

Extending Design Thinking with Emerging Digital Technologies



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Periodic Technical Report (Part B)

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Abbreviations

Abbreviation	Definition
ALA	Authorable Learning Analytics
AR	Augmented Reality
AWS	Amazon Web Services
ChoiCo	Choices with Consequences
DT	Design Thinking
ET	Emerging Technologies
Exten.(D.T.) ²	Extending Design Thinking with Emerging Digital Technologies
LNU	Linnaeus University
LA	Learning Analytics
MaLT2	Machine Lab Turtleworlds 2
NKUA	National and Kapodistrian University of Athens
NTNU	Norwegian University of Science and Technology
OU	The Open University
RP1	Reporting Period 1 (1 September 2022 - 29 February 2024)
RP2	Reporting Period 2 (1 March 2024 - 31 August 2025)
SIMPLE	SIMPLE (SME)
SmILE	Smart Interactive Learning Ecosystem
SorBET	Sorting Based on Educational Teaching
TCD	Trinity College Dublin
TPD	Teacher Professional Development
UCL	University College London
UGent	Ghent University

EXPLANATION OF THE WORK CARRIED OUT AND OVERVIEW OF THE PROGRESS

Extending Design Thinking with Emerging Digital Technologies (Exten(D.T.)²)

1. Project Summary

1.1 Context and Overall Objectives

The Extending Design Thinking with Emerging Digital Technologies (Exten.(D.T.)²) research project emerges against a backdrop of rapid advancements in digital media, where new technologies supersede older ones. Focused on educational innovation, particularly in mainstream schooling, Exten.(D.T.)² seeks to integrate design thinking (DT) approaches with cutting-edge digital tools, recognizing their potential to significantly change everyday educational practices. Leveraging four established digital systems and a web-based communication platform, the project aims to enhance them with features like embodied interactions, 3D printing, and authorable AI-analytics.

Exten.(D.T.)² aims to go beyond the state of the art by showing how emerging digital technologies may serve and enhance tried and tested digital solutions to uniquely support transforming educational practice in the digital era. The project's ambitious goal involves developing these digital affordances to a level of technical readiness suitable for deployment in schools, ensuring empirical validation of their educational added value. This requires excellent collaboration and coordination between the project partners, teacher professional development in design thinking pedagogy to align with real-world school practices, and rigorous evaluation of user experiences to inform policy guidelines for broader implementation.

Spanning six European countries and engaging thousands of K-12 students in multidisciplinary co-creation activities during its 36 month span, Exten.(D.T.)² explores the potentials and challenges of integrating Emerging Technologies into pedagogical practices. By fostering 21st Century skills and expanding the reach of DT in mainstream schooling, the project aims to significantly impact educational landscapes across Europe. Through its multidimensional approach and extensive scale, Exten.(D.T.)² aims to redefine educational paradigms, ultimately contributing to the advancement of EU policy priorities in digital literacy, skill development, and innovative education strategies.

1.2 Work Performed and Main Achievements

During the first 18 months, the project developed the Exten.(D.T.)² framework through a comprehensive literature review, identifying key practices, challenges, and requirements to enhance DT with Emerging Technologies effectively. This served as the foundation for creating the framework and accompanying guidelines, essential for deploying Exten.(D.T.)² across various learning contexts. Co-design and co-development activities focused on leveraging project technologies to teach DT, resulting in the creation of educational activities and a toolkit for classroom implementation. These efforts produced a range of digital artefacts, including games and simulations addressing environmental, cybersecurity, and sustainable development issues.

The work on shaping technologies, i.e., extending well-established and widely used digital educational solutions with emerging technologies for the digital enhancement and transformation of DT learning, saw the refinement and integration of tools, such as MaLT2, ChoiCo and nQuire and, with features like 3D printing and augmented reality, consolidated into the ExtenDT2 platform. Pilot school interventions involving over 200 students and teachers showcased the project's impact, generating datasets and insights for further refinement. Professional Development initiatives introduced teacher training modules, emphasizing the innovative potential of DT for addressing wicked problems. Evaluation

methodologies were conceptualized and devised, incorporating qualitative and quantitative data collection to assess project activities effectively. Ethical considerations were also carefully addressed, ensuring participant consent and data privacy adherence. Overall, Exten.(D.T.)²'s ongoing scientific and technical efforts promise transformative impacts on educational practices, aligning with EU objectives for digital literacy and innovative pedagogies.

1.3 Results Beyond the State of the Art

Exten.(D.T.)² aims to represent a significant advancement in educational innovation by seamlessly integrating DT with cutting-edge emergent digital technologies. Through meticulous co-design and co-development efforts, the project has produced a comprehensive framework and accompanying guidelines, empowering educators to deploy these innovative practices effectively. Leveraging advanced technologies like 3D printing, augmented reality and authoritative AI-analytics, Exten.(D.T.)² is creating a diverse range of educational tools and materials, enriching classroom experiences and nurturing 21st Century skills among students. Pilot school interventions, involving over 212 students and their teachers in Year 1, have yielded invaluable insights and data for further refinement. Professional development initiatives underscore the project's commitment to capacity building, ensuring sustainable implementation. Rigorous evaluation methodologies and ethical considerations guarantee the project's integrity and impact. Exten.(D.T.)²'s holistic approach promises to reshape educational landscapes, aligning with EU priorities for digital literacy and innovative pedagogies.

Key Needs for Further Uptake and Success:

To ensure the continued success and widespread adoption of Exten.(D.T.)², strategic efforts are needed to refine and validate the framework through further research and demonstration projects across diverse educational contexts. Access to markets, financial support and developing a sustainable business model to support the technical infrastructure and activities will be essential for scaling up production and dissemination of project outputs beyond the duration of the project. International collaboration efforts should be intensified to foster knowledge exchange and cross-border cooperation within and outside Europe. Additionally, establishing a supportive regulatory and standardization framework will facilitate seamless integration into existing educational systems. Addressing these needs will maximize the potential impact of Exten.(D.T.)², catalyzing transformative change in education across Europe and beyond. Exploring different ways for commercialization and providing support for intellectual property rights could enhance accessibility and sustainability beyond the project's lifetime.

1.4 Policy Relevant Evidence of Exten.(D.T.)² Project

The integration of design thinking and emergent digital technologies presents a transformative opportunity for European education systems, as evidenced by our project's preliminary findings. These findings demonstrate significant advancements in students' 21st Century skills, particularly in communication, collaboration, and programming. To leverage this innovation effectively, policy measures must prioritize comprehensive teacher training in both technology utilization and design thinking methodologies. This includes access to diverse technological tools such as online games, 3D modeling, and virtual robotics. Facilitating communication and knowledge sharing among educators across Europe is crucial for widespread adoption. Additionally, enacting supportive school legislation that empowers teachers with expertise in design thinking to train and support their colleagues will further enhance implementation efforts. These initial suggestions for policy recommendations align with EU priorities for promoting digital literacy, skill development, and educational innovation, ultimately contributing to the creation of more sustainable education ecosystems continent-wide.

2. Project Objectives

Exten.(D.T.)² aims to use Artificial Intelligence (AI); Augmented Reality (AR); 3D printing; and Virtual Robotics technologies, in order to enhance the pedagogical value, sustainable digitization and potential for wide deployment of Design Thinking (DT). Below are the five specific project objectives (PO) and a summary of the progress towards the achievement of each:

PO1: Design, develop, implement and scale-up a transformative pedagogical intervention, for supporting the implementation, monitoring and evaluation of Design Thinking projects digitally extended with emerging technologies. This will be done by:

- a) Extending a set of existing expressive digital constructionist learning tools designed to support the implementation of design thinking projects in online or blended learning settings and to foster 21st Century skills in students. The project will extend well-studied and widely used technological tools, namely MaLT2¹, ChoiCo², SorBET³, Cyberbotics⁴, with emerging technologies that bring added value into DT learning, i.e., Augmented Reality games, 3D printing/scanning of programmable models and Virtual Robotics.
- b) Mobilising and extending the existing and already widely used online platform nQuire⁵, where all these tools and DT activities will become available for wide use and learning at scale. It will also be a safe space for students to share digital productions and engage in discussion and discourse around their affordances and embedded socio-scientific content.
- c) Mobilising the co-creation Planet⁶, an existing and already used innovative online platform especially designed to support DT projects, which will be used in teacher professional development courses.
- d) Developing an Authorable Learning Analytics (ALA) system and a customizable dashboard enabling different educational stakeholders to get involved in the design of digital resources for DT (teachers, researchers, educational designers) with the capability of customizing the kinds of information they need to assess learner's creative learning and the kinds of automated reactions they wish the tool to provide to learners.

PO1 Summary status: On-track, achievable by M36

During the first 18 months the following has been done towards the progress of PO1:

- (a) WP4: The MaLT2 learning tool has been extended with 3D printing technology and Learning Analytics. The ChoiCo and SorBET learning tools have been extended to allow the design and play of Augmented Reality games (Google Maps with geolocation and real-time traffic data affecting the game in ChoiCo, and gesture recognition of multiple players to manipulate virtual objects using hands in SorBET). Both tools were also extended with Learning Analytics. Instead of Cyberbotics we chose to use and extend with Learning Analytics the Virtual Robotics tool GearsBot. GearsBot was chosen over Cyberbotics, since it is web-based and open source with good documentation. Furthermore cyberbotics is available only as a desktop application which makes it incompatible with the Exten.(D.T.)² web-based platforms (nQuire and ExtenDT2 platform).

¹ <http://etl.ppp.uoa.gr/malt2/>

² <http://etl.ppp.uoa.gr/choico/>

³ <http://etl.ppp.uoa.gr/sorbet/>

⁴ <https://cyberbotics.com>

⁵ <https://nquire.org.uk>

⁶ <http://cocreationplanet.eu>

WP5: The evaluation of pilot interventions implemented in Year 1 informed the extension of the digital learning tools in a meaningful way that meets the needs of teachers and students regarding digital DT in K-12 education.

- (b) WP3, WP4 & WP5: A new version of nQuire, coined as “nQuire for students” has been designed offering to students and teachers a password protected online space for conducting research studies as part of DT projects. nQuire for students has been connected with the ExtenDT2 platform⁷ hosting all other project tools and relevant DT activities. The DT Activity Plan Template, has been integrated into the nQuire platform and used by teachers and researchers to co-design and structure the DT activities for Cycle 2.
- (c) WP5 & WP6: The co-creation planet will be used in conjunction with the DT Activity Plan Template in professional development courses of Cycle 2, as tools to support teachers learning about the DT process and its implementation in the classroom.
- (d) WP3, WP4 & WP5: Learning Analytics (LA) has been developed and added to the learning tools (MaLT2, ChoiCo, SorBET). LA collects different user interaction event data with a learning tool (see D 4.1). The Virtual Robotics tool, GearsBot⁸ has been integrated with the ExtenDT2 platform. The first prototype of the dashboard for teachers has been created. Three participatory design workshops with teachers provided information on how teachers perceive 21st Century skills learning through the Exten.(D.T)² learning tools and contributed to the design of the ALA component and the customizable dashboard. The dashboard provides an overview of the learning activities using the data collected by LA. nQuire for students will be contributing data to the dashboard that teachers can use to capture students' engagement and provide support when and if needed. Data will be in the form of e.g., number of studies launched, in pilot or in draft, last time a student logged in, number of contributions, number of comments. It will be tested by the end users in the second half of the project.

