Deliverable Report

Extending Design Thinking with Emerging Digital Technologies

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(Integration of emerging new technologies into education and training)

Deliverable 3.2
Report on Supporting Materials for Teachers and Other Stakeholders

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1 Abbreviations

ChoiCo	Choices with Consequences
DT	Design Thinking
Exten.(D.T.)^2	Extended Squared
GearsBot	Generic Educational Autonomous Robotics Simulator
LNU	Linnaeus University
MaLT2	Machine Lab Turtleworld 2
NKUA	National and Kapodistrian University of Athens
NTNU	Norwegian University of Science and Technology
OU	The Open University
SIMPLE	SIMPLE - SME
SorBET	Sorting Based on Educational Technology
TCD	Trinity College Dublin
UCL	University College London
UGent	Ghent University
WP	Work Package

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4 Summary

This deliverable refers to the development of online supporting material that will enable the application of design thinking with emerging technologies in the classroom. This supporting material refers to, e.g., video tutorials, brief and extensive manuals, and guidelines for the technologies and the educational resources. The resources presented in this deliverable have been designed to address different stakeholders, e.g., students, parents, teachers, policy makers, researchers and they will be further refined after each evaluation cycle.

Table 1 below presents an overview of the deliverable by listing all supporting material produced by the project and the stakeholders that can use each resource.

Table 1: Summary of supporting material produced by the project

Type of material	**Description**	**Stakeholders**
Video materials for teachers and students	Tutorials on how to use different tools namely, ChoiCo, SorBET, MalT2, nQuire for students, GearsBot	Teachers and students
Exten.(D.T.)^2 project video	Introduces the project and invites teachers to take part in the project	Students, parents, teachers, policy makers, researchers
Project flyer for all stakeholders	Presents the Exten.(D.T.)^2 Digital Design Thinking model (see Section 5.7.), emerging digital technologies that the project deploys, details of funders and project partners, and contact information	Students, parents, teachers, policy makers, researchers
Manuals and demos on using technologies	Includes examples and demo games, guides and tutorials, model examples, logo commands MaLT2 etc.	Teachers, students, researchers
Design Thinking Activity Plan Template for teachers	Plan to assist teachers in designing and planning their design thinking activities with students, which is either co-designed by teachers and researchers or by teachers alone	Teachers, researchers
The Exten.(D.T.)^2 Digital Design Thinking model	A tailored version of a design thinking model for use at schools to guide teachers in producing DT activities	Teachers, students, researchers, policy makers

Podcast co-created with the AugMENTOR[1] Team	Explains the overall aim of each project, what both projects envisioned to achieve as a change in education, the technologies both projects use and the added values of those technologies, the activities that have been carried out up until now and their future plans	Students, parents, teachers, policy makers, researchers
Glossary	Explains key terms and concepts related to the project	Students, parents, teachers, policy makers, researchers
Project Reports	Submitted deliverables that aim to inform researchers and academics about the project progress and implementation	Researchers
Newsletters	Disseminate project-related information and any new updates occurring during 4 to 5 months period between each issue	Students, parents, teachers, policy makers, researchers
Teacher training material	Material (a set of slides) for conducting a three-hour workshop	Teachers, researchers
Guidelines for mass deployment	Guidelines on how each of the elements such as design thinking, emerging technologies, teachers' digital transformation background should be approached for implementing the Framework	Teachers, researchers and policy makers
Open Learn Online course for teachers	A course on "Teaching with Design Thinking and Emerging Digital Technologies" which will be hosted on the OU's Open Learn Create platform	Teachers
Publications	Published scientific papers related to the Exten.(D.T.)[2] project	Researchers and policymakers

[1] https://augmentor-project.eu/about-the-project/

5 Introduction

5.1 Objectives

The objective of this deliverable is to report on the supporting materials prepared for teachers and other stakeholders such as students, parents, policymakers and researchers in relation to the implementation of design thinking activities in schools. The material developed serves the objectives of Task 5.3, supporting teachers to design DT activities. It was also provided to the participants of the professional development courses, implemented as part of WP6.

5.2 Video materials for teachers and students

Based on feedback received from teachers, the project partners in Year 2 developed short video tutorials ranging from 1 to 3 minutes to guide teachers on how to use project technologies. Each video explains to users the functionalities of each digital tool, including ChoiCo, SorBET, MaLT2, nQuire for students and GearsBot. The videos mainly show the processes/how-tos of each tool.

5.2.1 ChoiCo

ChoiCo (http://etl.ppp.uoa.gr/choico/) is the educational digital tool that provides opportunity for teachers and students not only to play but also to modify the game components creating their own game versions (see Figure 1 and D3.1). The following short video tutorials have been produced to guide users. These videos are uploaded in a shared google drive and are hyperlinked to the Technologies page of the project website. In addition to the following videos, there are also some videos on the site to provide guidance on the former ChoiCo version.

- Introduction to ChoiCo
- How to play a ChoiCo game
- How to add or delete a choice
- How to add a field
- How to delete a field
- How to add a textual field
- How to set end rules
- How to add instruction for the players
- How to use Google maps
- How to use travel times

Figure 1: A screenshot of a video introducing ChoiCo

5.2.2 SorBET

SorBET (http://etl.ppp.uoa.gr/sorbet/) is a digital tool in which students can design, modify, share and play Tetris-like classification games (see Figure 2 and D3.1).

Figure 2: A screenshot of a SorBET video on how to play a game with a friend

The following short video tutorials have been produced to guide users in using this tool. These videos are uploaded in a shared google drive and are hyperlinked to the Technologies page on the project website.

