates a motor barrier.

• Atollo IZZI requires online access. The backup for connection failure should therefore be a prepared non-digital or alternative activity, not an assumed offline version of the platform.

Selecting the level of challenge and support

Step	Decision guide
1	Start with the learning objective and a short, familiar task—not with a permanent level label.
2	If the learner understands and completes the task easily, increase conceptual challenge, reduce support or move to a more demanding activity.
3	If the learner understands the concept but the interface blocks the response, keep the objective and adapt the interaction, display, device or support.
4	If the learner succeeds with prompts, keep the activity where appropriate and plan how to reduce prompts gradually.
5	If the learner cannot understand the task after accessible explanation, modelling and appropriate support, reduce language or steps, provide a prerequisite activity or select a less complex task.
6	Use activities from different levels when this best serves the objective. Levels guide selection; they should not become fixed descriptions of the learner.

Five-step inclusive digital lesson routine

Step	What to do
1. PURPOSE	Define what the learner should understand, practise or demonstrate. Decide why a digital activity adds value.
2. MATCH	Select the task, complexity, response method, use format and support according to the learner and the objective.
3. PREPARE	Preview the material; set accessibility options; test technology; organise the environment, adults, transitions and backup.
4. FACILITATE	Explain, model, observe, scaffold, adjust pace and keep the learner actively involved. Blend digital and non-digital learning.
5. REFLECT	Record learning, independence and barriers; decide what to repeat, adapt, report or transfer next.

The practical value of these tools lies in repeated use. A checklist should not become paperwork completed after decisions have already been made. It should make the next lesson, the next resource and the next version of the content more accessible, purposeful and effective.

7.2 Material quality and content development tools

Checklist D. Rapid material selection and accessibility review

Use before introducing an unfamiliar digital resource. This is a practical screening tool, not a formal accessibility audit.

Priority	Criterion	Status Yes / No / N/A	Action / notes
Essential	The educational objective is clear, accurate and relevant to the planned lesson or learner goal.		
Essential	The task primarily measures the intended learning rather than reading speed, fine-motor precision, memory for navigation or another unrelated skill.		
Essential	The level of challenge can be matched or adapted without permanently labelling the learner.		
Good practice	The material is modular: the educator can select individual activities, pause at a meaningful point or omit unnecessary sections.		
Essential	Instructions are short, concrete, consistent and understandable to the intended learner, with examples or modelling where needed.		
Essential	Each screen or step has a clear focus, with a calm visual hierarchy and no unnecessary information competing with the learning goal.		
Essential	Navigation, controls, progress and the way to repeat, go back, finish or exit are predictable.		
Essential	Text is readable and can be enlarged; contrast is sufficient; colour is not the only carrier of meaning.		
Essential	Essential information is not limited to a single inaccessible mode: meaningful images have text alternatives, audio/video has appropriate alternatives, and written information has support where needed.		
Essential	Audio, video, animation and pace are under user control and do not begin or advance unexpectedly.		
Essential	Buttons and response areas are visible, clearly labelled, sufficiently large and forgiving.		
Essential	An alternative exists when dragging, precise pointing, rapid response, typing or a time limit is not part of the learning objective.		
Essential	Feedback is immediate enough to support learning, explains what happened and indicates a constructive next step.		
Good practice	The learner can retry, revise or recover from an error without losing work or being trapped.		
Essential	The material works with the available devices, browsers, display settings and relevant assistive technologies.		
Essential	The design avoids unnecessary sound, motion, visual clutter, distracting rewards and excessive choice.		

Priority	Criterion	Status Yes / No / N/A	Action / notes
Good practice	The activity has a clear stopping point and can be combined with explanation, practical work, interaction or off-screen transfer.		
Essential	The material does not expose learners to inappropriate advertising, unsafe links, unnecessary data collection or unclear privacy conditions.		
Good practice	The educator can mediate or adapt the activity without changing the core learning objective.		
Essential	Previewing the material has not revealed a barrier that the intended learner cannot reasonably overcome through built-in access or planned support.		

Decision after Checklist D

• USE: all Essential criteria are met and any remaining Good practice actions are manageable in the planned context.

• USE WITH ADAPTATION: a barrier can be removed before the session without changing the learning objective or placing an unrealistic burden on the learner or educator.