PO2: Bring together different stakeholders in rethinking the nature of emerging technologies for design thinking activities by co-creating Exten.(D.T.)² resources and technologies for inclusive learning. This will be done through:

- a) Exten.(D.T.)² experts co-designing with stakeholders, i.e., teachers and policy-makers, a set of DT activities and associated material (e.g., lesson plans) that will tackle current wicked problems such as biodiversity, climate change, gender roles and migration, and support the development of 21st Century skills.
- b) Exten.(D.T.)² experts actively involving 250-300 teachers in a participatory process of design, data collection, analysis and feedback for DT activities.
- c) Exten.(D.T.)² experts co-producing with stakeholders a set of digital resources (e.g., AR games, digital 3D printable artefacts) to support the digital implementation of DT activities, by utilizing the project's extended technologies.

PO2 Summary status: On-track, achievable by M36

During the first 18 months the following has been done towards the progress of PO2:

- (a) (b) and (c):

⁷ extendt2.com

⁸ <https://gears.aposteriori.com.sg/>

WP3 & WP5: The two WPs have collaborated together on co-design workshops and activities. Teachers have had an active role in co-designing DT activities and resources, including the DT Activity Plan and the digital games and models, for school interventions in Years 1 and 2. 145 teachers have participated so far in co-design workshops across six countries. During the workshops, teachers received training about the project's approach to DT and were supported in drafting lesson plans for use with their students. Each lesson plan includes information related to activities to be carried out at each stage of design thinking, ways of assessing student outcomes, learning objectives of the DT project, social orchestration, teaching resources, and details about what the students' needs are. 21st Century skills and context-related considerations such as group formation, class setting, teacher role, and assessment methods have been taken into account in the participatory process. Wicked problems explored so far include cybersecurity, climate change, seawater pollution and sustainable transportation.

WP6: As part of the professional development activities, the teachers in interdisciplinary groups have developed and co-created design thinking activities and associated materials (e.g., activity plan template) on wicked problems and shared their experiences on the methodology and the technologies with the researchers by means of the evaluation tools developed by (WP7) or by discussions. This feedback has informed WP3, WP4 and WP6.

WP7 has provided evidence from school interventions and professional development activities which have informed the development of co-design activities with teachers, technology development and professional development activities (WP3, WP4 & WP6).

PO3: Support Teacher Professional Development (TPD) concerning the necessary competencies for the meaningful exploitation of the project's technologies in DT activities. This will be achieved through:

- a) A free online course on Open Learn, potentially reaching more than 60M citizens worldwide.
- b) Integration of the Exten.(D.T.)² approach and technologies in at least 5 existing academic courses about effective pedagogies to pre- and in-service teachers.
- c) Design and develop specialized TPD-accredited modules providing oriented knowledge and experience as well as support for infusing such an activity in mainstream institutions.
- d) Providing teachers with Exten.(D.T.)² experts' research knowledge on teacher's needs and challenges concerning the use of the project's technologies in the context of design thinking education which will be derived from the above channels, and proposing evidence-based mitigation actions emerging from the project evaluation.

PO3 Summary status: On-track, achievable by M36

During the first 18 months the following has been done towards the progress of PO3:

- (a) WP3, WP4, WP6: In order to potentially reach 60M citizens worldwide, a full draft of an online course, to be hosted on the Open Learn online platform has been co-produced with project partners integrating project's technologies, manuals and other supporting materials such as the DT Activity Plan Template and relevant hands-on activities as well as the new Exten.(D.T.)² Digital DT model produced by the project for use with students and teachers. The draft outline is edited by the OU's production team and changes will be addressed by project partners before this is transferred to the Open Learn platform. A certificate and a badge will be offered to teachers as evidence of completion. Within WP3 a new version of nQuire, coined as "nQuire for students" has been designed which offers to students and teachers a password protected online space for conducting research studies as part of DT

projects. nQuire for students has been connected with the ExtenDT2 platform hosting all other project tools and relevant DT activities.

(b) WP2, WP3, WP4, WP6, WP7: in Year 1, based on the Exten.(D.T.)² framework (WP2), learning modules on implementation of digitally enhanced DT projects were developed, and piloted into three existing academic teacher education courses by NKUA and UGent as part of Professional Development (PD) in WP6. Teachers of these courses used the supporting materials from WP3, including the template and the DT Activity Plans examples, to become familiar with implementing DT with digital technologies in the classroom and to design their DT Plans. Informed by evidence from WP7, in Year 2, revised learning modules are being used, and integrated in the newly developed ExtenDT2 platform (WP4), and the extended versions of the technologies. Also in addition to the new version of nQuire, nQuire for students, see above, the Activity Plan Template has been used to structure the training workshops implemented with teachers in the OU and NKUA. These are also considered part of PD and have a central role in the online course that is developed to reach more teachers.

(c) and (d)

WP3: nQuire for students is contributing data to the authorable learning analytics dashboard that teachers can use to capture students' engagement and provide support when and if needed. Data is in the form of: e.g., number of studies launched, in pilot or in draft, last time a student logged in, number of contributions, number of comments.

WP6: At 1 partner institute (UGent), the second implementation cycle in one academic course has started, reaching 65 pre-service teachers. Preliminary feedback on the use of the ExtenDT2 platform and the extended technologies has been given to partners in WP4, the extensive evaluation using the WP7 toolkit will be analysed in a further stage of the process. The second cycle implementation at other partner institutes has not yet started.

WP7: Analysis and report on the evaluation of activities and tools used during PD activities has provided evidence for the ongoing design and development of modules taking into account teachers' needs and challenges. Identified challenges concerned the DT methodology, the technologies and the acquisition of 21st Century skills. Based on the evaluation of Cycle 1 PD and a series of related recommendations – available in D7.1, the PD learning modules in UGent and NKUA were revised before implementation in Cycle 2, as were the supporting materials and the Activity Plan template (WP3). The learning modules, developed for academic PD, can in Period 2 of the project be used as a basis for development of specific TPD accredited modules on DT with extended technologies.

PO4: Create a network of schools and out-of-school organisations connected through nQuire, that will collaborate on design projects during and beyond the project timeframe and will empower children to define problems that influence their lives and provide them with the necessary 21st Century skills to solve these.

PO4 Summary status: On-track, achievable by M36

During the first 18 months the following has been done towards the progress of PO4:

WP5: Teachers and schools have been reached out to through an open call and/or existing previous collaboration contacts. This process has led to the creation of a network of 36 schools and 1 SME (SIMPLE) collaborating with the project so far. 28 of these have already participated in training sessions on the project approach and technologies. The remaining 8 who have expressed interest are kept informed about the project and its news through a mailing list.

More details are available in this database⁹. Teachers within this network can create and share DT Activity Plans and their students' digital artefacts from school interventions, in the nQuire platform. In the second half of the project, this network will grow as part of project outreach to more schools, aiming to at least double in size. In addition, we will contact and involve more out-of-school organisations in , aiming to help teachers contact with other stakeholders such as companies and NGOs. In Year 1, 9 teachers from 7 schools, co-designed with researchers 7 DT Activity Plans, which they then implemented in their classrooms, reaching 212 students in total. The DT activities involved a range of socio-scientific issues, such as cybersecurity and urban gardening and integrated different project technologies. The evaluation of pilot interventions (WP7) showed that through these activities students developed 21st Century skills such as collaboration, creativity and computational thinking. In addition, in Year 1 SIMPLE organized three co-design workshops with teachers regarding the design of Exten.(D.T.)² Learning Analytics and Dashboard.

WP6: WP4 developed the ExtenDT2 platform that contains a link to nQuire for students, a technology developed for use by schools, teachers, and students. Within a password-protected environment, students and teachers are able to design, manage, pilot and improve their own studies, and to collect data by peer students that can inform a DT project. During the Year 2 intervention in an academic course for pre-service teachers, UGent students will use the nQuire for students environment for sharing the digital prototypes in the feedback stage of the Exten.(D.T.)² Digital DT model. Feedback on creating groups and activities on the platform has already been provided to WP4 by Exten.(D.T.)² researchers. Other partners will provide the use of nQuire for students also in the first stages (discover and understand phase) of their learning modules. An elaborate data analysis of the evaluation of the implementations will inform WP4 on possible revisions of the technology. This revised version will later be used for empathizing and sharing activity plans and digital artefacts, developed during informal professional development activities and school interventions, and eventually by schools and school organisations beyond the Exten.(D.T.)² timeframe.

PO5: Develop a Framework for stakeholders and policy makers including guidelines on how to set up, monitor and evaluate DT projects supported by the project's emerging technologies. This will be achieved through:

- a) Exten.(D.T.)² experts' systematic evaluation of how student's design thinking knowledge, skills and attitudes are stimulated and enabled with the use of the Exten.(D.T.)² technologies, using innovative methodologies including existing frameworks of learning outcomes, learning analytics, surveys and interviews.
- b) Critical analysis of the gendered, cultural, geographical and societal effects regarding the use of AI, AR, 3D printing and Virtual Robotics, in DT activities. For instance, possible biases that may be introduced or reinforced by the adaptive feedback feature in the constructionist tools.

PO5 Summary status: On-track, achievable by M36

During the first 18 months the following has been done towards the progress of PO5:

- a) WP2: The first version of Exten.(D.T.)² framework and guidelines has been developed. This was based on the literature review where evidence from relevant documents informed the baseline showing a comprehensive view on how to set up and monitor as well as evaluate DT projects supported by the project's technologies. This considered the need for the development of student's design thinking knowledge, skills and attitudes, stimulated and

⁹ <https://docs.google.com/spreadsheets/d/1NjNsfuEq5wRU6pefibAgPH9mF6oLRKNwwwvdJZBIXYnw/edit#gid=0>

enabled with the use of the Exten.(D.T.)² technologies first as described in the literature and then how this has been reflected in the first Cycle of project's implementation.

WP5: The evaluation of pilot school interventions in Year 1, informed the further development of the Exten.(D.T.)² project with needs, opportunities and barriers that emerged through the implementation. It also led to the development of a new DT model that fits the needs of implementing DT with Digital Technologies in the classroom, named as "Exten.(D.T.)² Digital DT model". Moreover, the analysis of the participatory design workshops provided information on teachers' perceptions of 21st Century learning through the Exten.(D.T.)² digital learning tools.

WP6: The evaluation of the Year 1 pilot professional interventions in academic courses for pre- and in service teachers, informed the Exten.(D.T.)² partners on the skills and attitudes of these teachers with respect to the DT methodology and the technologies, and on their perception of acquiring 21st Century skills when performing an Exten.(D.T.)² project themselves. This gave insight into the opportunities and challenges of this group of stakeholders, and informed WP2 on the Exten.(D.T.)² framework, and WP6 on the developed learning modules for setting up, monitoring and evaluating DT projects. Evaluation of Year 2 PD interventions will expand these insights, and will furthermore reveal their experiences with using the newly developed ExtenDT2 platform and the enhanced technologies.

WP7: Evaluation has provided emerging evidence from Cycle 1 activities on students' DT knowledge, skills and attitudes. We have found that there are no pre-validated instruments to measure the development of knowledge, skill and attitudes for use with young people that address all of the aspects identified in the Cycle 1 evaluation. Additionally there is substantial cross-over with 21st Century skills. Thus, a unique set of instruments have been developed to evaluate these, which will be validated in Cycle 2.

- b) WP2 and WP4: Gender, cultural, geographical and societal effects around the use of AI, AR, 3D printing and Virtual Robotics, and ethical considerations have been identified based on similar contexts and technologies and are taken into account for developing and implementing the project's technologies. The framework includes components, perspectives and competences relevant for different stakeholders to implement DT with ET including the digital, professional, pedagogical and personal-ethical competencies for teachers and students. Evidence from the systematic evaluation of the school interventions is being collected from WP7 and WP5 and will inform the future development and refinement of the framework and guidelines. Regarding possible biases that may be introduced or reinforced by the adaptive feedback feature from WP4 in the constructionist tools, appropriate actions are bias identification, selecting fair data processing and analysis methods which are taken from the developers, and in general during the implementation of the activities, to avoid this.

