

Teachers' Guide on How to Create Effective Digital Learning Resources

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Introduction

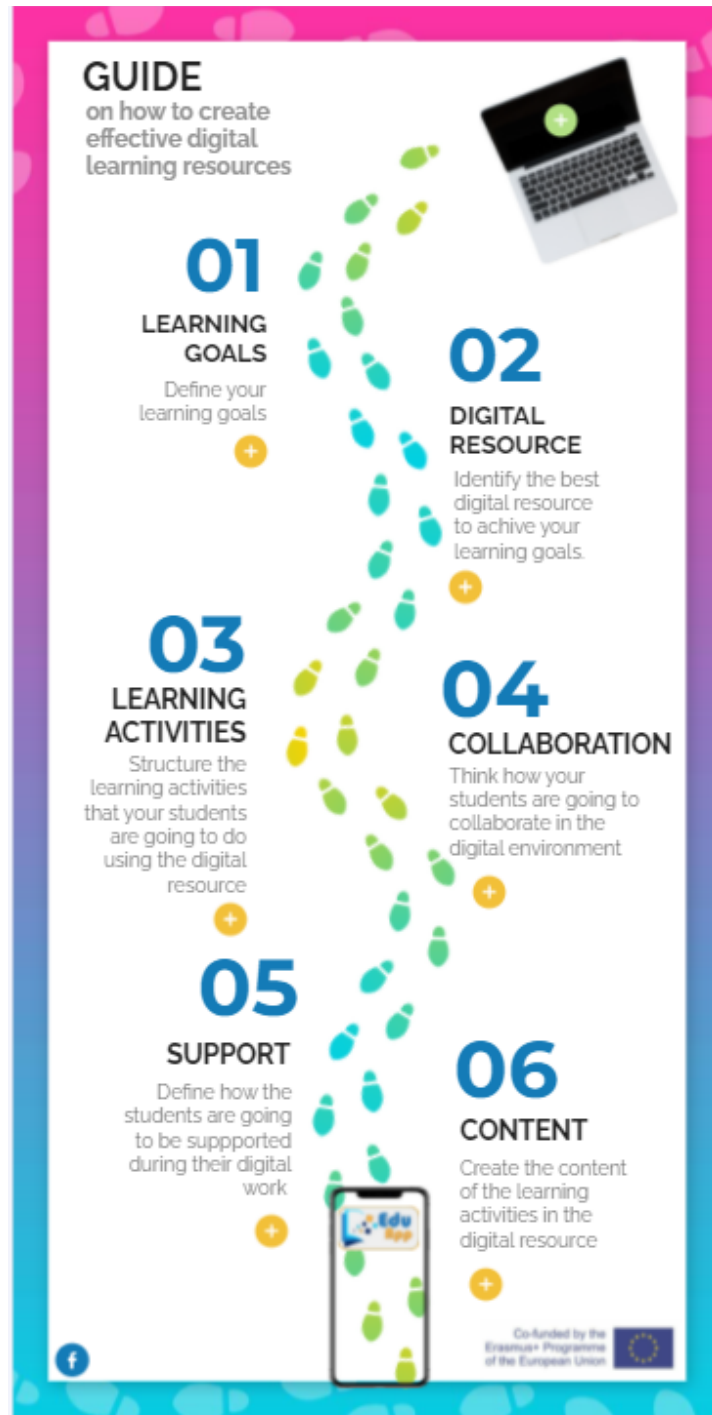
The **Erasmus EduApp project** (2020-1-RO01-KA226-095728) is about joining forces and expertise to create the framework and resources for digital education and communication in the partner institutions, as an answer to the challenges of the Covid-19 pandemic. The project objectives are:

1. To increase the access to digital learning resources for all students by creating a collection of video courses, tutorials and other resources applied in teaching, learning and evaluation, that will be available online and offline.
2. To develop the digital pedagogical competences of 16 teachers from the participating schools who will be trained into the e-learning and blended learning pedagogy and into creating video courses, tutorials, and other educational resources specific to their subjects and who will peer train other colleagues.
3. To facilitate and increase the communication between school, students, and teachers by developing an application, EduApp, free and open source, customised for each partner school.

This **Teachers' Guide on How to Create Effective Digital Learning Resources** was created as part of the EduApp project objectives.



An **effective digital learning resource** is a resource that can be applied to improve students' skills and content knowledge in a digital environment. This guide is organised in six sections accessible via the infographic [here](#).