• DO NOT USE YET: essential content is inaccessible, the learner cannot operate or respond, technical reliability is insufficient, privacy or safeguarding is unclear, or the required adaptation would replace the intended learning.

Checklist E. Content development, testing and publication quality assurance

Use throughout the production cycle. The phase labels DEFINE, DESIGN, BUILD, TEST, PUBLISH and MAINTAIN make the checklist suitable for staged sign-off rather than a single final inspection.

Priority	Criterion	Status Yes / No / N/A	Action / notes
Essential	DEFINE — Intended learners, contexts of use and likely barriers are based on user input and real educational conditions rather than an assumed “average” user.		
Essential	DEFINE — Each activity has an explicit learning objective and observable evidence of success.		
Essential	DEFINE — Content is accurate and educationally relevant; one activity does not combine unrelated learning demands without a clear reason.		
Essential	DEFINE — Required reading, memory, sensory, motor, communication and navigation demands are identified and compared with the learning objective.		
Essential	DEFINE — Differentiation, optional support, alternative responses and modular use are planned from the beginning rather than added after failure.		
Essential	DEFINE — Privacy, safeguarding, data minimisation, copyright, licensing, localisation and translation requirements are identified before production.		
Essential	DESIGN — Instructions use short, literal, active and consistent language; technical terms are defined and wording is suitable for translation.		
Essential	DESIGN — Complex activity is divided into manageable steps, and the information hierarchy makes the required action immediately clear.		
Essential	DESIGN — Visuals are relevant, recognisable, sufficiently large, consistent in style and free from details that compete with the concept.		
Essential	DESIGN — Text, colour and visual structure meet readability and contrast needs; meaning does not depend on colour, position or visual interpretation alone.		
Essential	DESIGN — Text, image, audio, video and animation are combined only when they clarify or reinforce the same learning purpose.		
Essential	DESIGN — Users can control pace, audio, video and motion; unnecessary time pressure, autoplay and sensory stimulation are avoided.		
Good practice	DESIGN — Choice, feedback, contexts and rewards support meaningful engagement and autonomy rather than distraction or compliance alone.		
Good practice	DESIGN — The material supports short learning episodes, clear stopping points, repetition and links to practical or off-screen activity.		
Essential	BUILD — Structure, headings, controls and form elements are programmatically meaningful and clearly labelled.		

Priority	Criterion	Status Yes / No / N/A	Action / notes
Essential	BUILD — Meaningful images have appropriate alternative text; decorative images are identified as decorative.		
Essential	BUILD — Audio and video have captions, transcripts, audio description or equivalent alternatives where required by the information conveyed.		
Essential	BUILD — Text enlargement, reflow, contrast changes and other personalisation do not hide content or break the task.		
Essential	BUILD — Interactive targets are large and forgiving, with alternatives to drag-and-drop, fine pointer control, rapid clicking or typing when these are not learning objectives.		
Essential	BUILD — All essential actions can be completed using the intended alternative input and relevant assistive technologies, including keyboard access where applicable.		
Essential	BUILD — Navigation is consistent; location, progress, back, repeat, finish and exit are clear; users can recover from errors or accidental actions.		
Essential	BUILD — Feedback is accurate, timely, respectful and informative, and it gives the learner a meaningful next action.		
Good practice	BUILD — Accessibility and personalisation settings are easy to find, consistent and under user or educator control; no single setting is forced on every learner.		
Essential	TEST — Content, instructions, answer logic, feedback, links and translations receive editorial and subject review.		
Essential	TEST — Automated accessibility checks are supplemented by manual review of keyboard use, zoom, contrast, media alternatives and reading order.		
Essential	TEST — The material is tested on the target devices, browsers, screen sizes, connection conditions and relevant assistive technologies.		
Essential	TEST — Intended learners, teachers and support staff test authentic tasks; observation includes understanding, completion, independence, fatigue and barriers—not satisfaction alone.		
Essential	TEST — Issues are logged by severity and source, prioritised, revised and retested; critical barriers are not closed on assumption.		
Essential	TEST — Language versions are reviewed in context for terminology, layout, audio–text alignment, task logic and accessibility—not only literal translation.		
Essential	PUBLISH — Teacher-facing guidance explains purpose, target use, technical requirements, access features, support expectations and known limitations.		
Essential	PUBLISH — The resource displays a version, publication or revision date, responsible owner and contact or issue-reporting route.		