- Introduction to a SorBET
- How to play with a friend
- How to modify Blockly
- How to modify a data table

5.2.3 MalT2

With MaLT2 (http://etl.ppp.uoa.gr/malt2/) students can create and share animated 2D and 3D figural models with text-based programming and dynamic manipulation. The models can vary from simple cubes to complex DNA models, jewels and fractal trees and anything one can imagine (see Figure 3 and also D3.1). Short video tutorials that guide users are listed below. These videos are uploaded in a shared google drive and are hyperlinked to the Technologies page on the project website.

- Introduction to MaLT2
- How to animate a graphical model
- How to draw a graphical model
- How to export a 3D printer file

Figure 3: A screenshot of a MaLT2 video on how to animate a graphical model

5.2.4 nQuire for students

nQuire for students (https://learn.nquire.org.uk/signin) is an online platform that teachers can use to create a study for their students to take part in or ask their students to create their own studies (see Figure 4 and D3.1). Six mini-video tutorials have been created to guide students and teachers on using this tool. These videos have been uploaded on the project YouTube channel.

- How to login to nQuire for students, change a display name and password (for both teachers and students)
- How to create a class and share student accounts - for teachers
- How to create a mission on 'nQuire for students'
- How to provide feedback on a pilot project
- How to make changes on a pilot project based on feedback
- How a teacher approves a mission and how a student share it with other survey participants

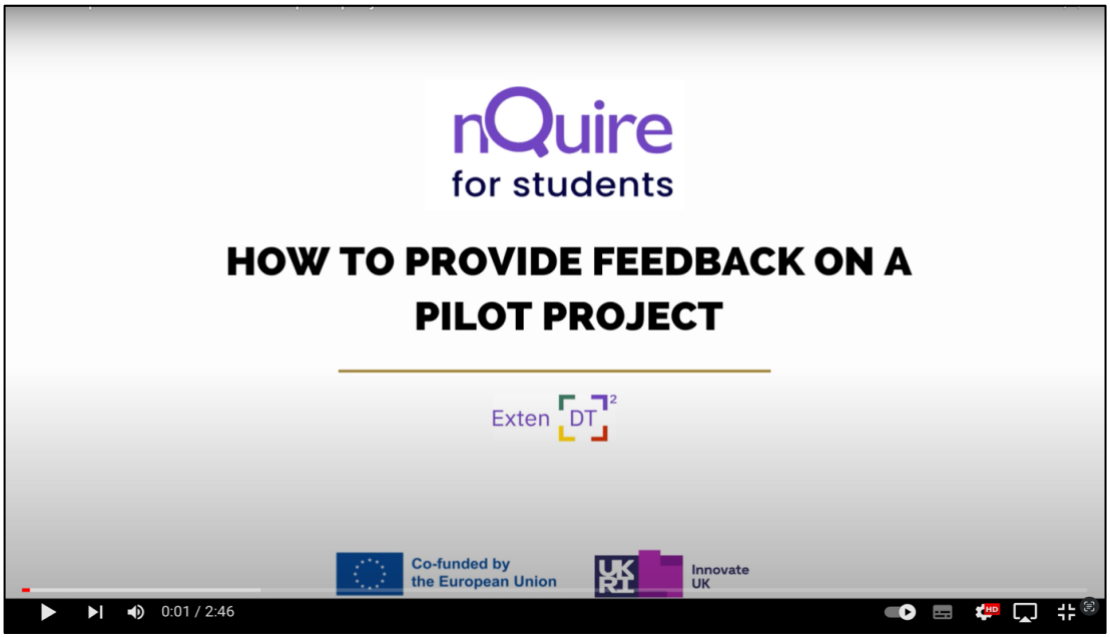


Figure 4: A screenshot of an nQuire for Student tutorial video on how to provide feedback on a pilot project

5.2.5 GearsBot

GearsBot (https://gears.aposteriori.com.sg/) has been added to the project technologies in Year 2. This is an open-source robotics simulator written in JavaScript and Python (see Figure 5 and also D3.1). A short video tutorial is produced to guide users on how to use GearsBot and is uploaded on the project's YouTube channel:
(https://www.youtube.com/watch?v=Zc7tCtucLC8)

Figure 5: A screenshot of a short tutorial on GearsBot

5.3 Exten.(D.T.)^2 project video

Two short videos have been produced to disseminate project information to all stakeholders who want to learn more about the Exten.(D.T.)^2 project.