01 | Learning objectives

What do I want students to learn?

The first task a teacher should do when creating a digital learning resource is clearly identify the **learning objectives** that the students should achieve with the digital resource.

These learning should attend to the specific learning objectives of the subject the teacher is teaching but should also contemplate the **21st century skills**.

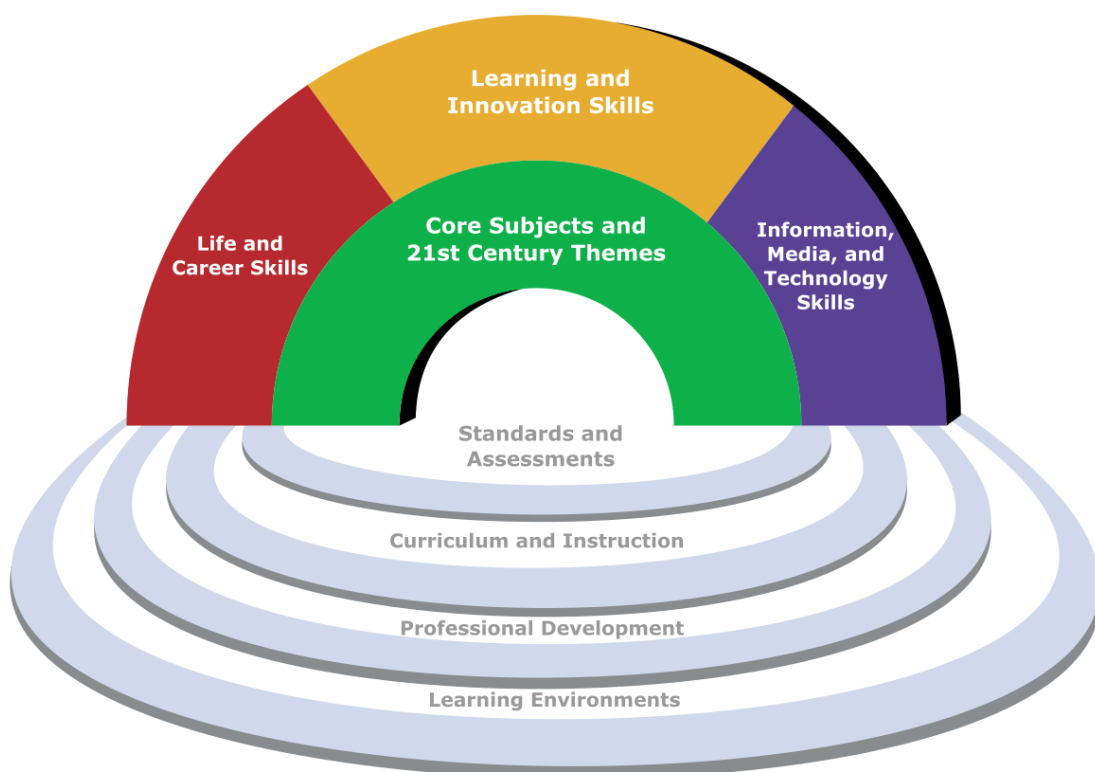


Figure 1. P21 framework for 21st century learning ([CC BY-SA 4.0](#)).

Another set of knowledge, skills and attitudes that should be present in the learning objectives are the ones of *The Digital Competence Framework for Citizens* (Vuorikari et al., 2022).

Consider that some learning objectives are more adequate than others when applying digital resources. For example, if the students have to justify their opinion concerning a

documentary about environmental issues, this would be a proper learning objective to achieve through their participation in an online forum.

Write a **short summary** in the digital resource about the activity and the assignments and products the students are expected to do.

Tip: Keep it simple! A few learning objectives are enough! If you have more, create another digital resource.

Eduapp example: [Lessons plans](#)



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02 | Digital resources

The production of highly complex digital educational resources is very demanding, and it is done frequently by a multidisciplinary team of content creators, programmers, specialists in graphic design and interface design and project managers. However, most teachers have skills that allow them to create or adapt digital resources, integrating animations, links, multimedia or other interactive elements, that allow them to take advantage of the digital environment.

What are the features of the core pedagogical principles of a good digital educational resource?