3. Explanation of the Work Carried out per WP

3.1 Work Package 1: Project Management

Summary of Work and Progress towards WP1 Objectives

The main objective of WP1 concerns the overall management of the project and provision and monitoring of procedures that ensure effective and timely delivery of the project activities in accordance with the Grant Agreement (GA) and Consortium Agreement (CA).

WP1 Objectives	Status
O1.1 To install managerial bodies and project management procedures.	Achieved
O1.2 To ensure and harmonise the development of activities in all RTD and other work packages	Status: On track, achievable by M36
O1.3 To facilitate communication between partners as well as with the European Commission.	Status: On track, achievable by M36
O1.4 To ensure the overall project quality	Status: On track, achievable by M36

The activities carried out and services provided that contributed to the above WP1 Objectives were:

- Prompt prepayment of EC financing to partners according to the GA and CA
- Establishment and support of governing and advisory bodies ensuring effective communication processes and transparent decision-making
- Regular communication via meetings and emails with different stakeholders (consortium partners, EC, sister projects etc.)
- Continuous monitoring of Risks, Deliverables, Milestones
- Preparation of instructions, guidelines and templates (continuous reporting elements; S&T and financial reporting for P1 and P1 Review)
- Review, quality control and submission of final documents to EC (P1 reports, deliverables, milestones)

Task 1.1: Project Coordination and Administration (Lead: LNU; Other Participants: All) (M1-M36)

The CA was signed before the project commenced. All EC advance financing prepayments were made promptly to eligible partners. The Kick-off meeting was organised in the first week (5-7 September 2023) and well attended by all partners, as was the second and third 6-monthly physical meetings organised by NKUA in Athens, Greece (29-31 March 2023) and UGent in Ghent, Belgium (27-29 September 2023) respectively. Regular monthly Operational Management Teams (OMT) meetings have occurred (14 in total) with WP leaders and the PIs of partners who do not lead a WP. This has ensured inclusivity and regular contact with all partners in the consortium. Updates from the EC, progress on deliverables, milestones and risks are reviewed, as well as progress in each WP. Relevant strategic, administrative, and financial aspects are further discussed at these meetings. The CO has liaised between the consortium, the PO and other sister projects. It helped establish the Ethics Advisory Board which includes an independent external advisor. It facilitated interaction and collaboration with the other sister projects in the cluster by inviting them to present their projects at the Kick-off meeting and inviting them all to present and participate in a joint workshop at the mis4TEL Conference (12-14

July 2023) in Guimares, Portugal. At M9 for internal monitoring purposes and M18 for formal P1 reporting the CO prepared templates for scientific and financial reporting to help monitor progress according to contractual agreements and flag any matters for attention.

Task 1.2: Monitoring of Scientific Progress (Lead: LNU; Other Participants: All) (M1-M36)

The monthly OMT meetings (see above) and individual WP Meetings - some on monthly, some bi-monthly and others on an as needed basis - have helped monitor the scientific and technical progress and quality at strategic and day-to-day level. Deliverables are reviewed on a peer basis with at least two other project partners involved as lead reviewers and a final quality check is carried out by the CO before submission. The project receives complementary independent scientific, strategic, and planning advice from two external advisory experts: Prof Barbara Wasson (University of Bergen) and Prof Tilde Bekker (Eindhoven University of Technology). They are recognised leaders in AI analytics and design thinking in mainstream education respectively. Prof Bekker virtually attended and provided advice during the Athens meeting.

The Innovation Management Strategy (IMS) was to be established at M3 and reviewed at M9 and M15. The status of project technologies, including further development and their TRL have been discussed in every monthly OMT meeting as part of WP4 updates, and since the Ghent physical meeting, has its own regular slot in the OMT agendas. Further plans on impact, dissemination, communication and exploitation activities related to the project results are covered in Sections 4 & 5. Also see D8.1: Dissemination and Exploitation Plan (M6) and D8.2: Updated Dissemination and Exploitation Plan (M18). Final plans and efforts to exploit the results for up to 4 years after project completion will be included in D8.3: Final Dissemination and Exploitation Plan and referred to in D8.4: Policy Brief. The Policy Brief will be prepared at the project end and shared with existing national policy contacts and the Horizon Europe projects with which the project is liaising in a common cluster.

Task 1.3: Open Access and Data Management (Lead: LNU; Other Participants: All) (M1-M36)

The Initial Data Management Plan (D1.2), submitted in M8, and the Updated Data Management Plan (D1.3) cover handling of research data during and after the project; what data will be collected, processed/generated; what methodology and standards will be applied; whether data will be shared/made open and how; and how data will be curated and preserved. This deliverable together with the complementary D8.1 (see above) and D9.1 (Initial Ethics Assessment) also address and discuss how the project adheres to the obligatory open access related to scientific publications and research data and the data management policy of the EU and to the GDPR. The consortium partners additionally agreed to draw up a Joint Data Controller Agreement which was finalised in M12.

Status of Deliverables and Milestones due at M18

D1.1 (M3), D1.2 (M8) and D1.3 (M18) submitted.

Deviations and Corrective Actions

There are no deviations. Work is progressing as planned.

3.2 Work Package 2: The Exten.(D.T.)² Framework

Summary of Work and Progress towards WP2 Objectives

This WP lays the foundations of the Exten.(D.T.)² approaches built on the best available research and rooted in the challenges for supporting the digital transformation of the education ecosystem. Its target is the development of a Framework that identifies the key components, perspectives and competencies for supporting DT in a resilient and inclusive way with ET.

WP2 Objectives	Status
O2.1 Identify Best Practices, Challenges and Requirements to enhance Design Thinking learning with Emerging Technologies in a valuable way for students', teachers' and educational stakeholders' digital literacy	Achieved
O2.2 Develop Exten.(D.T.) ² Framework to reach requirements from O2.1	Status: On track, achievable by M35
O2.3 Develop a set of Guidelines for teachers and other stakeholders to support the deployment of the Framework in different learning contexts (online & blended) and for all students	Status: On track, achievable by M35

The activities carried out that contributed to the above WP2 Objectives were:

- Meetings with all the partners (i.e., monthly and as needed) to discuss and make decisions on the respective work and approach on actions to achieve WP2 objectives
- Continuous feedback and communication on actions via email, sharing of documents with a focus on the different WPs needs and connections to WP2
- Comprehensive literature review on relevant topics and establishment of the literature review's objectives, search strategy and choice on the appropriate databases, documents' inclusion criteria, categories for data extraction and analysis and findings
- Preparation of templates for the partners to share their input
- Organising a workshop for the development of the first framework version and guidelines
- Developing a survey for feedback towards the final framework and guidelines
- Creation of visualization of the framework and the guidelines
- Adding the framework and the guidelines to the project's website
- Close collaboration with other WPs to constantly monitor activities performed to iteratively inform the development of the framework and the guidelines

Task 2.1: Theoretical Review (Lead: NTNU; Other Participants: All) (M1-M6)

A literature review was conducted to identify best practices, challenges and requirements to enhance DT with ET in a valuable way for students', teachers' and other educational stakeholders' digital literacy (D2.1). This work was a basis for creating and developing the framework (O2.2) and the guidelines (O2.3). Based on the literature, the aim was to shed light on what is known on relevant topics and deliver this information as a baseline for critical thought and grounding the work of WP2-WP7 and the project in general. D2.1 comprehensively presents the current best practices, approaches and perspectives for integrating the project's technologies (Learning Analytics-Feedback, AR-motion sensors, 3D printing and VRobots) in STEAM and Design Education regarding both online and blended learning contexts. In the first steps of this literature review we familiarized ourselves with the above mentioned topics. Monthly, and as needed meetings, happened, followed by actions where all the partners contributed. Each of the partners shared their experience, approach, scientific actions and literature based on their knowledge and WP objective. We established the literature review's objectives, search strategy and choice on the appropriate databases, documents' inclusion criteria, categories for

data extraction and analysis and focus of the findings. Based on these actions, the relevant documents were further analysed on different aspects (e.g., design thinking, STEAM, pedagogy, technology, teachers, students, professional development, best practices, challenges, needs, requirements, criticism, competencies, skills, school, formal, and informal education). Findings were presented showing the overview, best practices, challenges, requirements and their respective sub-sections showing relevant perspectives for students, teachers, educational stakeholders, DT and ET. This task is complete.

Task 2.2: Development of the Exten.(D.T.)² Framework (Lead: NTNU; Other Participants: All) (M7-M35)

A two stages approach (i.e., literature review and participatory workshop) was followed for the first version of the Exten.(D.T.)² framework (see D2.2. v1), with all partners contributing. In the first stage, the first draft of the framework was created based on the collected and analysed relevant documents (from scientific literature, reports and frameworks developed by the EU, OECD, UNESCO, other) in the context of digital competences, digital citizenship and DT, including relevant works (from D2.1 and other). The focus of the documents' analysis comprised: critical components in relevant frameworks to enhance educational values and involve digital technology in educational contexts, key competencies known and reported in the context of educational settings, considerations to empower and enhance competencies in students, teachers, and related educational stakeholders and perspectives for including all genders, hard-to-reach populations, geographical and societal obstacles regarding the access and use of technologies. The first draft of the framework was a "schema" and presented at the second stage, via a participatory workshop with experts from all the project partners. During the workshop, participants gave critical reflections on the initially presented framework, which were then analyzed. This created the first version of the framework which uses the visual metaphor of a "tree", and is shared on the project website. Following this, and to inform the final version of the framework, to have evidence-based iterations, a feedback/reflection template has been developed where all partners add their perspectives and input on the framework based on the Cycle 1 project activities for their respective work in the WPs. A survey has also been developed for collecting feedback from stakeholders, teachers, educational researchers, policy makers, education technologists, education designers etc. and examining the framework's clarity, suitability, actionability and importance of the suggested components, perspectives and competences including open-ended questions.

Task 2.3: Guidelines for Mass Deployment (Lead: NTNU; Other Participants: All) (M7-M35)

Task 2.3 is highly connected to Task 2.2 as it refers to the guidelines for mass development for teachers and other stakeholders to support the deployment of the Exten.(D.T.)² framework in different learning contexts and for all students (see D2.3. v1), with all partners contributing. The development of the set of guidelines concurred with the framework's development at all stages (including the participatory workshop detailed in Task 2.2). Suggestions and aspects were considered based on insights from the literature, including relevant frameworks, reports, and guidelines. The focus is primarily on teachers but also on other stakeholders who may be interested in incorporating DT and ET into their practices. The guidelines are organised on three core elements, as defined in the framework: components, perspectives, and competencies. Using the feedback/reflection template (Task 2.2) all partners contribute with their perspective on the guidelines, based on the Cycle 1 project's activities for each WP. With the survey (Task 2.2) feedback will be collected from stakeholders, teachers, educational researchers, policy makers, education technologists, education designers and others to refine the guidelines for their final version form.

Status of Deliverables and Milestones due at M18

D2.1 (M6); D2.2 v1 (M9) (*v2 due M35*); D2.3 v1 (M9) (*v2 due M35*).

Deviations and Corrective Actions

There are no deviations. Work is progressing as planned.