Priority	Criterion	Status Yes / No / N/A	Action / notes
Essential	PUBLISH — Rights, licences, third-party assets, attribution and conditions for reuse or adaptation are documented.		
Essential	PUBLISH — Data-protection, safeguarding and analytics arrangements are transparent and collect no more information than necessary.		
Good practice	MAINTAIN — Stable links, a maintenance owner, a review cycle and a process for correcting technical, accessibility, content and cross-language issues are in place.		
Essential	CLAIMS — Statements about accessibility, standards conformance or effectiveness are limited to what has actually been tested and documented.		

7.3 Rapid decision tools for practitioners

These tools are designed for use under real classroom conditions. They do not assume that every difficulty requires a lower learning level or more adult help. The first task is to identify the source of the barrier and make the smallest effective adjustment while keeping the learner actively involved.

The five-question pause before adapting

• What is the learning objective?

• Is the current barrier mainly the concept, language, visual presentation, interaction, navigation, environment, support or technology?

• What is the smallest change that could remove this barrier?

• Will the learner remain the person who thinks, chooses and responds?

• What should be recorded or changed before the next session?

Checklist F. Rapid practitioner response card

Use the table to respond to common difficulties without automatically lowering expectations or increasing adult control.

Observed issue	Check first	Try now	Plan next time
The learner does not start or appears unsure what to do.	Is the purpose, first step or interaction unfamiliar?	Show the goal and one first step; model once; open the exact screen needed; use one short instruction.	Preview the pathway, add a visual routine and reduce start-up navigation.
The learner clicks randomly or responds impulsively.	Does the learner understand the task? Are there too many options, small targets or sensory distractions?	Pause; restate the objective; reduce visible choices; enlarge or change the response method.	Reduce interface load and teach the interaction separately if needed.
The learner makes repeated errors.	Is this a misconception, an unclear instruction, inaccessible feedback or an unsuitable challenge level?	Use a concrete example, rephrase, model thinking, switch modality or provide one scaffolded attempt.	Adjust the next task or support only after identifying the source of error.
The learner appears to know the answer but cannot operate the interface.	Is vision, motor control, reading, timing or the input method blocking the response?	Keep the learning objective; use touch, keyboard, click–click, pointing, a switch or another accessible response route.	Select or develop material with an equivalent low-motor response option.
Engagement drops or fatigue appears.	Is the task too hard, too easy, too long, overstimulating, physically demanding or disconnected from the goal?	Pause, shorten, offer movement or regulation, change modality, add a meaningful choice or move to an off-screen task.	Adjust session length, challenge, sensory settings and stopping points.
The learner shows sensory distress or withdrawal.	Is sound, motion, brightness, visual clutter, room noise or unpredictability contributing?	Stop or reduce the stimulus; mute or pause media; simplify the screen; move to a calmer setting; use the learner's regulation plan.	Prepare sensory settings and a predictable pause/stop signal before the next session.
The adult is doing too much of the task.	Is the learner waiting for prompts or has support become automatic?	Use wait time; return control; move to the least intrusive prompt; let the learner complete the final action.	Plan prompt fading and record the support level needed for success.
The learner struggles to stop or move to the next activity.	Was the ending unexpected or was the next step unclear?	Use a timer, visual cue, "last task" signal and a clear next activity.	Build the same transition routine into future sessions.
The technology fails or loads too slowly.	Is the issue the device, connection, link, browser, account or platform?	Move to the prepared backup rather than troubleshooting while the learner waits.	Record the exact device, browser, unit, screen, action and error; test before reuse.

8. Conclusion

Inclusive digital education is not achieved through technology alone, nor by adding isolated accessibility features to otherwise conventional materials. It emerges from the relationship between the learning objective, the design of the material, the learner's strengths and support needs, the teacher's pedagogical decisions, and the conditions in which learning takes place. The central contribution of the Atollo project is to bring these dimensions together within a practical framework for designing, selecting and implementing digital educational materials.

The Atollo project shows that inclusive digital education requires more than access to devices or digital content. It requires materials that are accessible, pedagogically meaningful and adaptable, and it requires teachers, schools and systems that are prepared to use them well.