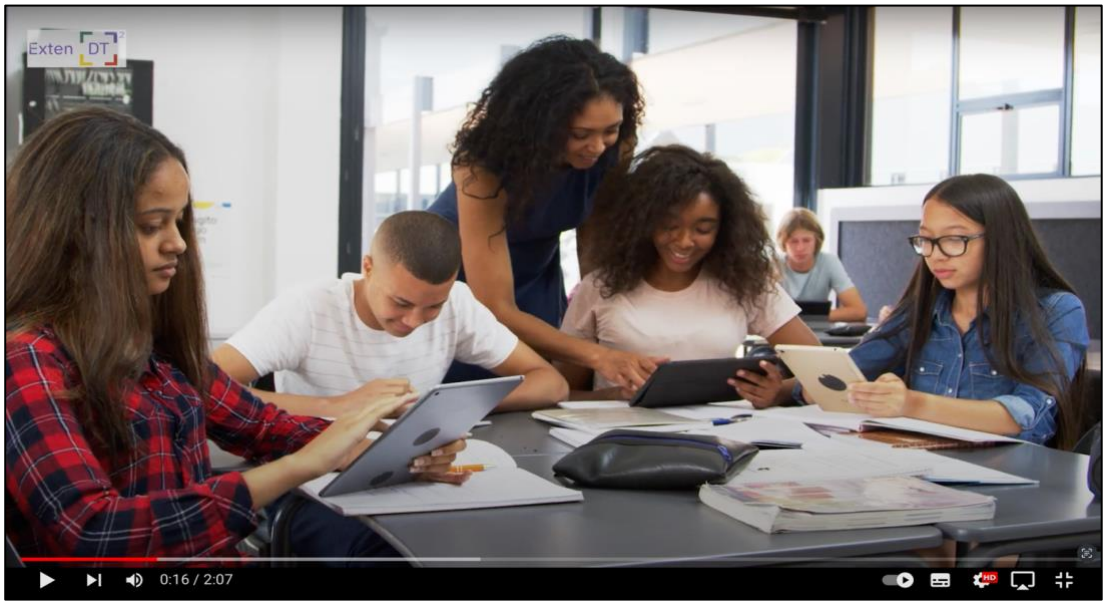


Figure 6: A screenshot of the Exten.(D.T.)^2 video

The first video (Figure 6) gives an overview of the project aims, approach and partners (https://youtu.be/NUao0DGH8iI) and the second video invites teachers to take part in professional development activities the project has designed (https://youtu.be/3EYvvRSdLx0). They are disseminated through the project YouTube channel and project website.

5.4 Project Flyer for all stakeholders

The project partners have prepared a flyer to disseminate project information (Figure 7).

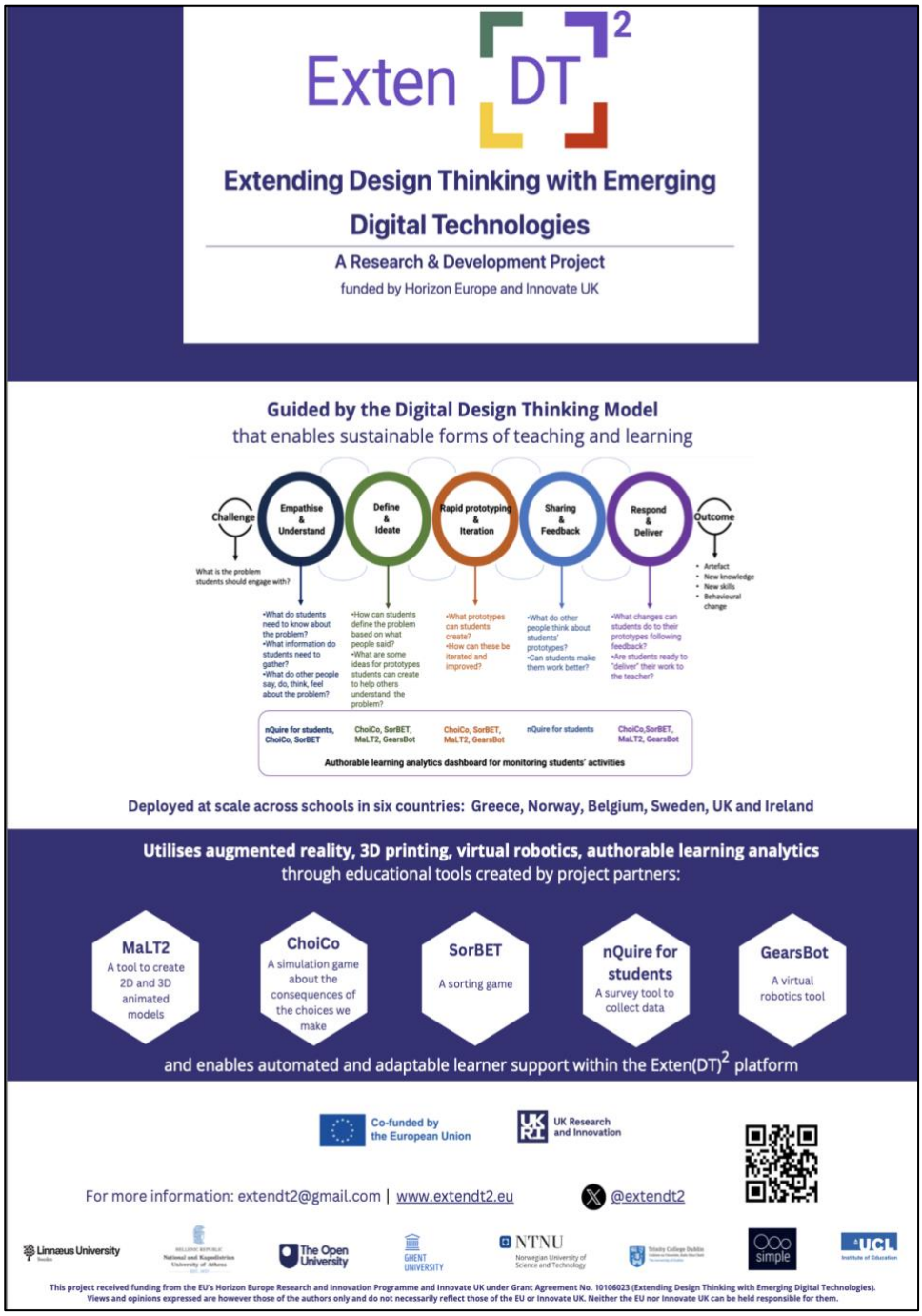


Figure 7: A screenshot of the Exten.(D.T.)² flyer

The flyer presents the Exten.(D.T.)² Digital Design Thinking model (see Section 5.7), emerging digital technologies that the project deploys, details of funders and project partners, and contact information. The purpose of the flyer is to provide important information related to the project in a visual form to interested stakeholders.

5.5 Manuals and demos on using technologies

In Year 1, project members prepared manuals, modal examples, other guides and tutorials to help teachers and students use project technologies. These manuals and guides can be obtained under each technology on the page entitled 'Technologies' on the project website.