3.3 Work Package 3: Co-Design of Educational Resources and Materials

Overview of Work and Progress towards WP3 Objectives

WP3 concentrates on the co-design and co-development of educational activities using the project technologies to teach design thinking, the production of supporting material as to how to use these activities with students, and the creation of a toolkit to support the design and implementation of DT in the classroom. It designed, tested and shared with partners material for delivering a three-hour teacher training workshop that included the following: a) introduction to design thinking, b) the Exten.(D.T.)² Digital DT model produced by the project, following Year 1 activities with schools, c) hands-on activities on how to use the project’s technologies, and d) guidance on how to complete an activity plan using DT and project technologies. Supporting materials have been created including: a) short video tutorials and written guides on how to use each project technology, b) a DT activity plan template (word and online versions) which teachers can use to organise their lessons and structure DT activities, and c) example online artefacts using project technologies to showcase tools extended functionalities. The above supporting material is accessible through the project website. Development of a toolkit to support the DT process with the project’s technologies (See O3.3) is to be followed through.

WP3 Objectives	Status
O3.1 Design a set of educational activities using the project technologies to support DT projects that will be developed and implemented in schools	On-track, achievable by M30
O3.2 Design a set of training material to support the Professional Development activities that will be developed and implemented with teachers	On-track, achievable by M30
O3.3 Develop a toolkit for supporting the Design Thinking process with the project’s technologies	On-track, achievable by M30

The activities carried out that contributed to the above WP3 Objectives were:

- Seven (N=7) lesson plans detailing educational activities for students have been completed and implemented in Year 1 of the project
- The following digital artefacts have been created making use of the project’s technologies: a MaLT2 digital model that represents a maquette of a construction for a vertical garden, a ChoiCo game about environmental issues, a ChoiCo game about food choices while shopping, a ChoiCo game about Cybersecurity, a ChoiCo and a SorBET games for reducing school energy costs, a ChoiCo game on Sustainable Development Goals (SDG’s) and a virtual robotic solution using GearsBot for fire rescue.
- Two ChoiCo games, 12 SorBET games, one MaLT2 game with extended functionalities to help pupils and teachers create prototypes while getting engaged in DT activity in their classrooms have been created
- Designing, testing and sharing with partners content for a three-hour teacher development workshop on how to use DT and project technologies with students
- 24 video tutorials produced to support the use of project technologies by teachers
- 11 written support documents produced to support use of project technologies by teachers
- An activity plan template has been developed and revised following school implementations in Year 1 of the project. This is available on the project website in word and online formats

Task 3.1: Co-design and Development of Educational Activities using Project Technologies Lead
 OU: Other Participants: All) (M1-M24)

Educational activities using the project’s technologies have been designed by teachers and researchers from LNU, UGent, NTNU, NKUA and the OU. Activities made use of all technologies including ChoiCo, SorBET, MaLT2, GearsBot and nQuire for students. Specifically, two ChoiCo games that include geolocation, 11 SorBET games, one MaLT2 microworld, and one GearsBot example have been created to help teachers understand the functionalities of the tools and to assist pupils create prototypes whilst getting engaged in DT projects in their classrooms. SorBET and MaLT2 have been extended to support: a) gesture recognition - players in SorBET can classify falling objects in different containers using hand gestures, and b) 3D printing features - students can print 3D objects from MaLT2, accordingly. For GearsBot, this tool has been used in one of the activity plans of Year 1 which has been co-designed with teachers and the functionality of collecting analytics has been also considered and will inform the authorable learning analytics dashboard of the project. It is noted that the process of co-designing with teachers varied across countries, with the OU and NKUA audio recording the process while the rest of the partners took notes. The process and associated documentation has been reconsidered before the start of Year 2 activities to ensure data are captured in a similar manner across countries. 145 teachers participated in co-design workshops in Year 1 and 2 of the project delivered by the OU, UGent, NKUA, NTNU, SIMPLE and LNU.

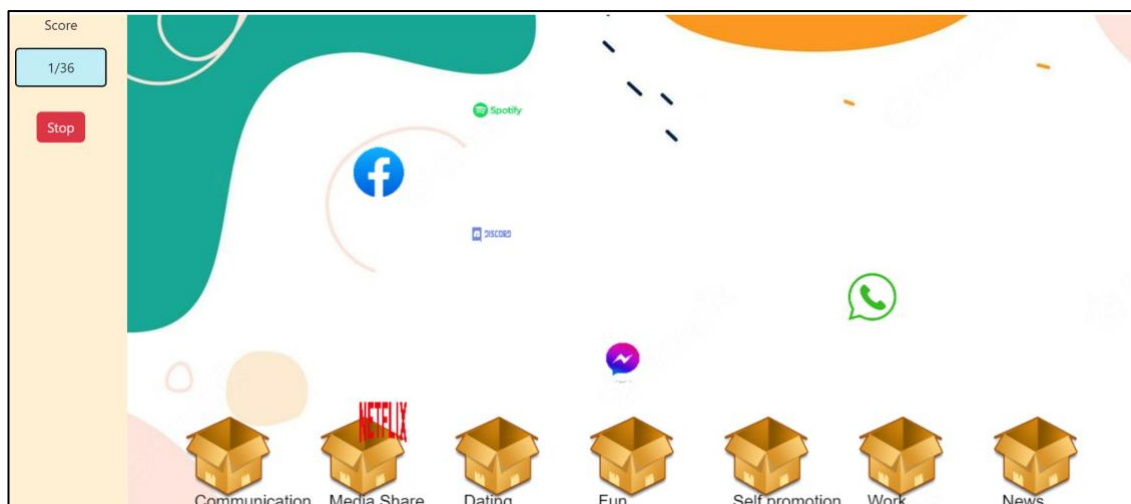


Figure 1: Screenshot of the "App game", designed by teachers and researchers to prompt discussions in the classroom about mobile usage during the "Discover" phase of Design Thinking.

Task 3.2 Co-design Online Supporting Material for Stakeholders (Lead: OU; Other Participants: All) (M12-M24)

This task, which is the development of online supporting materials that includes the guidelines to use design thinking and technologies in the classrooms, will start in M19 and end in M24. A plan will be produced as to how these resources should be designed to ensure they address different audiences, as stated in the deliverables as being teachers, students, parents, policy makers. OU will consider what the best approach is and invite partners to a workshop to discuss and decide on next steps.

Task 3.3: Co-design Teacher Training Material (Lead: OU; Other Participants: All) (M9- M35)

A list of resources is now available on the project website for any interested stakeholder to access. These have been devised by project partners to support teachers in using project technologies, including short video tutorials and written guides. In addition, the activity plan template used in Year 1 activities at schools has been revised, following feedback from teachers. It is now shorter and easy to complete. It requires less time by teachers to fill it in, accommodating the fact that teachers had limited time to engage with the project in Year 1. Two versions of the activity plan are available: a web-based version developed on nQuire¹⁰, which lets teachers share their activity plans with the wider teacher community,

¹⁰ <https://nquire.org.uk/mission/extendt2-activity-plan-for-teachers/data>

and a downloadable word version. In addition, in collaboration with project partners and teachers, content for a three-hour teacher development workshop has been produced (in the form of slides with activities) with the following: a) introduction to design thinking, b) the Exten.(D.T.)² Digital DT model produced by the project following Year 1 activities with schools, c) hands-on activities on how to use the project's technologies, and d) guidance on how to complete an activity plan using DT and project technologies.

Task 3.4: Co-design an Online (DT)² Toolkit (Lead: UGent; Other Participants: OU & NKUA) (M3-M30)

Technology scientists, education scientists and teachers will co-design an online toolkit, which will extend the existing Co-creation planet platform¹¹ originally created to coach university students during a DT process. The platform will be expanded with a planet that guides teachers through the different phases of the development of a digital based DT thinking intervention, using the DT methodology themselves. This activity is being carried out in Year 2 and 3 and will incorporate the developed activities of Tasks 3.1-3.3 above.

Status of Deliverables and Milestones due at M18

D3.1 (M9) and D3.3 (M12) submitted - contributed to MS3 (achieved M9) and MS4 (achieved M12).

Deviations and Corrective Actions

There are no other deviations. Work is progressing as planned.

¹¹ <http://cocreationplanet.eu/>

3.4 Work Package 4: Shaping Technologies

Overview of Work and Progress towards WP4 Objectives

The main objective of WP4 is to extend well-established and widely used digital educational solutions with emerging technologies for the digital enhancement and transformation of DT learning. The aim is to support students develop both design thinking and computational thinking skills while using these technologies to empathize, brainstorm, ideate, prototype, test and deliver solutions to STEAM and wicked socio- scientific problems.

WP4 Objectives	Status
O4.1 Extend the nQuire functionality to integrate the project technologies and support the online implementation of the Design Thinking activities (WP5) and teacher training activities (WP6)	On-track, achievable by M36
O4.2 Iteratively design, develop, and evaluate two complementary digital game tools enhanced with AR components, to support immersion and empathy through embodied learning	On-track, achievable by M36
O4.3 Iteratively design, develop and evaluate a 3D rapid prototyping environment that will allow the programming, design and print of 3D models	On-track, achievable by M36
O4.4 Design and develop an Authorable Learning Analytics and feedback component and a dashboard for supporting the monitoring, evaluation and assessment of digital Design Thinking projects	On-track, achievable by M36

All objectives are on track and progressing to plan. Learning tools are extended with AR components and ready for the second round of school interventions. MaLT2 learning tool has been extended with 3D printing functionality and is ready to be used in the second-school interventions phase. The first prototype of the Authorable Learning Analytics and feedback component and a dashboard are developed and ready to be used by end users. After receiving feedback from end-users, the prototypes will be refined and improved to the new version.

The activities carried out that contributed to the above WP4 Objectives were:

- OU developed a new nQuire version for students¹²
- NKUA extended MaLT2 tool with 3D printing, SorBET tool with Augmented Reality (AR) in the form of multiple players controlling the game with body gestures and with block-based programming for the game rules, and ChioCo with AR in the form of google maps interface, geolocation (recognizing and following user’s location while designing a game) and live traffic data used in the games. All these tools are extended by learning analytics
- NKUA extended the three learning tools (MaLT2, SorBET and ChoiCo) to export data on user activity in the form of learning analytics. The data will be used by the Authorable LA component and the dashboard
- SIMPLE developed the ExtenDT2 platform (see Figure 2) and its updated architecture (see Figure 3 - NB: the original architecture can be seen in D4.1). All learning tools are integrated into the ExtenDT2 platform and accessible through the platform. The teachers can set up activities and assign them to student groups through the platform

¹² <https://learn.nquire.org.uk/signin>

- LNU, SIMPLE, and NTNU chose, modified and integrated the GearsBot (Virtual Robotics) learning tool into ExtenDT2 platform
- SIMPLE developed Authorable Learning Analytics and feedback component inside of the ExtenDT2 platform
- LNU developed the first prototype of the dashboard for teachers

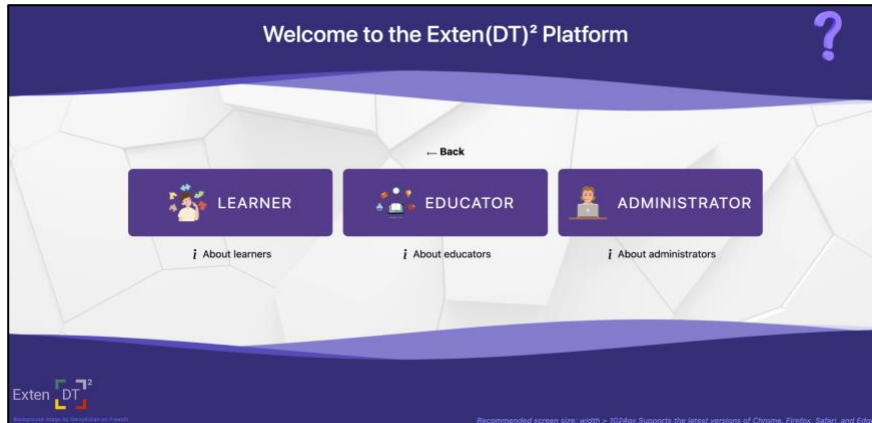


Figure 2: The ExtenDT2 platform.