Across the project, 45 digital educational units were developed, piloted and optimised across four programme levels in Mathematics and ICT. Their development and implementation generated the evidence base for this Toolkit.

The central conclusion is clear: inclusive digital materials can strengthen participation and engagement for learners with SEN when they are embedded in thoughtful teaching, appropriate support and accessible learning environments.

The four learning levels used in the Atollo IZZI materials illustrate this principle. They allow teachers to adjust challenge, language, abstraction and required independence without assuming that chronological age, diagnosis or school placement determines what a learner can achieve. The levels should be treated as flexible teaching resources rather than fixed categories. A learner may use activities from different levels within the same topic, and the appropriate combination of challenge and support may change over time.

The project also reinforces an important distinction between learner autonomy and unsupported use. Autonomy does not require the absence of adult assistance. For many learners, independence develops through clear modelling, predictable routines, purposeful prompts and the gradual reduction of support. Teacher mediation should enable access to the task without replacing the learner's thinking, choice or response. The aim is not for every learner to use every digital resource independently, but for each learner to participate as actively and meaningfully as possible.

A further lesson from Atollo is that inclusive digital materials should be developed through an iterative process. The pilot did not provide universal proof of effectiveness across all learners or educational contexts. It provided practical evidence about usability, perceived engagement, implementation conditions and barriers that became

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visible during use in real educational settings. This evidence was used to revise the materials and strengthen the accompanying guidance. The same cycle - design, use, observation, reflection and revision - should continue after publication.

The responsibility for inclusive digital education cannot rest with individual teachers alone. Schools and education systems must provide suitable infrastructure, professional learning, time for preparation and collaboration, accessible procurement criteria and processes for maintaining digital resources. Developers must integrate accessibility and usability into the complete production cycle. Policymakers must ensure that publicly funded digital transformation does not create new forms of exclusion. Learners and families must have meaningful opportunities to influence the resources and decisions that affect them.

The Toolkit should therefore be used as a decision-making framework rather than as a fixed prescription. Its principles, checklists and rapid-response tools can support teachers, school leaders, content developers and policymakers in asking the most important practical question: **Can this learner use this material to participate meaningfully in the intended learning, in this context, with the support currently available?**

When the answer is no, the response should not automatically be to lower the learning objective or exclude the learner from the activity. The first task is to identify the barrier and determine whether it can be removed through better design, a different interaction method, an adjusted learning level, clearer guidance, additional support or a more appropriate learning environment. This is the continuing work of inclusive digital education.

8.1 Key takeaways

Begin with the learning objective, not with the technology
A digital activity should be used because it supports a clearly identified learning objective, not simply because a device or platform is available. The educational purpose should determine the choice of material, level, interaction format and support.

Design for learner variability from the outset
Differences in language, reading, attention, memory, sensory access, motor interaction and required support are predictable parts of every learning environment. Inclusive materials anticipate this variability rather than waiting for individual learners to experience failure before adaptations are introduced.

Match the level of challenge with the level of support
An activity should be neither inaccessible nor unnecessarily simplified. Levels should remain flexible, and difficulty with an activity should first be examined to determine whether it results from the learning concept, the language, the interface, the interaction method, the environment or insufficient support.

Teacher mediation and learner autonomy are complementary
Appropriate adult support does not undermine independence. Modelling, prompting and structured guidance can enable learners to participate successfully and gradually assume greater control. Support should be sufficient to provide access but should not replace the learner's thinking or response.

Digital materials work best as part of blended teaching
Digital activities should be connected to communication, practical experience, hands-on materials, peer interaction, reflection and transfer to other contexts. No single format - whole-class, small-group, paired, individual or home-supported use - is appropriate for every learner or every objective.

Inclusion requires continuous and shared improvement

Digital resources should be tested with real users, reviewed after implementation and maintained over time. Teachers, learners, families, developers, school leaders and policymakers share responsibility for identifying barriers and ensuring that accessibility and participation remain central throughout the life of a resource.

8.2 Strategic value of the Toolkit

The Atollo Inclusive Digital Education Toolkit represents more than a collection of practical resources, recommendations and checklists. Its strategic value lies in its ability to bring together research-informed knowledge, experience from pilot implementation in different national contexts and practical guidance for creating accessible and inclusive digital learning environments for learners with special educational needs and disabilities.