Table 2: Supporting materials developed for each technology

Technologies	**Supporting materials**
ChoiCo	Example games, guides and tutorials, ChoiCo extensive manual
SorBET	Demo games, guide and tutorials
MaLT2	Model examples, guide and tutorials, Logo commands MaLT2
nQuire for students	Manual on how to use nQuire for students Manual for teachers on approving and ending launched missions on nQuire for students Video guides
GearsBot	A web link to GearsBot supporting materials

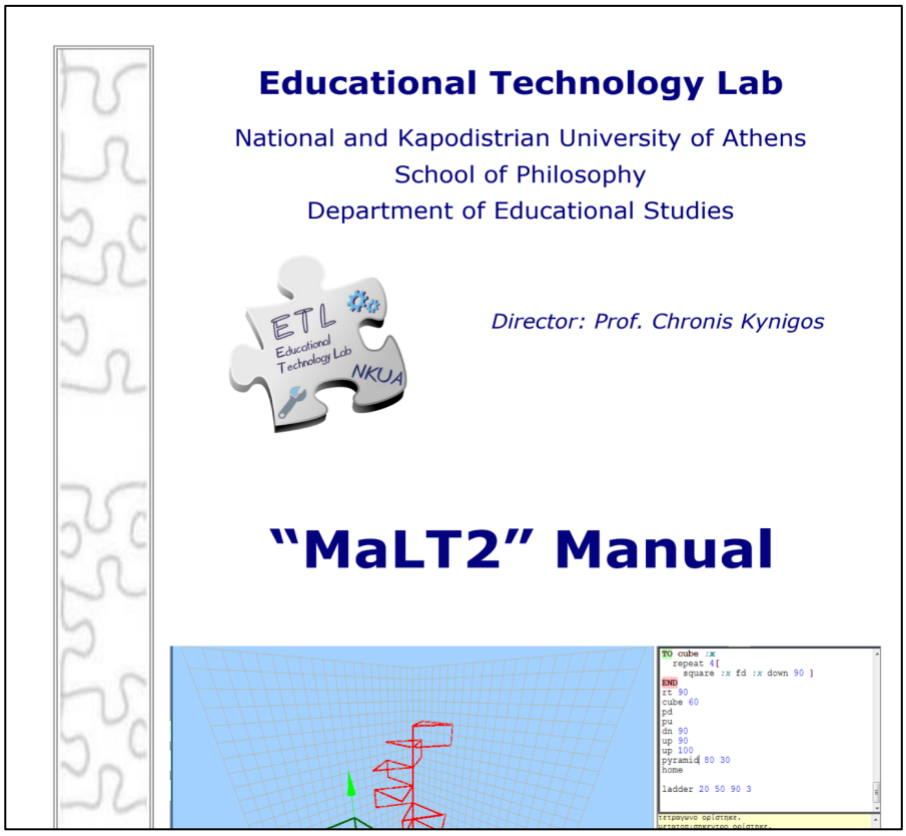


Figure 8: A screenshot of the MaLT2 manual

5.6 Design Thinking Activity Plan Template for teachers

The Design Thinking (DT) activity plan template aims to assist teachers in designing and planning their design thinking activities with students. It is similar to a lesson plan and is either co-designed by teachers and researchers or by teachers alone. It is a strategic document that identifies the critical elements, structure and flow of a DT educational activity with emerging technologies. It is structured in a way that addresses teachers' personal pedagogy, beliefs, knowledge, reflections and practices (See D5.1). It asks teachers to state the problem or issue students are going to deal with in their design thinking project, the learning objectives of the project, details about who the students are, a description of the activities they will carry out at each stage of design thinking and the way the teacher plans to assess student outcomes. The template is available on the project website: https://extendt2.eu/dt-activity-plan-template/, and online on nQuire: https://nquire.org.uk/mission/extendt2-activity-plans-for-teachers/data (Figure 9). It has also been integrated into the ExtenDT2 platform: https://extendt2.com