The architecture as illustrated in Figure 3 is an evolution of the one presented in D4.1 and includes the extended learning tools (ChoiCo-ext, SorBET-ext, MaLT2-ext). An additional learning tool named GearsBot (Virtual Robotics) was integrated into the ExtenDT2 platform. The refined architecture was deployed on Amazon Web Services (AWS) which includes a virtual private cloud (VPC), a network with two subnets, one of which is private and reserved for secure entities like the DBMS, and also one which is publicly available and intended to be used for services that are publicly accessible such as the web service, and DBMS service e.g., Aurora Database with PostgreSQL (see D4.2).

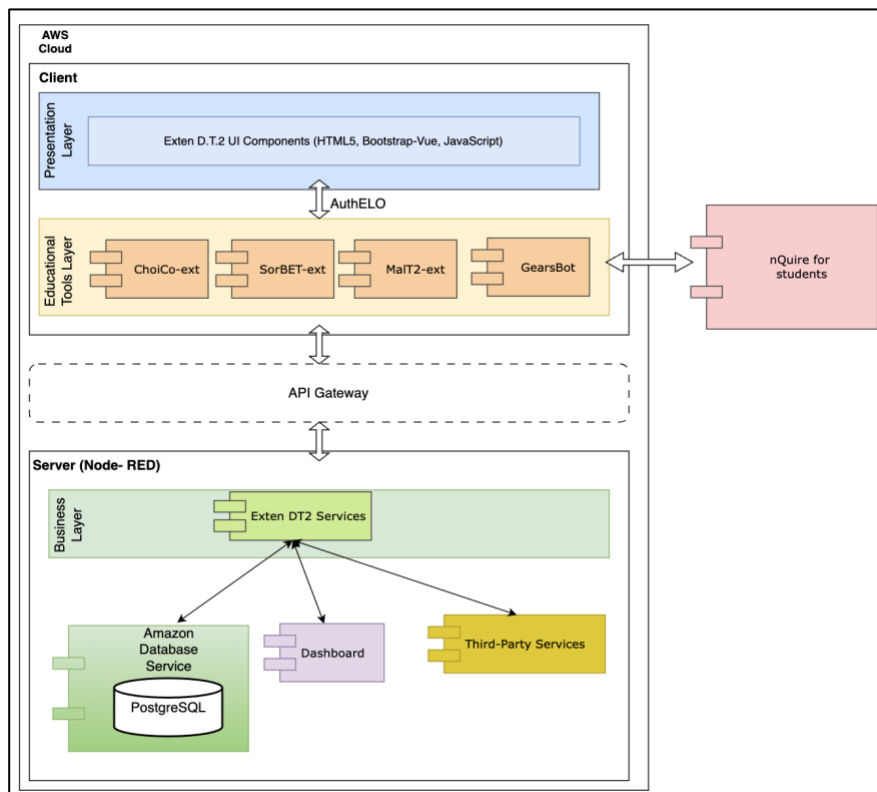


Figure 3: ExtenDT2 current architecture (February 2024).

Task 4.1: Extend the nQuire Platform (Lead: LNU; Other Participants: OU) (M1- M30)

The new version of nQuire, developed by the OU and named: ‘nQuire for students’¹³ has been further developed to include the following: a) nQuire for students is now accessible via the ExtenDT2 platform, as other project tools. When selected, students and teachers navigate to a separate window through which they can log in and access nQuire for students. b) URLs of games (ChoiCo and SorBET) can now be pasted into a separate field and shown under the mission briefing. c) A classroom management system has been developed to enable teachers to organise their students in classes under a school and also create accounts for students to access nQuire for students. d) To support students in improving the design of their studies, a set of prompting questions has been added to the authoring tool (e.g., Does your study have leading questions?) with explanations as to what each one means. This set of questions can also help teachers when providing feedback to studies created by students. e) A filtering functionality has been developed to enable students and teachers to search and find studies based on whether they are on pilot, draft or launched, school they belong to, and stage of design thinking they relate to.

Task 4.2: Extend ChoiCo and SorBET Game Applications with AR components (Lead: NKUA; Other Participants: LNU & NTNU) (M1- M30)

NKUA based on the literature review extended the two game applications and these are detailed in D4.1. Based on the requirements, on collected feedback from co-design activities (WP3) and on evaluation of pilot implementations with the original tool versions (WP5) NKUA extended ChoiCo and SorBET with new features (e.g., block-based programming, stabilization for mobile usage) and with AR components. SorBET has been extended with the component of gesture recognition by any web camera, allowing users to control the game objects using their gestures. This allows for 2 players to play simultaneously in front of a PC or a large setting (e.g., a projector), enhancing collaboration and communication. Moreover, the affordance of block-based programming was integrated into SorBET, allowing students to program game settings and rules (e.g., change the velocity or density of the falling objects). ChoiCo has been extended to support AR gameplay and design in the form of geolocation and real-time data affecting the game interface, content and flow. Using Google Maps API, the users can design choice-driven simulation games on google maps interface (street or ground), add pins to their current location as they move around, and use real-time traffic data in the game database, affecting the game fields. Both applications have reached TRL4. The new versions were integrated into the ExtenDT2 platform where teachers and students can use them to create, share and save their activities online. The current version will be validated in Year 2 school interventions and professional development courses (WP3 & WP5).

Task 4.3: Extend MaLT2 Programmable Modeler with 3D Printing/Scanning Technologies (Lead: NKUA; Other Participants: NKUA & SIMPLE) (M1- M30)

Based on the literature review NKUA recognized the requirements for extending MaLT2 online application, and these are detailed in D4.1 MaLT2 was extended so that it extracts any 3D model programmed by the user into file formats that can be printed by most commercial 3D printers. To achieve this NKUA transformed the old JavaScript version into JavaScript ES6 and integrated the latest three.js library for model creation and extraction. The object extraction functionality has been added to the user interface, allowing the user to easily extract and download the created models into .obj or .stl files. NKUA collaborated with SIMPLE to create and print a number of demo 3D models with the Creality 4 printer. At M18 MaLT2 has reached TRL4. The extended version of MaLT2 has been integrated into the ExtenDT2 platform where teachers and students create, share and save their MaLT2 activities online. The MaLT2 extended version will be evaluated in Year 2 school interventions and professional development courses (WP3 & WP5).

Task 4.4: Extend Learning Tools to Capture and Generate Data for Analysis (Lead: LNU; Other Participants: NKUA, NTNU, OU & SIMPLE) (M1-M6)

¹³ <https://learn.nquire.org.uk/signin>

NKUA has extended the three educational tools (ChoiCo, SorBET, MaLT2) to capture user interaction data in the form of events for LA and extract them to a database through the AuthELO system (Task 4.5). These data include student interactions with the affordances of the tools accompanied with important information for learning (e.g., in MaLT2 when a student uses a slider to animate the 3D model an event named “slider_use” is sent to the database including information about the start and end value, the slider name, the timestamp and the number this event has occurred since the activity started). The detailed list of captured events can be found in “D4.1 Appendix A Educational Tools Data Description”. The list of events will be refined after gathering teachers’, students’ and researchers’ feedback in Year 2 school interventions. The list of events was used as input in the workshops with teachers (Task 5.4) to provide input for the development of the adaptive feedback component and the authorable dashboard Task 4.6. Virtual Robotics, specifically the GearsBot tool, was integrated into the ExtenDT2 platform but not extended with LA at that time. This task is complete.

Task 4.5: Development of an Authorable Learning Analytics and Adaptive Feedback Component for DT Constructionist Activities (Lead: SIMPLE; Other Participants: LNU, NKUA, NTNU & OU) (M3-M35)

SIMPLE carried out an initial experimental prototype for the Authorable Learning Analytics and an Adaptive Feedback component for DT constructionist activities has been designed and developed. The implementation details are reported in D4.2. This has been integrated with the ExtenDT2 platform in a loosely coupled manner as an individual member component of the ecosystem. Initial configuration experiments have shown that it integrates well with the platform and is able to interoperate effectively with some of the constructionist activity components present in the platform. Three workshops, conducted with Greek teachers exploring the added value of Learning Analytics in MaLT2, ChoiCo and SorBET tools and accordingly, informed the further development of the LA component and the customizable dashboard (Task 4.6). The LA component communicates with three of the learning tools that export data (Task 4.4) and allows teachers to choose which data is useful to be captured for a learning activity. This feature provides teachers an active role in the AI design as they can choose to collect a different set of data from the same learning tool (e.g., MaLT2) depending on the activity they have designed. Moreover, the adaptive feedback components allow teachers to program their own AI rules based on the captured LA data. These rules determine when and what kind of feedback will be given to the students by the system during a learning activity. Based on the outcomes of the Cycle 2 evaluation, SIMPLE will improve these two components in terms of usability and also to meet the needs of teachers.

Task 4.6: Development of a Customizable Dashboard (Lead: LNU; Other Participants: NTNU, NKUA & OU) (M3-M35)

SIMPLE has conducted workshops with teachers regarding what data to collect for LA (see also Task 5.4). The output of these workshops is a set of events grouped into categories and assigned 21st Century skills. Based on this given information LNU developed the first prototype of the dashboard for teachers. Teachers can see an overview of learning activities and events captured by LA. The prototype does not use real data yet. It contains only developer test data, which are used to present to end users what the dashboard can do and gather more requirements and functionalities from teachers. After receiving feedback from teachers, the dashboard functionality will be refined and improved.

Status of Deliverables and Milestones due at M18

D4.1 (M6) and D4.2 (M12) submitted and have contributed to MS4 (achieved M12) and MS6 (achieved M15).

NB: Due to a typo MS6 should now read: Authorable Learning Analytics and Dashboard are developed in TRL4 and have been connected with the “ExtenDT2 platform” (instead of the “nQuire platform) see deviations below”.

Deviations and Corrective Actions

SIMPLE collaborated with LNU, NKUA, NTNU, OU to derive a technical specification of the content along with the data format of the data generated by the learning tools that will be used by the LA components for analyses and visualisation. The diverse data formats of those tools were considered, and a flexible architecture was designed to allow integration in a non-invasive manner and ingestion of this information into a single data repository for analysis,

nQuire is an established OU product and must comply with OU standards with no exceptions where compliance is not possible e.g., information security, accessibility. It soon became apparent that it is not possible to be used as an experimental platform for implementing integrations with third party learning and other components that did not comply with certain policies.

This led to the decision to develop a learning platform that will operate as an ecosystem of diverse components and that will allow the seamless integration and interoperability of the technologies developed by NKUA and OU as well as any web component in the context of DT processes. The platform to be implemented is based on previous work done by SIMPLE in collaboration with UCL that is called SmILE (Smart Interactive Learning Ecosystem) and will operate as the “ExtenDT2 platform”.

This deviation is further considered under Section 7: Use of Resources. The transfer of financial resources between the WP4 project partners who were expected to work on the nQuire platform to SIMPLE, who developed the ExtenDT2 platform instead, means there is no significant deviation in resources or costs. Work is progressing as planned.