What distinguishes the Toolkit from many existing resources is this combination of evidence-informed principles, practical implementation experience and multi-country piloting. It does not present inclusive digital education only as a theoretical concept, nor does it present the Atollo model as a universally validated solution. Instead, it translates broad commitments to inclusion, accessibility and equal participation into practical decisions that arise in everyday educational practice: how to design an understandable task, how to select an appropriate learning level, how to prepare the classroom, how to provide support without removing learner agency, and how to determine whether a digital material is suitable for publication or use.

The Toolkit identifies principles that proved relevant across different participating contexts, while recognising that languages, curricula, infrastructure, professional roles and available support vary between education systems. This combination of shared principles and contextual adaptation makes the Toolkit applicable beyond the Atollo IZZI materials. Its value therefore lies not only in supporting the use of one set of digital resources, but also in offering a transferable framework for the development, selection, implementation and evaluation of inclusive digital educational materials more broadly.

A particular strength of the Toolkit is the way it connects different levels of responsibility. At classroom level, it supports teachers and teaching assistants in planning, implementing and reviewing digital learning activities. At organisational level, it assists school leaders and support professionals in addressing infrastructure, staff competence, accessibility and collaborative planning. At production level, it gives authors, editors and developers criteria for pedagogical quality, usability, differentiation and accessibility. At policy level, it supports the integration of inclusive requirements into funding, procurement, professional development and quality-assurance processes.

Chapter 7 provides the operational core of this approach. Its checklists and decision tools convert the principles of the earlier chapters into actions that can be used before, during and after a lesson, when selecting an existing material, or throughout the development, testing and publication of new content. In this way, the Toolkit functions both as an explanatory document and as a practical quality-improvement instrument.

The European Agency for Special Needs and Inclusive Education highlights that digital transformation and inclusive education should be understood as interconnected processes that can reinforce educational equity, accessibility and system resilience. In this context, the Toolkit provides a practical framework that supports the integration of inclusive digital practices into wider educational, social and organisational systems. Its recommendations recognise that meaningful digital inclusion cannot be achieved through educational interventions alone, but requires coordinated support involving teachers, teaching assistants, school leaders, support professionals, families, institutions, developers and policymakers.

The strategic relevance of the Toolkit is further reinforced by its alignment with key international and European policy frameworks. Its principles and recommendations support the implementation of the United Nations Convention on the Rights of Persons with Disabilities, Sustainable Development Goals 4 and 10, the EU Strategy on the Rights of Persons with Disabilities 2021–2030 and the European Pillar of Social Rights (European Commission, 2017, 2021; United Nations, 2006, 2015). In this perspective, accessible digital education is not merely a technical or instructional concern. It contributes to learner agency, communication, digital competence, lifelong learning, equal opportunities and fuller participation in society.

The Toolkit should not be viewed as a static set of recommendations. Its long-term value will depend on whether the resources remain accessible, technically reliable and educationally relevant; whether teachers continue to receive professional support; and whether feedback from learners, families, practitioners and institutions informs future revisions. Its most transferable contribution is therefore not one particular platform or set of units, but a coherent process for making inclusive decisions throughout the design, implementation, evaluation and maintenance of digital education.

In this way, the Toolkit provides a foundation for the continuous improvement of inclusive digital education. It supports long-term efforts to strengthen educational participation, accessibility and social inclusion for learners with disabilities across different contexts, while encouraging all actors involved in digital education to treat inclusion as a shared, ongoing and system-wide responsibility.

8.3 Future directions for inclusive digital education

Future development should not be framed primarily as the introduction of more technology. The priority should be to create digital learning environments that are better designed, better supported, more carefully evaluated and more responsive to learner diversity. Building on the Atollo experience, five connected directions should guide subsequent work.

Maintaining accessibility and quality over time

The first priority is to protect and extend what has already been developed. Digital materials require continuing maintenance because browsers, devices, platforms, accessibility standards and educational expectations change. Resources should have an identified owner, version number, review date and process for reporting accessibility, content or technical problems. Updates made in one language version should be checked across all relevant versions. Accessibility should also be retested after significant changes rather than assumed to remain intact.

Sustainability should include maintaining the guidance and practical tools around the materials, not only keeping the platform technically available. Teachers need current information about available accessibility features, supported devices, content revisions and known limitations. Long-term use depends on a combination of technical stewardship, editorial responsibility and continued communication with users.