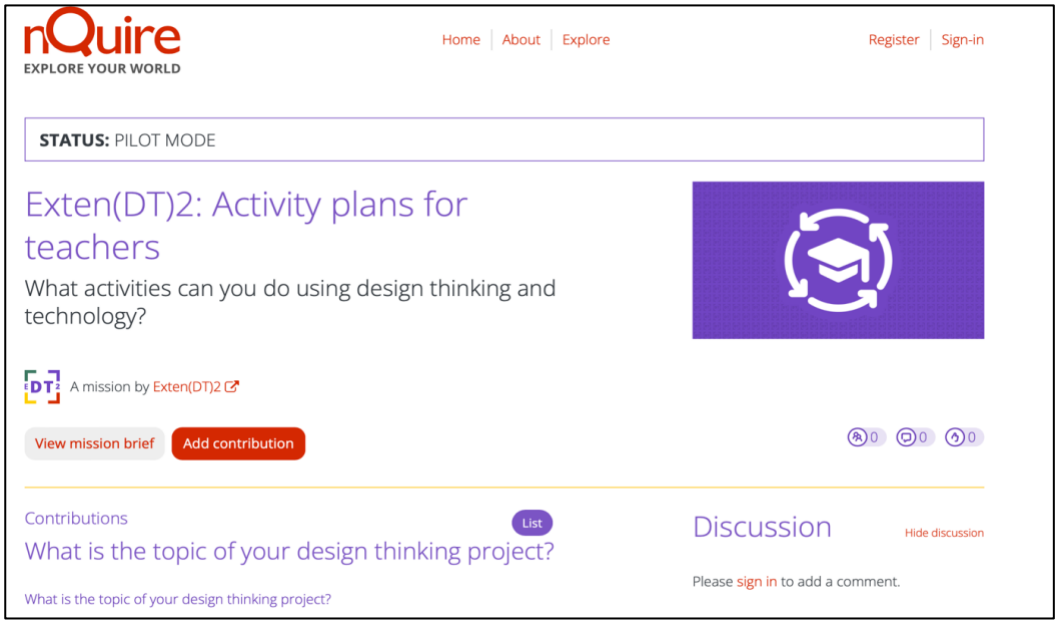


Figure 9: A screenshot of the activity plan made available on the Public nQuire

5.7 The Exten.(D.T.)² Digital Design Thinking model

To guide teachers in producing DT activities, a tailored version of a design thinking model for use at schools has been produced by the project partners, following recommendations from the first cycle of school implementations. This has been coined as the Exten.(D.T.)² Digital Design Thinking model (see Figure 10). The model features the following five stages: empathise and understand, define and ideate, rapid prototyping and iteration, sharing and feedback, and respond and deliver. It prompts teachers to create activities and select project technologies for each stage of DT as defined by the model (see D3.1). The model stages align

with the DT activity plan template; the activity plan template has been structured according to the Exten.(D.T.)² model. A more detailed description on the process and rationale between the development of the model can be found in D5.1.

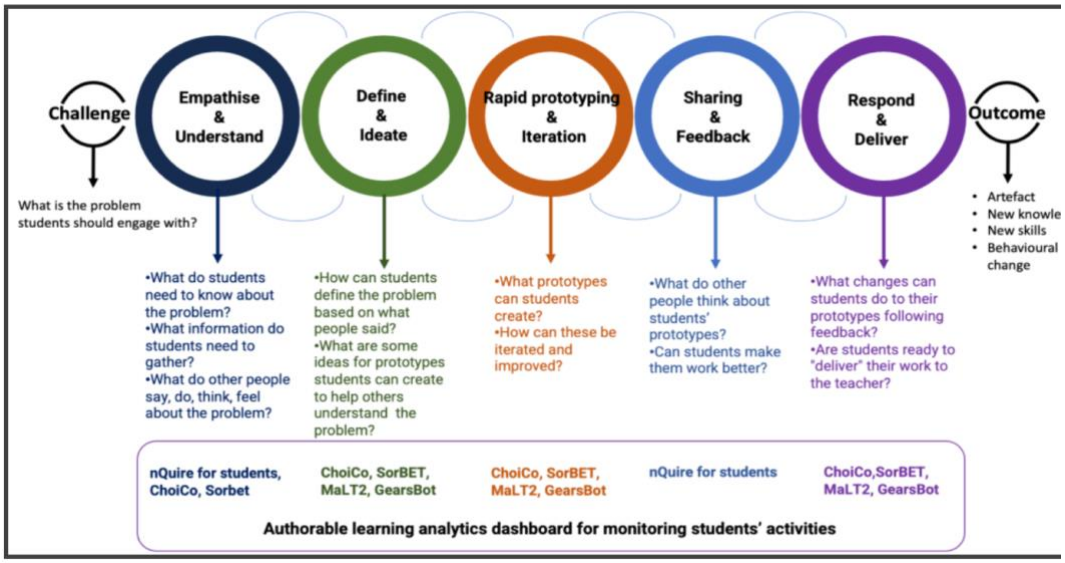


Figure 10: The Exten.(D.T.)² Digital Design Thinking model

5.8 Podcast co-created with the AugMENTOR Team

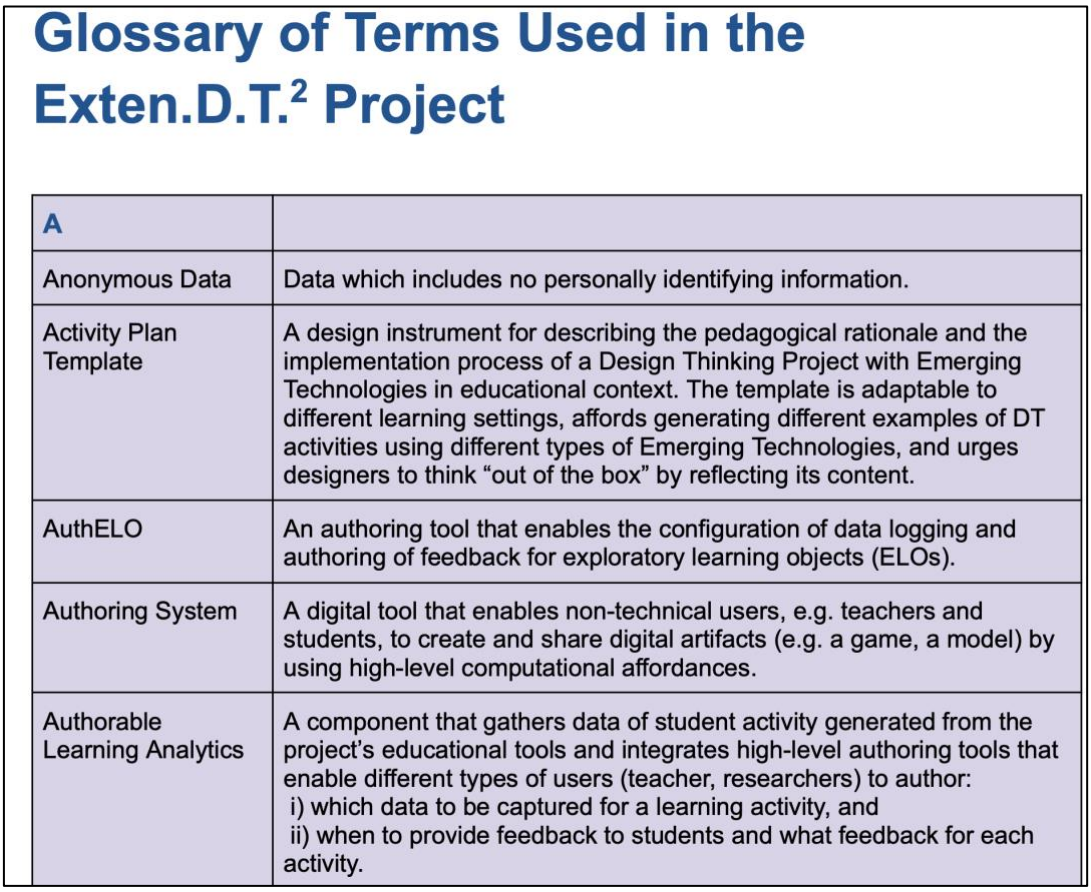
In collaboration with researchers from AugMENTOR, a sister project from the same funded HE call as Exten.(D.T)², a first podcast was produced (Figure 11) and published on 9 January 2024 and shared through the YouTube channels of both projects.