According to Becta (2007), the core pedagogical principles for digital educational resources are:

- The resource favours **inclusion** and **access**. The digital learning resource should support inclusive practices in their design and in the supporting materials for teachers and learners.
- The resource favours **learner engagement**. The resource should engage, challenge, and motivate learners through a complex mix of aesthetics, technical and educational design and be strengthened by the context in which it is applied.
- The resource promotes **effective learning**. The resource should include a range of approaches that allows the learner to choose one that suits them, provide evidence of which learning outcomes have been fulfilled, support appropriate learner agency and autonomy, encourage their metacognitive skills, provide authentic learning and multiple perspectives of a topic .
- The resource includes feed-up, feedback, feedforward **assessment to support learning**. The resource has the possibility to provide feedback to the learners on their acquisition of knowledge and skills. This includes rapid feedback that helps



learners to evaluate their progress and opportunities for peer or self-assessment.

- When the resource includes **robust summative assessment**, it provides a summative assessment that can be used to provide information on learner performance. The assessment must be valid and reliable, informative, should deal with a range of achievement levels and to be retained and accessed over time by users.
- The resource can be **innovative**. The resource can be innovative in the approach to teaching and learning or innovative in the design and use of technology.
- The resource should be **easy to use**. The resource should provide appropriate guidance for learners and teachers, but not require extensive training or reading of instructions. The resource must not have barriers that can compromise the learner experience.
- The resource should **match the curriculum**. The resource should be aligned to the programme or learning activity planned by the teachers by having clear objectives, relevant content, learning activities and assessment appropriate to the curriculum goals.

What are the features of the core design principles of a good digital educational resource?

According to Becta (2007), the core design principles for digital educational resources are:

- The resource should **support the learner and have robustness**. For that aim, the resource can have support functions that identify common user problems and their solutions, navigational actions that can be undone, quick, auditory, or visual responses to user actions and allow the user to exit at any point.



- The resource should **facilitate human-computer interaction**. To facilitate human-computer interaction, the resource should have icons and navigation that are clear and consistent within the resource, action systems that follow generally used conventions, appropriate visual and auditory cues and feedback, and aesthetics that support the educational objectives.
- The resource should have **quality of assets**. The resource's assets should be accessed consistently and easily, be technically stable and be presented or provided in a commonly accepted format. The use of the resource's assets must respect authors' rights.
- The resource must have an **accessible design**. The resource should ensure that no user (teacher or learner) is unable to use the resource due to their access requirements or preferences.
- The resource must have **interoperability**. The resource should be easily found and identified through resource searching services, run or play in different environments (e.g. browser or learning platforms), and have the rights properly described.
- The resource should have **effective communication**. The resource should ensure that key information, user guidance and known benefits or issues are communicated clearly to teachers and learners. Furthermore, the resource should use a clear and objective language that can be easily understood by the learners.



Which digital resources can I use?

There are many **types of digital resources** that teachers and students can choose to use, such as:

- **Animations** (e.g., [Science Animations of The Royal Society](#)) are very engaging and can be applied to focus students' attention on a topic and to improve their learning.
- **Apps** can be easily installed in smartphones and tablets and many of them have an educational purpose.
- **Digital textbooks** and **open textbooks** (e.g., OpenStax™) can be used by students to learn specific topics anywhere and at any time in several types of devices.
- **Educational games** can help students to learn in a more pleasant way.
- **Graphing calculators** are available online and are resources that can help students learn mathematics.
- **Graphics, infographics, interactive maps** and **interactive graphics** (e.g., [NASA Global Climate Change](#)) can help the students better understand concepts and relations between things.
- **Interactive models** (e.g., [Smithsonian 3D Digitization](#)) can be used to present models of animals, plants, fossils and human biology, chemistry and physics models useful to deepen students' learning.
- **Online assessments** (e.g., Google Forms® and [Socrative](#)®) are useful to provide information to teachers about the students' progress but also for the students having feedback on their learning. Online assessments also have the advantage of auto-correction.
- **Online books, news articles** and other types of online written texts are easily accessible and powerful learning materials.



- **Online courses** (e.g., [edX](#)) with different duration are easily available and are powerful ways of improving students' knowledge of a specific topic.
- **Podcasts** and other audio resources can be very engaging for students because they can listen to them everywhere and use them to better learn different concepts.
- **Simulations** (e.g., [PhET simulations](#)[®]) are very helpful in science and mathematics because they can recreate natural processes, such as plate tectonics, that are hard to explain with static visuals in the classroom.
- **Videos** (e.g., [Khan Academy](#)) can be a powerful tool to explain complex topics.
- **Visuals**, such as public domain illustrations and photographs, 360° photographs can help learners to better understand concepts and the context of certain natural processes or historical events.