Building stronger evidence with learners and families

The Atollo pilot provides an important foundation, but further research should examine how inclusive digital materials function when they become part of regular practice over a longer period. Evaluation should extend beyond initial engagement, satisfaction or task completion. It should consider understanding, participation, autonomy, wellbeing, digital competence, transfer of learning and the amount and type of support required.

Future evaluation should include more direct and accessible ways for learners to express their experiences. Teacher observations are valuable, but they cannot fully substitute for learner voice. Families and support professionals can also contribute evidence about repeated use, learning outside school and whether skills transfer into everyday contexts. Methods should be adapted so that learners with different communication and cognitive profiles can participate meaningfully in evaluation.

Long-term research should also examine which outcomes are associated with the material itself and which depend on teacher mediation, classroom organisation, infrastructure or other contextual factors. This would support more accurate conclusions about what works, for whom, under which conditions and with what support.

Strengthening professional learning and communities of practice

Access to digital materials does not automatically create the competence needed to use them inclusively. Teachers need opportunities to develop combined knowledge of digital pedagogy, accessibility, differentiation, subject teaching, classroom organisation and specialised learner support. Initial teacher education and continuing professional development should therefore include practical experience in evaluating, adapting and implementing inclusive digital materials.

Professional learning is likely to be most effective when it is connected to real classroom problems. Communities of practice can enable teachers to share examples, compare adaptations, discuss unsuccessful attempts and jointly develop solutions. The Atollo materials and the tools in Chapter 7 could serve as shared resources for peer mentoring, lesson study and cross-country professional exchange.

Schools and systems must recognise this work as part of professional practice. Teachers require time to preview materials, prepare accessibility settings, collaborate with assistants and specialists, and reflect on learner responses. Professional communities cannot be sustained through individual goodwill alone.

Embedding inclusive quality in policy, procurement and infrastructure

Accessibility and inclusion should become baseline criteria for publicly funded and institutionally procured digital educational materials. Procurement procedures should require evidence of accessibility testing, compatibility with relevant assistive technologies, clear information about limitations, and responsibility for future maintenance. Usability and pedagogical accessibility should be considered alongside technical conformity.

Common quality expectations across countries could make it easier for schools, municipalities and teachers to identify suitable resources. At the same time, common expectations must allow adaptation to national languages, curricula, teaching traditions and support structures. Cross-national alignment should establish minimum inclusive quality requirements without assuming that one implementation model will be appropriate in every context.

Infrastructure also remains an inclusion issue. Reliable devices, connectivity, technical support and accessible learning environments are prerequisites for participation. Systems should avoid situations in which teachers are expected to compensate individually for structural deficiencies in equipment, software or organisational support.

Exploring adaptive and AI-supported learning responsibly

Adaptive and AI-supported technologies may eventually provide more responsive pathways through content, but they should follow rather than replace the foundations of accessible design, strong pedagogy and teacher competence. New functionality should be introduced only when it provides identifiable educational value and does not create additional barriers or inequalities (UNESCO, 2023).

For learners with disabilities and other learners requiring specialised support, automated interpretation carries particular risks. A system may incorrectly interpret slow response time, imprecise movement, repeated attempts, language differences or attention fatigue as lack of understanding. This could result in unsuitable feedback, reduced challenge or inaccurate learner profiles.

Future adaptive tools should therefore be developed through participatory processes involving learners, teachers, families, accessibility specialists and developers. They should use proportionate and transparent data practices, protect privacy, allow professional oversight and provide teachers with the ability to question or override automated decisions. AI should support flexible access and informed teaching; it should not replace professional judgement, determine expectations for learners or reduce complex learning processes to behavioural data.

These priorities are interdependent. Better evidence depends on sustained implementation and learner participation. Professional competence depends on institutional support. Common accessibility requirements matter only when they improve real classroom use. Emerging technologies will be inclusive only when they are built on accessible foundations and governed responsibly.

The next stage of inclusive digital education should therefore be guided by a principle of **consolidation before innovation**: maintain what works, investigate what remains uncertain, involve those most affected, strengthen the systems around teachers and learners, and introduce new technology only where it clearly improves access, participation or learning. This approach offers the strongest basis for extending the contribution of Atollo beyond the project period.

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Breaking barriers through education

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