3.5 Work Package 5: School Interventions

Overview of Work and Progress towards WP5 Objectives

The main goal of WP5 concerns the iterative design and implementation of digital-based DT interventions with students that will provide evidence of the effectiveness of the project’s approach and technologies. The specific WP5 objectives are:

WP5 Objectives	Status
O5.1 To co-design, with teachers, industry, policy-makers and scientists, Digital-based Design Thinking interventions that deal with real-world problems	On-track, achievable by M36
O5.2 To implement O5.1. interventions in school settings and generate data for evaluation (WP7)	On-track, achievable by M36
O5.3 To evaluate with teachers and students the ALA and Dashboard components	On-track, achievable by M36

All objectives are on track and progressing according to the project plan. The activities carried out and services provided that contributed to the above WP5 Objectives were:

- Iterative development and refinement of the DT Activity Plan Template document to support the co-design process of DT interventions. The Template has been used by partners and teachers for co-designing interventions and DT activities
- Refinement of the DT Activity Plan template based on evaluation results. Integration of the template into nQuire and ExtenDT2 platforms
- Development of 4 Activity Plan examples that were used as supporting material and guides by partners and teachers in co-design activities
- Collaboration with WP3 for structuring and implementing co-design sessions with teachers.
- Integration of the DT Activity Plan Template into teacher professional development (WP6) courses to train new teachers on co-design DT activities
- Design and implement 9 pilot interventions reaching 212 students across 4 partners
- Development of school intervention guidelines and checklists for the smooth implementation of the interventions
- Support all partners in organizing and implementing pilot and Cycle 2 interventions through 1-1 meetings
- Develop and use the school intervention database¹⁴ for monitoring the progress of school interventions across partners and the reach of targeted KPIs
- Regular meetings with WP3 and WP7 which are strongly connected to the co-design activities and the evaluation of interventions
- Organization of participatory design workshops with 10 teachers to inform the design of the learning analytics and feedback components

Task 5.1: Design Exten.(D.T.)² Interventions for Schools (Lead: NKUA; Other Participants: All) (M3-M24)

In Year 1 NKUA developed the “Design Thinking Activity Plan Template” for supporting researchers and educators in the design of the DT activities using the project technologies. They also developed

¹⁴ <https://docs.google.com/spreadsheets/d/1TqFqZDyNDFuSfswzSjWs-N09bLEkYMytZ8hNoDvCeeQ/edit#gid=0>

four examples of use as supporting material. The first version of the template was grounded on: a) the literature review of WP2, and b) feedback provided by researchers and teachers during an online workshop organized by NKUA in M2. For the first version, the 4-stage Double Diamond DT model was used. The template was used by 9 teachers to co-design 7 pilot DT activities (WP3 & WP5) for school interventions. The activities varied in the DT issue (e.g., cybersecurity, environmental issues), the technology used, the related subject matter and expected learning outcomes. The Activity Plan was also used in WP6 Professional Development activities by participant teachers to learn the Exten.(D.T.)² approach to DT. Based on Year 1 evaluation results NKUA revised the DT Activity Plan Template to create the second version for Year 2 interventions. A major outcome of this task was the development of a new DT model by all partners, named the Exten.(D.T.)² Digital DT model¹⁵, which describes the implementation of DT activities in the classroom with technologies. This need occurred since all existing DT models were not classroom- and tech-oriented and could not cover the needs of educators for the Exten.(D.T.)² innovative approach. The new template integrates the Exten.(D.T.)² Digital DT model and other changes to leverage the co-design process. NKUA collaborated with the OU and SIMPLE to create two digital versions¹⁶ of the new AP template that were integrated into the nQuire platform and ExtenDT2 platform accordingly (WP3 & WP4). The 2nd version of the Activity Plan Template is currently being used by teachers and researchers for the co-design of Year 2 interventions, expecting to produce 22 DT Activity Plans.

Task 5.2: Pilot Intervention in Schools (Lead: NKUA; Other Participants: All) (M6-M12)

NKUA has created a database¹⁷ to keep track of all interventions that will be implemented throughout the project including important information. In Year 1 NKUA, NTNU, OU and UGent collaborated with teachers to co-design and implement DT interventions with students in real school settings. The pilot activities used the existing versions of project technologies to evaluate their integration in DT projects and further inform their extension for Year 2. The pilot interventions engaged 212 students and 9 teachers from 7 schools. All project technologies were used in at least 1 intervention, providing data for Year 2 developments. Before piloting, NKUA collaborated with TCD to determine the research dataset to be collected during the interventions and created 2 data collection checklists; one for the participant teacher and one for the researcher(s). Each partner was responsible for data collection, data transcription and translation (questionnaires, interviews and audio recording), data analysis (WP7) and reporting of case studies (WP7). WP7's overall analysis of pilot interventions informed the technology development (WP4), the redesign of the activity plan template (see Task 5.1) and the design of new DT learning activities for Year 2 (WP3& WP5). Selected pilot interventions and their results were presented in 1 webinar. This task is complete.



Figure 4: A teacher keeping notes while groups are working with nQuire tool during a school intervention in Greece.

¹⁵ <https://extendt2.eu/flyer>

¹⁶ <https://nquire.org.uk>

¹⁷ <https://docs.google.com/spreadsheets/d/1TqFqZDyNDFuSfswzSjWs-N09bLEkYMytZ8hNoDvCeeQ/edit#gid=0>



Figure 5: Two student groups designing a game for sustainability issues in ChoiCo.

Task 5.3: Second and Third Cycle Interventions in Schools (Lead: NKUA; Other Participants: All) (M12-M30)

For the second Cycle of interventions, all the partners (academic and the SME, SIMPLE) are collaborating with teachers to co-design (see Task 5.1 & WP3) and implement interventions with students in a school setting. Teachers and schools were reached, a) through an open participation call¹⁸ for teachers published on the project website and communicated by partners separately, and b) through existing networks of collaborating schools. Currently, 22 interventions are planned to be implemented in 22 schools with about 600 students. The implementation of Cycle 2 of interventions and data collection will take place in M19-M22. Preparations for the Cycle 3 interventions are expected to take place on M24-M27 and implementation of interventions on M28-M33.

Task 5.4: Informing the Design and Testing of the LA and the Adaptive Feedback Feature for Learner Input (Lead: NKUA; Other Participants: All) (M6-M30)

NKUA collaborated with UCL and SIMPLE to organize hands-on workshops with teachers that informed the authorable learning analytics and dashboard components developed in WP4 (Task 4.6). The workshops followed a participatory design method based on Repertory Grid, a widely used technique in user research that elicits user requirements and provides feedback on conceptual models while minimising researcher bias. Three workshops were conducted with Greek teachers who were familiar with the project tools but not with the learning analytics feature. The workshops explored LA in MaLT2, ChoiCo and SorBET tools accordingly. Each of them lasted one and a half hours and the participants were 11 teachers in total. The process followed was based on a board (physical or digital) with cards, prompts, and post-its that urged participants to be creative, forgetting any predisposition against learning analytics and eliminating any discomfort caused by a lack of data literacy skills. The teachers moved through the four stages of the methodology considering the affordances of the tool they were assigned, combining them to highlight concepts from the educational practice that are important based on their experience and perception, connecting these concepts to 21st Century skills and finally considered each one of the technologies in relation to the concepts they created. During the process, participants were free to discuss each other's perceptions to explore more concepts, clarify them and include them in their board. For the collection of LA from the GearsBot, NTNU's researchers in collaboration with teachers collected input through one-to-one meetings.

¹⁸ <https://extendt2.eu/call-for-teachers/>

The researchers then analyzed teachers' ideas and responses and developed a first correlation between clusters of educational aspects and 21st Century skills based on the tool usage filtered by teachers' perceptions. The results were used as a guide to develop a prototype of an authorable visualisation dashboard that presents LA based on the feedback given by teachers. The dashboard visualises data collected by the interaction of learners with the learning tools while completing certain activities and supports grouping around 21st Century skills allowing at the same time teachers to author and organise data according to their perception and educational purpose of each learning activity (Tasks 4.5 and 4.6). In the next 2 Cycles testing sessions will be conducted with teachers and learners to explore usability issues and the added value of the dashboard and the LA components.



Figure 6: Participatory design workshop with teachers to inform the design of Learning Analytics and dashboard representations in ChoiCo tool.

Status of Deliverables and Milestones due at M18

D5.1 (M6) and D5.2 (M12) submitted. Work in D5.1 has contributed to MS3 (achieved M9).

Deviations and Corrective Actions:

In order to follow the school year, which in most countries starts in September and ends in June, there has been a shift in the initial months planned for the interventions' preparation and implementation as follows: intervention preparation and co-design: October-January, implementation and data collection: February-June. Thus, Cycle 1 took place during M2-M12, Cycle 2 will take place during M14-M22 instead of M9-M15, and Cycle 3 during M25-M33 instead of M18-M30.

This deviation does not affect the overall progress in the project or the activities of other work packages.

3.6 Work Package 6: Professional Development

Overview of Work and Progress towards WP6 Objectives

The overall objective of WP6 is the design and development of a learning module that allows and supports pre- and in-service teachers to develop and organise Design Thinking (DT) projects involving Exten.(D.T.)² project’s digital tools in their classroom and support them towards the transformation of their roles in the digital transition of education. The specific WP6 objectives are:

WP6 Objectives	Status
O6.1. Iterative design of pre- and in- service Professional Development activities for established teacher training initiatives	On track Achievable by M36
O6.2. Implement Professional Development activities in three Cycles; from pilot to wide scale	On track Achievable by M36
O6.3. Design and develop online Professional Development courses, available to all teachers for support and self-training	Before track Achievable by M36

The activities carried out that contributed to the above WP6 goals were:

- Learning modules on design thinking with integrated digital tools were developed in NKUA and UGent, and tested in academic courses at the respective universities
- Face-to face and online workshops for teachers were organised in which design thinking and the Exten.(D.T.)² digital tools were introduced and explained
- Flyers for inviting teachers to take part in Exten.(D.T.)² activities (co-creation as well as professional development) were developed and distributed, physical as well as online
- A draft version of the online PD course on developing and implementing Exten.(D.T.)² projects was developed and is ready for feedback

Task 6.1: Design of Professional Development activities (Lead: UGent; Other Participants: NKUA, OU & TCD) (M3-M12)

During Year 1 Professional Development (PD) modules for providing pre- and in-service teachers the tools for developing and organising DT projects involving the Exten.(D.T.)² project digital tools were designed, developed and piloted in existing academic courses in both institutes. Both developed modules consisted of a constructionist methodology for teachers to design DT digital based interventions for secondary education. Supporting tools were also developed. These consisted of templates, such as the DT Activity Plan Template designed in WP5, videos and manuals for using the technologies and examples of the games and DT activity plan templates, showing the participating teachers what was expected. The modules were implemented in three academic courses in UGent and NKUA, reaching 69 participants. In order to evaluate the outcomes of the PD activities (see Task 6.2), in M3-M6, evaluation tools for the PD learning materials were created in WP7 (TCD) and customized to the implementation settings in NKUA and UGent. These evaluation tools contained documents for informed consent, observation protocols, pre-, intermediate and post surveys. In Year 2, as the second UGent intervention already started in November 2023, the UGent module was revised and adapted, based on recommendations after the Year 1 intervention and taking into account the possible integration of the ExtenDT2 platform and nQuire for students (WP4 – SIMPLE, NKUA, LNU, OU, NTNU). Full details on the development of the modules can be found in D6.1.

Besides these modules, designed for integration in the academic courses, PD of teachers was also (an implicit) part of the co-creation activities with teachers (WP3 – NKUA, UGent, OU, NTNU, LU,

SIMPLE). Indeed: in order to co-create Exten.(D.T.)² activities, teachers have to learn about the methodology and the tools. The co-creation activities are described in WP3.