The teacher and student should select the most suitable to achieve the learning objectives proposed. For example, the next infographic summarises some specific digital educational resources that can be applied to foster entrepreneurship.

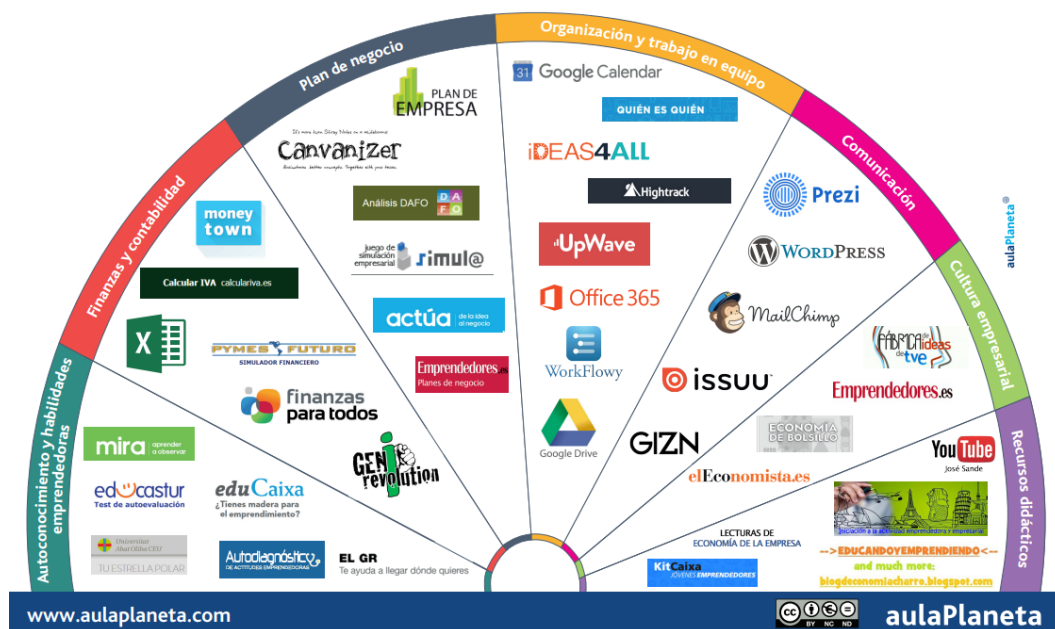


Figure 1. 40 tools to explore entrepreneurship in classrooms (www.aulaplaneta.com; [CC BY-SA 4.0](#)).

In the next online websites, you have a comprehensive **list of digital resources** and their main features:



<https://elearningindustry.com/digital-education-tools-teachers-students>



<https://www.edutopia.org/article/essential-apps-physical-and-digital-classroom>



<https://www.nwea.org/blog/2021/75-digital-tools-apps-teachers-use-to-support-classroom-formative-assessment/>



<https://www.weareteachers.com/free-online-learning-resources/>

When the teachers select the digital resource **most suitable** for the activity, they need to consider the **target group** and whether to apply it **face-to-face** or in an **online learning** setting.

When the students are selecting the digital resources for an activity, they need to reflect on and be able to argue their selection of the digital resource matching the activity the best.

Tip: A good domain of a few digital resources is better than a superficial domain of many digital resources.

EduApp example: [Genially; H5P](#)



03 | Learning activities

Which activities are the students going to do?

Create an effective sequence of activities focused on the students' active work.

The first activity should be used to engage the students in the work and present the problem or issue they are going to research.

The following activities should mobilise students' skills to solve the problem or issue, such as reasoning and problem solving, critical thinking or collaboration.

You can add an elaborative activity for those students who usually want to learn more.

One task, at least, should be used for the students to evaluate their learning and reflect about what they have done and learned and how to progress onwards (transferring knowledge to new contexts).

Notice that the activity should clarify the type of the participation of the learners and indicate the expected time needed to its completion.

When implementing the learning activities, be aware of the emotional state of the students. If they are tired or bored, the efficacy of the activity for their learning could be compromised.

Tip: Use the full potential of the digital resource to achieve a learner centered focus in the students' action. The students should interact with the digital resource and not only have a passive attitude of reading text or listening to a video.