Figure 11: A screenshot of the podcast co-produced with the AugMENTOR Team

The Podcast explains the overall aim of each project, what both projects envision to achieve as a change in education, the technologies both projects use and the added values of those technologies, the activities that have been carried out up until the point of broadcast and the future plans of each project. The podcast was produced to disseminate project related information to other researchers and academics. Researchers Irene Angelica Chounta from AugMENTOR and Sagun Shrestha from Exten.(D.T.)^2 were the podcasters for the first episode.

5.9 Glossary

The team has developed a glossary (Figure 12) explaining key terms and concepts related to the project. It aims to help stakeholders understand key terms related to the project. *(https://extendt2.eu/wp-content/uploads/2023/03/extendt2_glossary_v1_march_2023.pdf).*



Glossary of Terms Used in the Exten.D.T.^{2} Project

A	
Anonymous Data	Data which includes no personally identifying information.
Activity Plan Template	A design instrument for describing the pedagogical rationale and the implementation process of a Design Thinking Project with Emerging Technologies in educational context. The template is adaptable to different learning settings, affords generating different examples of DT activities using different types of Emerging Technologies, and urges designers to think "out of the box" by reflecting its content.
AuthELO	An authoring tool that enables the configuration of data logging and authoring of feedback for exploratory learning objects (ELOs).
Authoring System	A digital tool that enables non-technical users, e.g. teachers and students, to create and share digital artifacts (e.g. a game, a model) by using high-level computational affordances.
Authorable Learning Analytics	A component that gathers data of student activity generated from the project's educational tools and integrates high-level authoring tools that enable different types of users (teacher, researchers) to author: i) which data to be captured for a learning activity, and ii) when to provide feedback to students and what feedback for each activity.

Figure 12: Glossary of terms used in the Exten.(D.T.)^2 project

5.10 Project reports

Project reports (i.e., submitted deliverables) are all classified as public and have been shared online on the project website (https://extendt2.eu/deliverables/). They are aimed to inform researchers and academics about the project progress and implementation. The list of reports is updated accordingly as the project progresses (Figure 13).

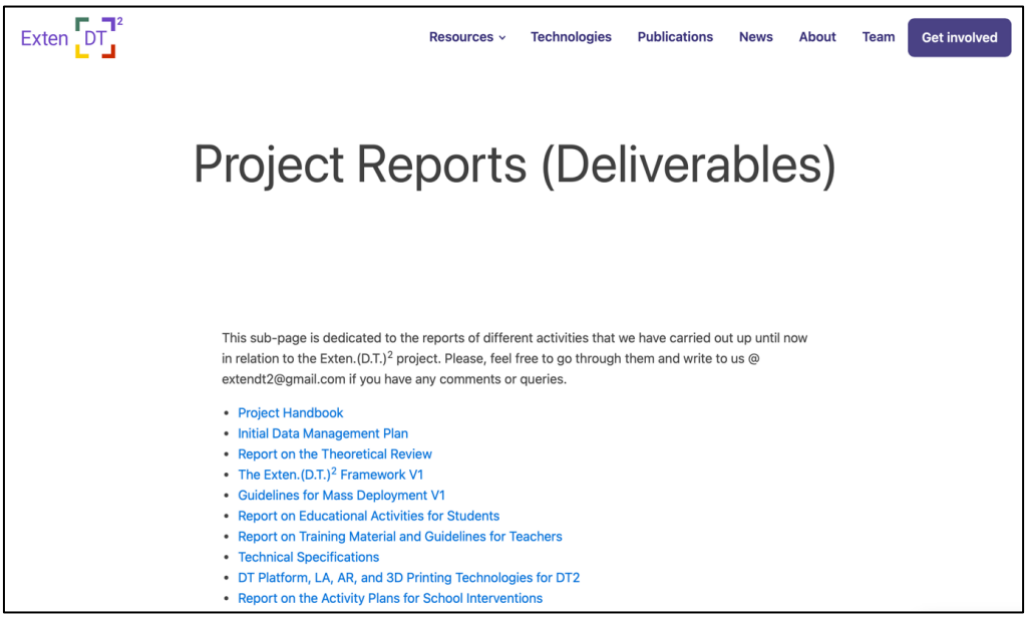


Figure 13: A screenshot of the website that lists project reports

5.11 Newsletters

Four newsletters have been published in March, July and December 2023, and May 2024 (Figure 14).

Figure 14: A screenshot of the latest newsletter, May 2024 issue

They disseminate project-related information and project news every 3-4 months. All newsletters can be accessed via the project website (https://extendt2.eu/our-news/).