Task 6.2. Implement Professional Development Activities in Three Cycles; from Pilot to Wide Scale (Lead: UGent; Other Participants: All) (M6-M30)

In Year 1, the PD modules were piloted in existing academic courses in UGent and NKUA that were taken by pre-and in-service teachers. During Year 1, 69 teachers participated in these courses. Before every intervention, informed consent was obtained. During the implementation, students received instructions on DT as an innovative methodology to address wicked problems and learned how to enhance their DT projects with the existing (not enhanced) digital tools ChoiCo, MaLT2 and SorBET (NKUA) and ChoiCo (UGent). In total, 9 ChoiCo games and 3 SorBET games were developed, on various themes. During the implementation, both UGent and NKUA used the evaluation tools co-created together with WP3, WP5 and WP7 for data collection. Analysis of the data was done by the partners and TCD (WP7). WP7's overall analysis and recommendations of the Year 1 interventions was used for revising the PD modules. A description of the implementation and results of the data analysis can be found in D6.1. In Year 2, UGent has started the second Cycle of implementation within the academic course with a revised module, and applying the Exten.(D.T.)² Digital DT model, developed for implementation of technology enhanced DT activities in the classroom. 65 pre-and inservice teachers are participating, co-creating 15 prototypes of ChoiCo games on either SDG 10 or SDG11. Revised supporting materials were used and the creation of these games occurred within the ExtenDT2 platform, using the extended version of ChoiCo. On the platform, groups and activities were created, with help from the available resources (videos) on the platform and input from OU. At the time of writing, the final stages of Exten.(D.T.)² DT model are being completed. The data collection toolkit was discussed with TCD (WP7) before the implementation. The second implementation in the academic course in NKUA is planned in spring 2024.

In addition to the above-mentioned academic workshops, all partners in Year 1 were involved in the organisation of on-line and face-to-face PD workshops on the Exten.(D.T.)² project, methodology and technologies in non-academic settings. Non-academic PD workshops, using the ExtenDT2 platform, extended technologies and nQuire for students are planned between M19-M24. Teachers for these workshops are reached by means of flyers, open calls, or personal contacts from all the partners. Besides the modules, designed for integration in the academic courses and PD workshops of teachers, PD of teachers was also (implicit) part of the co-creation activities with teachers (WP3 – NKUA, UGent, OU, NTNU, LU, SIMPLE). Indeed: in order to co-create Exten.(D.T.)² activities, teachers have to learn about the methodology and the tools. The co-creation activities are described in WP3.

Task 6.3. Design and Development of Open Online Courses (Lead:OU; Other Participants: UGent, NKUA) (M24-M36)

Recently, OU designed a draft version of an Open Learn Create course on 'Teaching with design thinking and digital technologies' for teachers and interested stakeholders (e.g., parents, informal learning organizations, teacher trainers) to access during or after the project on the Open Learn online platform. This draft version comprises a description of the Exten.(D.T.)² project, the learning goals, besides information on design thinking, the technologies, the ExtenDT2 platform and how to apply these in a classroom setting. All partners will address the draft version, which will be edited by the OU's production team during Period 2.

Status of Deliverables and Milestones due at M18

D6.1 (M12) submitted. Work in D6.1 has contributed to MS3 (achieved M9).

Deviations and Corrective Actions:

There are no deviations. Work is progressing as planned.

3.7 Work Package 7: Evaluation

Overview of Work and Progress towards WP7 Objectives

The main objective of WP7 is the evaluation of Exten.(D.T.)² activities, in order to inform the development and refinement of tools and activities in WP3, 4, 5 and 6, and the Framework (WP2). The specific WP7 objectives are:

WP7 Objectives	Status
O7.1 To design an evaluation framework and tools for Exten.(D.T.) ² activities	Status: On track, achievable by M36
O7.2 To conduct an evaluation of Exten.(D.T.) ² tools and activities in schools	Status: On track, achievable by M36
O7.3 To provide an evidence base for further developments of the final project outputs	Status: On track, achievable by M36
O7.4 To identify good practice	Status: On track, achievable by M36
O.7.5 To develop a critical understanding of the potential, opportunities, barriers, accessibility issues and risks of using emerging technologies for teaching and learning using Design Thinking, from multiple perspectives	Status: On track, achievable by M36

WP7 has completed the design and re-design of the evaluation framework and tools for implementation in Cycles 1 and 2. Evidence from Cycle 1 on the co-design activities, PD and school interventions (WP3, WP6 & WP5 respectively) have resulted in a series of recommendations which have fed into the development of co-design activities, teacher PD and Exten.(D.T.)² Framework (WP5, WP6 & WP2). Additionally, 3 systematic reviews of the literature have been completed on instruments to assess the development of 21st Century skills, Digital Competencies and DT, which has informed the redesign of surveys and other data collection instruments for Cycle 2 and will contribute to the development of the Framework and data collection and evaluation by stakeholders (WP2, WP5 & WP7).

The activities carried out and services provided that contributed to the above WP7 objectives were:

- Development of a data collection toolkit for use in Cycle 1 pilots
- Implementation of the evaluation toolkit in school interventions and PD activities
- Analysis of data from the school interventions and PD activities
- Reports on the results of the data analysis
- Systematic review of the latest instruments for the assessment of 21st Century skills
- Systematic review of the latest instruments for the assessment of Digital Competencies
- Systematic review of the latest instruments for the assessment of Design Thinking knowledge, skills and attitudes
- Analysis of the results of the reviews to identify interrelations and identify appropriate, instruments for use in student and teacher surveys
- Development of the teacher and student surveys based on the results of the analysis of the results of the systematic reviews and adaptation of those instruments as necessary
- Identification of good practice and recommendations to inform Cycle 2 developments
- Development of the Cycle 2 evaluation toolkit based on the experiences and results of the Cycle 1 evaluation and systematic reviews
- Monthly, weekly and bi-lateral meetings with partners and WP leads throughout according to development sprints, partners' data collection schedules and data analysis support needs

Task 7.1: Development of Cycle 1 Evaluation Toolkit (Lead: TCD; Other Participants: NKUA, UGent, NTNU, OU) (M24-M36)

At the commencement of this task, the primary aim was to establish a shared vision for the evaluation across the consortium through collaborative meetings and shared documents, through which the project aims and requirements of the evaluation from the perspective of each WP were identified. TCD then developed an evaluation toolkit for use in school interventions (WP5) and professional development activities (WP6) in collaboration with those WP leads. The draft evaluation plan was shared with all partners for feedback, followed by revisions and the construction of the evaluation instruments which were also provided to all partners for review. The final toolkit includes data collection instruments and guides as well as data analysis and reporting templates which were made available for use by all partners for use in T7.6. This task is complete.

Task 7.2: Literature Review (Lead: TCD; Other Participants: NKUA) (M7-M34)

A systematic review of the literature commenced on schedule (M7) and is to be followed throughout the project lifetime to ensure the integration of evidence informed good practice and innovation. TCD leads the 21st Century skills and Design Thinking reviews, while NKUA leads on the Digital Competencies review. Each review has a lead person who collaborates to develop search strings that are both specific to their topics enabling reliable comparison at later stages. Up to now the search strings have been used in several education, psychology, social science and computer science databases. These resulted in a total of 13 172 results for the 21st Century skills review; 5 587 results for the Design Thinking review and 10 144 results for the Digital Competencies review. After removing duplicates, 23 174 abstracts were reviewed, which resulted in 432 full-text reviews and 54 papers identified for extraction. From these, 48 validated surveys were identified with a total of 1 788 items for consideration in Task 7.4. The full results of Task 7.2 will be available in D7.2 (due M25) and inform the development of the Framework (WP2).

Task 7.3: Teacher's Evaluation Toolkit (Lead: TCD; Other Participants: NKUA, UGent) (M13-M30)

A review of existing evaluation toolkits for teachers to use during DT activities is currently underway, along with the development of the co-design process.

Task 7.4: Survey Development (Lead: TCD; Other Participants: NKUA, UGent) (M13-M30)

Informed by the results of the Cycle 1 evaluation (T7.6 & 7.7) and the literature review (T7.2); innovative survey instruments for teachers and students have been developed and integrated into the Cycle 2 evaluation toolkit (T7.5).

Task 7.5: Development of Cycle 2 and Cycle 3 Toolkits (Lead: TCD; Other Participants: LNU, NKUA, UGent, NTNU, OU) (M13-M26)

The Cycle 2 evaluation toolkit enables a range of instrumental case studies to be implemented depending on local teacher needs and project requirements. It includes the surveys developed in Task 7.4 to be implemented as part of all school interventions and PD activities and a guide on how to modify data collection for different case study contexts.

Task 7.6: Evaluation of activities and tools (Lead: TCD; Other Participants: LNU, NKUA, UGent, NTNU, OU) (M7-M30)

The Cycle 1 toolkit (T7.1) was implemented in school interventions and teacher PD activities (WP5 & 6) in Belgium, Greece, Norway and the UK. Cycle 2 evaluation will commence from M19.

Task 7.7: Evaluation Data Analysis and Reporting (Lead: TCD; Other Participants: LNU, NKUA, UGent, NTNU, OU) (M7-M36)

The Cycle 1 evaluation utilised constant comparative analysis of data collected in each case study (T7.6) to result in a series of short case-study reports. A cross-case/cross-country analysis was then undertaken of the results of these case studies and survey data. Reviewing the results of this analysis with partners, a series of recommendations for consideration in Cycle 2 and Cycle 3 development across WP2, WP3, WP4, WP5, WP6, WP7 and WP9 were identified. These were categorised under 'design thinking

pedagogy', 'technology', '21st Century skills', 'evaluation and ethics'. The final report on the Cycle 1 evaluation, including each of the individual case-study reports is available in D7.1.

Status of Deliverables and Milestones due at M18:

D7.1 (M13) submitted and contributed to MS5 (achieved M13).

Deviations and Corrective Actions

There are no deviations. Work is progressing as planned.

3.8 Work Package 8: Dissemination, Exploitation and Impact Generation

Overview of Work and Progress towards WP8 Objectives

The main aim of WP8 is to ensure project activities and outcomes are effectively disseminated during the project period and exploitation will be achieved by the end of the project, by engaging students and teachers with designed activities as well as other stakeholders, such as educational policy makers, in using the proposed tools, materials and approach. The specific WP8 objectives are listed below:

WP8 Objectives	Status
O8.1 Develop a dissemination and exploitation plan	Achieved
O8.2 Develop the project website, social media presence, newsletters	Achieved
O8.3 Develop an OpenLearn online course for dissemination and exploitation	On-track, achievable by M36
O8.4 Produce conference and journal publications including a policy report	On-track, achievable by M36
O8.5 Ensure wide participation and student and teacher engagement with the DT projects	On-track, achievable by M36
O8.6 Ensure the sustainability of the project through the AI dashboard, and associated tools	On-track, achievable by M36

Activities carried out that contributed to the achieving these objectives include:

- Development of a dissemination and exploitation plan
- Design of the project website¹⁹ which is regularly updated with project related news, resources and new information
- Use of social media, 'X', LinkedIn and YouTube to disseminate project information
- Producing quarterly newsletters with project news and progress
- Flyer for the project, to advertise the project particularly at face to face events
- A first draft of the Open Learn Course
- Workshops carried out with teachers introducing DT and project technologies
- Dissemination of project activities and outcomes to researchers and stakeholders at various events including presenting seven papers in conferences, such as mis4TEL and EARLI
- Collaboration with sister projects and production of common outputs (papers, presentations, podcasts)

Task 8.1: Dissemination and Exploitation Activities (Lead: OU; Other Participants: All) (M1-M6)

The project website has been redesigned focusing on consistency in terms of visual elements and information arrangement. There is a dedicated call for teachers to participate in the project as well as relevant resources they can use to teach design thinking. The website is regularly updated with project news, quarterly newsletters, publications and resources for teachers and others. The project uses social media to disseminate information and aims for updates to be shared on a weekly basis. Channels include

¹⁹ www.extendt2.eu

Linked-In²⁰, X²¹ and YouTube²². YouTube is used to publicise video tutorials on how to use project technologies as well as podcasts. Newsletters²³ are published quarterly (March, July and December 2023 so far) covering project news and activities, such as the release of new versions of technologies.. Newsletters are disseminated through the project website and social media pages. Another initiative is the Exten.(D.T.)² project flyer, which presents the Digital Design Thinking model that the project has developed, drawing from lessons learnt in Year 1 of the project. It also lists the funders, partners, the project website, and social media handles. Finally, the project team is working with the Open University's production team to develop an Open Learn free course for the dissemination and exploitation of project outcomes during and beyond the project period.