EduApp exemple: [H5P videos](#)



04 | Collaborate

How can students collaborate?

Use the full potential of the digital resource for the students' **collaboration** with each other and with the teachers.

The students should know how they are supposed to collaborate and if there are specific assignments that imply collaboration.

Collaboration between teachers of the same subject or different subjects can be a very good idea for co-creating of the digital educational resource. There are active online communities where teachers share their resources and successful learning experiences in digital environments and enlighten common doubts that other colleagues can have. Respect the licensing of the resource when reusing them.

Tip: Resources such as [Canva](#) can be used for the students do different tasks online at the same time.

EduApp example: [Moodle course](#), [Microsoft Teams](#)



05 | Support

How can I support my students?

Try to give **feedback and feedforward** to your students during their works and not only at the end of the work. The students need to know how they are progressing in the tasks and how they can further improve their skills.

Giving the learners quick, opportune, and frequent formative feedback is a critical factor of success in digital environments. In the creation of learning activities, the teacher should plan strategies for regular feedback and feedforward to the students, using digital technologies for facilitating their progress and intervening when necessary. This process should allow students' autoregulation and offer solutions for them to overcome their difficulties or expand their knowledge.

The teacher could also anticipate the needs of orientation of the students, creating for example, a help section, with frequently asked questions, or video tutorials. Support, feedback and feedforward should highlight the skills already acquired by the learners and offer new possibilities for improvement, for being effective. Feedforward should include tips or strategies that the learners can fulfill the tasks and improve their skills.

The students can also help other students to achieve their goals using collaborative tools.

Tip: Resources such as [H5P](#) or [Kahoot!](#) can be used for the students' assessment and for them to receive immediate feedback.

Resources such as [Moodle](#) and Microsoft [Teams](#) can be used for dialogue-based feedforward.

EduApp example: [Moodle course](#)



06 | Content

Which principles should I take into account when creating digital content?

The cognitive load theory (CLD) is supported in the idea of intrinsic, germane and extraneous cognitive loads (Figure 2).

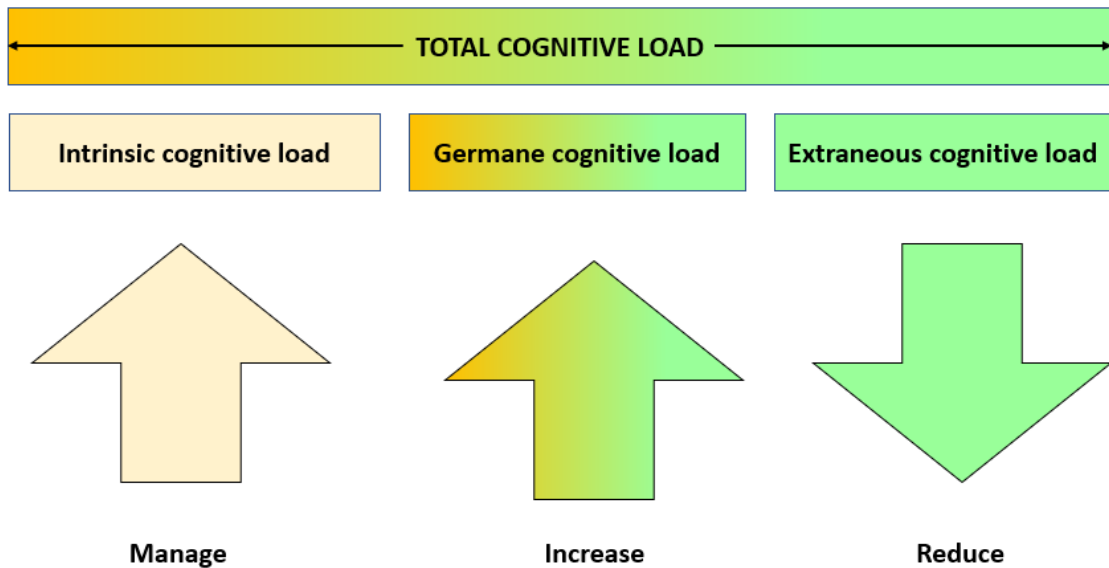


Figure 2. Total cognitive load (adapted from Chong, 2005).