5.12 Teacher training material

Material (a set of slides) for conducting a three-hour workshop with teachers has been produced. This material covers three different components: The first component incorporates what design thinking is, how it differs from problem-based learning, what the different popular models of DT are and presented the Exten.(D.T.)^2 Digital Design Thinking model developed by the project. The second component details how to access and use project technologies via the ExtenDT 2 platform. The third component presents the DT activity plan template and encourages discussion on how to fill in each part of it. This material has been used to design a first version of the Open Learn online course for teachers (See Section 5.14)

5.13 Guidelines for mass deployment

The guidelines for mass deployment are connected to the first version of the Exten.(D.T.)^2 Framework [V1] which was formed at the early stages of the project based on the literature and consultations with stakeholders, as part of WP2. The Framework has important elements, including components, perspectives, and competences in relation to design thinking, emerging technologies, teachers' digital competences among others, followed by guidelines on how these should be approached. The Exten.(D.T.)^2 Framework and the guidelines are shown below (and described in detail on the project's website: (.https://extendt2.eu/guidelines-for-mass-deployment/). This will be useful to any relevant stakeholders of DT learning who may be interested in incorporating digital technologies in their practices.

Figure 15 uses the tree as a metaphor to symbolise various aspects of supporting Design Thinking (DT) with Emerging Technologies (ET).

- The trunk symbolises the different actors (component shown in red block) in this context who will be empowered by their competencies to actively engage in the DT activities with ET.
- The cluster of leaves represents the five core components (shown in the red bubbles) that are related to the actor component and are essential for supporting DT with ET.
- Perspectives (presented in the green text, lines and arrows) are listed around the tree as crucial considerations (next to the components), which symbolise the air to promote the growth of the tree.
- The roots signify the foundational competencies (shown in the purple boxes with arrows) that students, teachers, or educational stakeholders possess. These suggest that branches should be connected to the roots, and they are the essential building

blocks for further growth and development and underpin effective DT learning with ET.

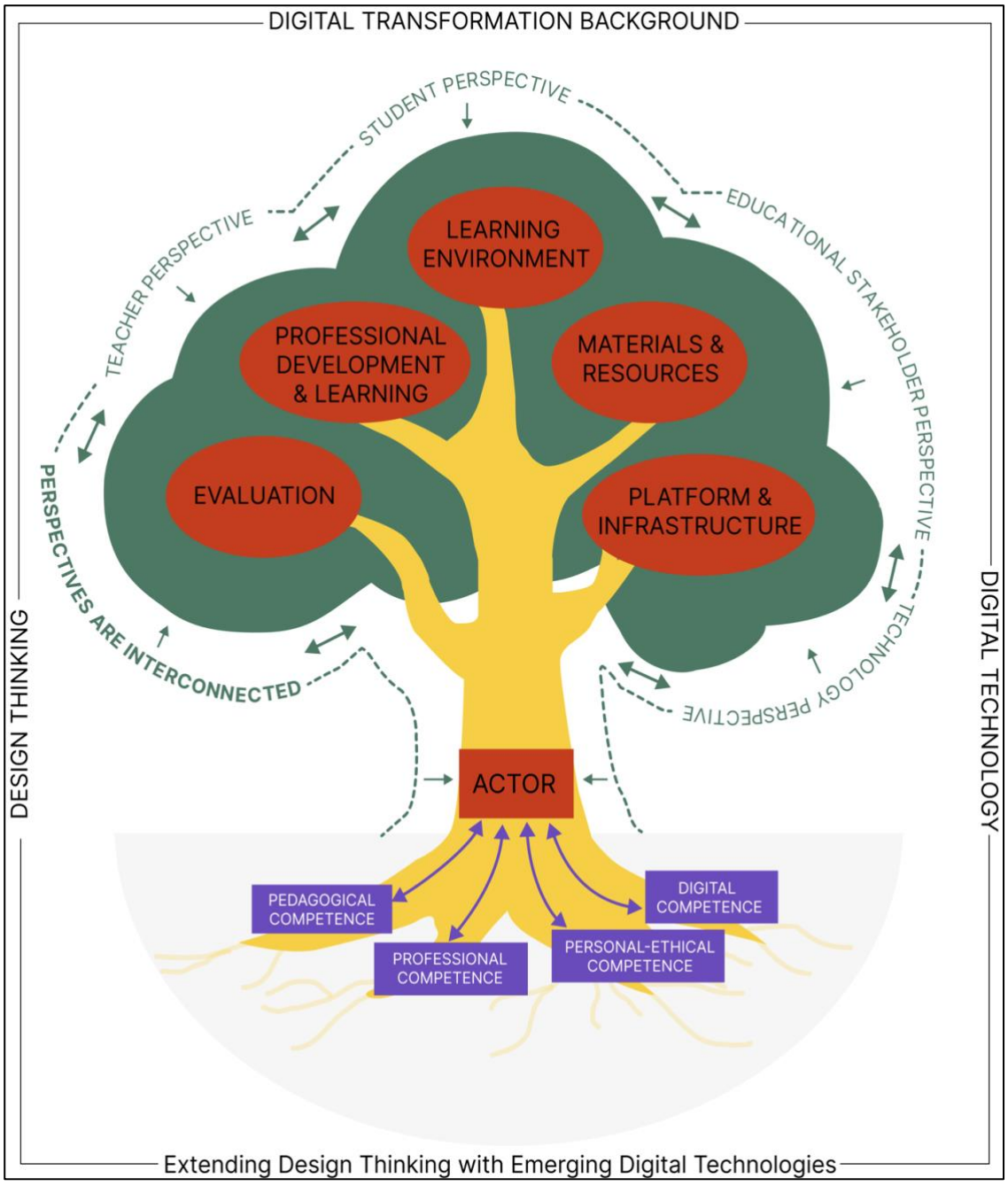


Figure 15: A tree metaphor

Members of the project team involved in WP2 have produced guidelines on how each of the above elements should be approached for implementing the Framework reaching a broad audience.