The intrinsic load is related to the complexity of the learning materials that the students intend to mentally learn – therefore it is influenced by the students’ prior knowledge and the level of difficulty of the resource (Chong, 2005). The germane load is the demand placed on the working memory that is imposed by mental activities that contribute directly to learning (Chong, 2005). The extraneous load is related to mental activities during learning that do not contribute directly to learning – this extraneous load should be reduced by a proper design of the learning materials (Chong, 2005). According to the cognitive load theory (CLT):

“Learning will be impaired if the learning content causes a cognitive overload. Since the capacity of the working memory is very limited, the theory assumes that presenting different sources of information in the same modality (for

example, only visually) easily results in a split-attention effect, which leads to poor learning performance. To avoid this, a method suggested by the cognitive load theory is to present information in different modalities (for example, auditory text plus visual displays).” (Chong, 2005, p. 106).

Due to the previous reasons, it is important to manage the intrinsic cognitive load, increase the germane cognitive load, and reduce the extraneous cognitive load. One way of doing that is respecting the multimedia learning principles when designing learning with multimedia materials (see Table 1).

Table 1. Multimedia Learning Principles (Table adapted from Learning House, 2019).

PRINCIPLE	DESCRIPTION	HOW TO ADDRESS	COGNITIVE LOAD EFFECT
Coherence	People learn better when you exclude extraneous material.	<ul style="list-style-type: none"> ● Include only graphics, text, and narration that support learning goals. ● Don't use background music. ● Use simple visuals. 	Reduces extraneous load
Signaling	People learn better when you use cues that highlight the organization of the essential material.	<ul style="list-style-type: none"> ● Use arrows, highlighting, and other signals to draw attention to important information. ● Include a slide that indicates the organization of your presentation and refer back to it when you advance to a new section. 	Reduces extraneous load
Redundancy	People learn better from graphics and narration than from some graphics, narration, and printed text.	<ul style="list-style-type: none"> ● When delivering a narrated presentation, use either graphics or text, but not both. ● Minimize the use of text during a narrated presentation. 	Reduces extraneous load
Spatial Contiguity	People learn better when you present corresponding words and pictures near rather than far from each other on the page or screen.	<ul style="list-style-type: none"> ● Place text in close proximity with the graphics it refers to. ● Provide feedback close to the questions or answers it refers to. ● Present directions on the same screen as an activity. 	Reduces extraneous load

		<ul style="list-style-type: none"> ● Have people read any text before beginning an animated graphic. 	
Temporal Contiguity	People learn better when you present corresponding words and pictures simultaneously rather than successively.	<ul style="list-style-type: none"> ● Time narration appropriately to play along with animations. 	Reduces extraneous load
Segmenting	People learn better when you present a multimedia message in user-paced segments rather than as a continuous unit.	<ul style="list-style-type: none"> ● Allow users to control the pace of the lesson. ● Break down long segments of material into smaller pieces. 	Manages intrinsic load
Pre-training	People learn more deeply from a multimedia message when they know the names and characteristics of the main concepts.	<ul style="list-style-type: none"> ● Define key terms (such as names, definitions, locations, and characteristics) before beginning a process-based presentation, either in a separate presentation, handout, or similar material ● Ensure people know how to use a tool (such as Excel) before asking them to perform learning activities within it. 	Manages intrinsic load
Modality	People learn more deeply from pictures and spoken words than from pictures and printed words.	<ul style="list-style-type: none"> ● During a narrated presentation with graphics, avoid using on-screen text, unless it: <ul style="list-style-type: none"> ○ Lists key steps ○ Provides directions ○ Provides references ○ Presents important information to non-native English speakers 	Manages intrinsic load
Multimedia	People learn better from words and pictures than from words alone.	<ul style="list-style-type: none"> ● Include images to illustrate key points. ● Ensure that all images enhance or clarify meaning. ● Favor static images over animations (with some exceptions). 	Optimizes germane load
Personalization	People learn better from multimedia presentations when you use conversational language (rather than formal).	<ul style="list-style-type: none"> ● Use contractions. ● Use first and second person (“I,” “you,” “we,” “our,” etc.). ● If using a script, try to sound extemporaneous. 	Optimizes germane load

		<ul style="list-style-type: none"> ● Use polite speech (“please,” “you might like to,” “let’s,” etc.). 	
Voice	People learn better when narration is spoken in a human voice rather than in a machine voice.	<ul style="list-style-type: none"> ● Include narration that’s performed by a human rather than a computer. 	Optimizes germane load
Image	People do not necessarily learn better when the speaker’s image is on the screen.	<ul style="list-style-type: none"> ● Avoid including a video of yourself during an asynchronous multimedia presentation containing pictures and words. ● Consider including your face when: <ul style="list-style-type: none"> ○ There are no words or pictures. ○ You wish to establish instructor or social presence 	Optimizes germane load

Adapted from Mayer (2009).