5.14 Open Learn online course for teachers

The first version of a professional development online course on "Teaching with Design Thinking and Emerging Digital Technologies" has been created. It will be hosted on the OU's Open Learn Create platform (https://www.open.edu/openlearncreate/). The course aims to help teachers:

- Explain to their students what design thinking is and why the Exten.(D.T.)² Digital Design Thinking Model can help them to teach DT in the classroom.
- Demonstrate the added value of using digital technologies for DT activities.
- Experiment with project's digital technologies and reflect on which ones to use in their own DT projects.
- Identify problems relevant to students' needs that can be solved using DT.
- Develop an activity plan teachers can implement with their students.

The course will be piloted in each partner country in August 2024, revised and made live by October 2024. It should reach approximately 2 000 participants. It is a powerful means of disseminating project outcomes at a national and international level.

5.15 Publications

So far, ten (N=10) papers related to the Exten.(D.T.)² project (see Table 3) have been published as open access on different scientific publication platforms. More details about each publication can be found on this page: https://extendt2.eu/publications/.

Table 3: Publications related to the Exten.(D.T.)² project

Paper title	Authors	Publication venue
Learning Analytics for Open Learning Environments: Connection to 21st Century Skills	Sokratis Karkalas, Alisa Lincke and Marianthi Grizioti	Methodologies and Intelligent Systems for Technology Enhanced Learning, Workshops - 14th International Conference (Mis4TEL 2024) URL not available yet
Using the Repertory Grid Technique in a Co-design Process for Learning Analytics: Conceptualisation and Connection to 21st Century Skills	Sokratis Karkalas, Filothei Chalvatza, Manolis Mavrikis, and Maria-Stella Nikolaou	Methodologies and Intelligent Systems for Technology Enhanced Learning, Workshops - 14th International Conference (Mis4TEL 2024) URL not available yet
Teaching and learning with design thinking and emerging digital technologies in K-12: Impact on students and teaching recommendations	Christothea Herodotou, Sagun Shrestha, Feiran Zhang, Christina Gkreka, Carina Girvan, et al.	Methodologies and Intelligent Systems for Technology Enhanced Learning, Workshops - 14th International Conference (Mis4TEL 2024) URL not available yet

Design Thinking Activities for K-12 Students: Multi-Modal Data Explanations on Coding Performance	Isabella Possaghi, Feiran Zhang, Kshitij Sharma and Sofia Papavlasopoulou	IDC '24: Proceedings of the 23rd Annual ACM Interaction Design and Children Conference (https://dl.acm.org/doi/10.1145/3628516.3655786) Open access
High-performing Groups during Children's Collaborative Coding Activities: What Can Multimodal Data Tell Us?	Feiran Zhang, Isabella Possaghi, Kshitij Sharma, and Sofia Papavlasopoulou	IDC '24: Proceedings of the 23rd Annual ACM Interaction Design and Children Conference (https://dl.acm.org/doi/10.1145/3628516.3655805) Open access
Combining Design Thinking with Emerging Technologies in K-12 Education	Marcelo Milrad, Christothea Herodotou, Marianthi Grizioti, Alisa Lincke, Carina Girvan, Sofia Papavlasopoulou, Sagun Shrestha and Feiran Zhang	Methodologies and Intelligent Systems for Technology Enhanced Learning, Workshops - 13th International Conference (MIS4TEL 2023) (https://link.springer.com/chapter/10.1007/978-3-031-42134-1_2) Open access
Classification and Mathematical Thinking: Tinkering with Classification Games in a Constructionist Environment	Chronis Kynigos, Marianthi Grizioti and Maria Latsi	Digital Experience in Mathematics education (https://link.springer.com/article/10.1007/s40751-023-00131-8) Open access
Integrating Computational Thinking and Data Science: The Case of Modding Classification Games	Marianthi Grizioti and Chronis Kynigos	Informatics in Education (https://infedu.vu.lt/journal/INFEDU/article/766/info) Open access
Intelligent techniques in e-learning: a literature review	Miloš Ilić, Vladmir Mikić, Lazar Kopanja and Boban Vesin	Artificial Intelligence Review (https://link.springer.com/article/10.1007/s10462-023-10508-1) Open access
Online Polyglot Programming Education with LFT (Lingua Franca Transformer)	Socrates Karkalas, Filothei Chalvatza and Manolis Mavrikis	Proceedings of the 15th International Conference on Computer Supported Education - Volume 1: CSEDU (https://www.scitepress.org/PublicationsDetail.aspx?ID=2THeW75pJrg=&t=1) Open access

6 Conclusions

A wide range of supporting materials, such as video tutorials, text-based guidelines, an online course, have been produced and are disseminated to a range of stakeholders, such as teachers, students and researchers to help them to understand and implement DT activities. Additional resources targeting policy makers will be produced after Year 2 data analysis is completed (August 2024). This includes a policy brief created in collaboration with sister projects. In preparation of this activity, a list of policy makers has been compiled capturing relevant bodies in each partner country. Amongst these are organisations such as Scientix, eTwinning and Ecsite. In addition, we applied and will receive support for dissemination activities from the Horizon Results Booster (activities are expected to start in October 2024). The support will target dissemination of project outcomes and achieving impact at the school/teacher level and policy level across participating countries.