In what ways can I present the content of the resource?

Use text, videos, animations, figures, and other forms to present content. Visuals, such as graphics, schemes, infographics are a good way to present information, tutorials and tasks for the students.

Applying different approaches presenting the content should be considered like storytelling, case studies, problem-solving, the use of reflection tools.

Once the digital resource is ready, share it in Open Educational Resources platforms (OER).

Select a Creative Commons license to share your work.



Tip: Use short but rigorous text. If you can write the same information with 10 words, do not use 20 words! Keep a focus on the learning objectives when you are creating content.

EduApp example: [courses and tutorials](#)



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01 | Learning goals - EduApp example

Countries	Links to Lesson Plans
Denmark	https://eduapp-project.eu/wp-content/uploads/2022/12/Lesson-plan-transfer-genially.pdf
Romania	https://eduapp-project.eu/wp-content/uploads/2023/04/Lesson-Plan-Communication.pdf
Netherlands	Lesson-plan-living-area-Meaningfulness.pdf (eduapp-project.eu)
Portugal	https://eduapp-project.eu/wp-content/uploads/2023/03/Lesson-plan-Portugal.docx-1.pdf
Spain	https://eduapp-project.eu/wp-content/uploads/2023/04/LessonPlan1.pdf

02 | Digital resources - EduApp example

Countries	Links to Genially
Denmark	https://view.genial.ly/624421b65a2d1100181404d5/interactive-content-forflytning
Romania	https://view.genial.ly/62a8b3592e13460011932dcf/interactive-content-copy-comunicarea
Netherlands	https://view.genial.ly/62a8f809af947400111becb8
Portugal	https://view.genial.ly/62442c171d9c5900114a79a0/interactive-content-primeiros-socorros-aplicados-a-criancas



03 | Learning activities - EduApp example

Countries	Links to H5P videos
Denmark	https://eduapp.projekter.eu/wp-admin/admin-ajax.php?action=h5p_embed&id=19
Romania	https://eduapp-project.eu/wp-admin/admin-ajax.php?action=h5p_embed&id=11
Netherlands	https://eduapp-project.eu/wp-admin/admin-ajax.php?action=h5p_embed&id=16
Portugal	https://eduapp-project.eu/wp-admin/admin-ajax.php?action=h5p_embed&id=22
Spain	https://eduapp-project.eu/wp-admin/admin-ajax.php?action=h5p_embed&id=28

04 | Collaborate - EduApp example

Countries	Links to examples
Denmark	https://eduapp.projekter.eu/wp-admin/admin-ajax.php?action=h5p_embed&id=29
Romania	https://youtu.be/hM-SZZVzYnc
Netherlands	https://eduapp-project.eu/wp-admin/admin-ajax.php?action=h5p_embed&id=15
Portugal	https://eduapp-project.eu/wp-admin/admin-ajax.php?action=h5p_embed&id=21
Spain	https://www.youtube.com/watch?v=8v1yUMJrVHc&feature=youtu.be



05 | Support - EduApp example

Countries	Links feedback
Denmark	https://eduapp-project.eu/wp-content/uploads/2022/10/Evaluation-Intramuscular-Injection.pdf
Romania	https://eduapp-project.eu/wp-admin/admin-ajax.php?action=h5p_embed&id=18
Netherlands	https://view.genial.ly/6387c5e0124d8000196d6421/interactive-content-evaluation-intake-interactive
Portugal	https://eduapp-project.eu/wp-admin/admin-ajax.php?action=h5p_embed&id=4
Spain	https://docs.google.com/forms/d/e/1FAIpQLScyQ6PN9vSOU5clWYzTL7qZL-gg-ALcifLGarXc5cqJAs1fXA/viewform

06 | Content - EduApp example

Countries	Links to Courses and Tutorials
Denmark	https://eduapp-project.eu/?page_id=695
Romania	https://eduapp-project.eu/?page_id=662
Netherlands	https://eduapp-project.eu/?page_id=704
Portugal	https://eduapp-project.eu/?page_id=712
Spain	https://eduapp-project.eu/?page_id=724



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