Task 8.2: Engage ment Activities (Lead: OU; Other Participants: All) (M7-M18)

In Year 1, 5 teachers from Greece, 3 from the UK, 4 from Norway and 1 each from Belgium and Sweden attended online workshops that introduced DT and project technologies. Announcements seeking teachers to take part in the project were circulated during the first year of the project in social media and local networks of schools. In Year 2, a total of 131 teachers attended these workshops: 60 from Belgium, 23 from Nepal, 43 from Greece, 4 from UK and 1 from Bangladesh. In Year 2, workshops, entitled 'Teaching with design thinking and emerging digital technologies', were developed with the aim to help teachers learn about and design lesson plans using DT and digital technologies while also showcase and give time to use project technologies. These workshops were delivered by the OU, Ghent, NKUA, NTNU, SIMPLE and LNU. The OSOS network has not been approached yet. Project partners are using their own networks to recruit students and teachers and implement DT activities. Regarding the OpenLearn course, a first draft has been produced and is under revisions. To overcome language barriers to using material, the Pybossa platform or a GenAI solution will be considered for translation.

Task 8.3: Production of Conference and Journal Publications including Policy Report (Lead: OU; Other Participants: All) (M19-M36)

Fifteen academic outputs have been produced and presented. In December 2022, Boban Basin published a paper entitled 'Intelligent techniques in e-learning - a literature review' in Artificial Intelligence Review. In June 2023, Isabella Possaghi published a conference paper 'Designing emerging technology-supported learning activities based on the DT approach for K-12 users' in the 'Proceedings of the 22nd Annual ACM Interaction Design and Children Conference'. In the same month, Marianthi Grizioti and Maria Stella Nikolaou presented 'Enhancing students' 21st Century skills through playing and modifying embodied digital classification games' at the 16th International Conference on Technology in Mathematics Teaching (ICTMT 16) in Athens which was attended by 100 teachers and researchers. Marianthi Grizioti and Chronis Kynigos published a paper 'Integrating Computational Thinking and Data Science: The Case of Modding Classification Games' in the Informatics in Education Journal. Øyvind Jalland Schjerven & Kristoffer Nyvoll from NTNU produced a master's thesis entitled 'A Study on the Use of Virtual Robotics and Design Thinking to Support Learning in K-12 Education' In July 2023, Christina Gkreka delivered presentation on 'Construction of spatial orientation meanings during an outdoor activity with use of dynamic screen-based spatial representations' at the 13th Congress of the European Society for Research in Mathematics Education (CERME13) which was attended by 900 participants. In August 2023, Marcelo Milrad, Christothea Herodotou, Marianthi Grizioti, Alisa Lincke, Carina Girvan, Sofia Papavlasopoulou, Sagun Shrestha and Feiran Zhang published a conference paper 'Combining Design Thinking with Emerging Technologies in K-12 Education' in the Lecture Notes in Networks and Systems book series (LNNS, volume 769). It was presented at the International Conference in Methodologies and Intelligent Systems for Technology Enhanced Learning (mis4TEL 2023) in Guimaraes, Portugal, July 2023. In August 2023, a short conference paper 'Extending Design

²⁰ <https://www.linkedin.com/company/extend-t-2/?viewAsMember=true>

²¹ <https://twitter.com/extendt2>

²² www.youtube.com/@extendt2

²³ <https://extendt2.eu/our-news/>

'Thinking with Digital Technologies' was presented at the 20th Biennial EARLI Conference in Greece by Manolis Mavrikis, Marcelo Milrad, Chronis Kynigos, Marianthi Grizioti, Christothea Herodotou, Lieva Van Langenhove, Katrien Strubbe, Sofia Papavlasopoulou, Carina Girvan, Filothei Chalvatza and Maria-Stella Nikolaou. 50 participants attended this presentation. A paper, 'An Embodied Instrumentation Approach for Spatial Thinking Development using Geospatial Technology' was presented at the 13th International Conference of ICT in Education in Greece by Christina Gkreka and Chronis Kynigos. It was attended by 80 teachers and researchers. Marianthi Grizioti and Maria-Stella Nikolaou presented a paper on 'Developing a Digital Kinesthetic Sorting Game: The Case of Cultivating Classification and Collaboration Skills by Secondary School Students' in the same ICT in Education Conference in Greece. In October, Carina Girvan & Chronis Kynigos delivered the presentation 'Leveraging the powerful ideas of constructionism to enhance emergent design thinking pedagogy' in the Constructionism Conference, New York which was attended by 300 participants. In November 2023, Sokratis Karkalas, Filothei Chalvatza & Manolis Mavrikis published a paper on 'Online Polyglot Programming Education with LFT (Lingua Franca Transformer)' in the Proceedings of the 15th International Conference on Computer Supported Education (CSEDU 2023). In February 2024, Chronis Kynigos & Marianthi Grizioti presented a paper on 'Emerging Technologies and Tinkering tools: the Case of MaLT2' in the 3rd Panhellenic Scientific Symposium "The Logo Tree in Greece". The session was attended by 100 researchers and teachers. In the same month Katrien Strubbe and Ilse Mariën presented a paper related to the Exten.(D.T.)² project at the 8ste Vlaams Congres van Leraars Wetenschappen, which was attended by 400 teachers.

In addition to the engagement in scientific events, up until February 2024, the project partners delivered seventeen presentations in several other academic and non-scientific events. For instance, in April 2023, Sofia Papavlasopoulou delivered a presentation on Exten.(D.T.)² aims and discussion on the AR,VR, etc. for the next generation internet and metaverse and its role to education at the Temple University, Institute for Business and Information Technology, Philadelphia, Pennsylvania. (25 participants). In September 2023, Marcelo Milrad gave an online keynote speech to the Brazilian Association of Mathematics Education on 'Computational Thinking (CT) and Learning Analytics in Mathematics Education: Enhancing the programming experiences for Teachers and Students (150 participants). In October 2023, Chronis Kynigos gave a presentation at the Third International Workshop on Computational Thinking, Code Skills and AI in Schools in Växjö, Sweden (50 participants). In November 2023, Marcelo Milrad, Chronis Kynigos, Carina Girvan, Sofia Papavlasopoulou, Marianthi Grizioti, Manolis Mavrikis and Christothea Herodotou delivered an online session on 'Design thinking and emerging technologies at schools across Europe: Reflections on the first year of implementation of Exten.(D.T.)² as part of the European Open and Digital Learning Week 2023 organised by EDEN Digital Learning Europe, which (attended by 45 academics and educators). The publication of Journal papers will be continued in Year 2 and 3, and a policy report will be produced in Year 3 of the project, likely in collaboration with other sister/cluster projects.

Status of Deliverables and Milestones due at M18

D8.1 (M6) and D8.2 (M18) submitted. Work in D8.1 contributed to MS2 (achieved M6).

Deviations and Corrective Actions

There are no deviations. Work is progressing as planned.

3.9 Work Package 9: Ethics

Overview of Work and Progress towards WP9 Objectives

The main objective of WP9 is to provide ethical oversight and input into the project’s research (WP7) and technology development (WP4). The specific WP9 objectives identified and listed below are:

WP9 Objectives	Status
O9.1 To establish a project Ethics Advisory Board (EAB) with an independent expert	Complete
O9.2 To review the project on an ongoing basis and raise potential ethical issues across WPs	On track, achievable by M36
O9.3 To identify how ethical issues will be addressed and who will be responsible for addressing them	On track, achievable by M36
O9.4 To provide input into project developments and ongoing practice	On track, achievable by M36

The activities carried out that contributed to the above WP9 objectives were:

- Recruitment of an external and independent ethics advisor
- Creation of the Ethics Advisory Board (EAB) and outlining its remit
- Review of the initial project proposal and project developments up to M6
- Review of the DMP
- Periodic review of project developments to-date and input into ongoing/future developments
- Periodic review of data collection by researchers and response
- Periodic review of data collection through automated tools
- Periodic review of approaches to gain informed consent and assent
- Periodic meetings (approx. 6-monthly) of the EAB with the involvement of WP leads, task leads and other partners as required
- Attendance at WP7 meetings and consortium meeting (virtually) in Athens
- Communication with the OMT via the WP lead

Task 9.1: Set up Ethics Board (Lead: TCD; Other Participants: LNU) (M1-M4)

This task is complete. The Ethics Board was set up following the identification of a suitable external expert. The EAB is composed of Dr Carina Girvan (TCD) (Chair), Johanna Velander (LNU) and Prof Adam Hedgecoe (Independent Expert Advisor, Cardiff University, UK). The scope of the team and terms of working were verbally discussed and agreed at the first meeting. Other potential members to be included in future meetings were identified as: Prof Manolis Mavrikis (UCL), Filothei Chalvatza (SIMPLE), Dr Alisa Lincke (LNU), Dr Marianthi Grizioti (NKUA) and Prof Christothea Herodotou (OU) who represent each of the partners involved in the technical development of tools (WP4). Dr Ahmed Taiye Mohammed, lead author of the three deliverables around the Data Management Plan, is also invited to meetings as relevant.

Task 9.2: Review and input into initial project developments (Lead: TCD; Other Participants: All) (M9-M36)

All PIs are aware that they must not commence research unless they have relevant ethics approvals in place. All partners were reminded of this at the start of the project and at the Kick-off meeting. Related to this task the EAB met 5 times during the first 18 months (14 February 2023, 28 February 2023, 21 March 2023, 31 March 2023 and 29 February 2024) and minutes of meeting are available in the

Appendices of D9.1 and D9.2 During the meetings WP leads provided the EAB with an update on the status of their WPs, highlighting any issues or questions they had regarding ethics in terms of their own WPs and/or the project as a whole. These were reviewed by the Board. Members of the Board attended WP7 meetings with all partners during the development of the initial evaluation toolkit to gain familiarity with the proposals and raise questions regarding ethics. It was noted that at this stage in the project the design of the evaluation followed very standard social science approaches and there were no concerns raised regarding technology or approaches to gaining informed assent from children. The Board explored hypothetical issues regarding project technology developments with all partners, noting that there were too many unknowns at this stage to make a clear determination but there is value in raising issues so that mitigation measures can be considered in advance and included in the design.

Task 9.3: Periodic Review (Lead: TCD; Other Participants: All)

Following the completion of Task 9.1 the EAB has met five times (see Task 9.2 above) to review project developments and provide input into these by way of a review and response to data collection in Cycle 1 and planned data collection in Cycle 2; review and response to the planned data collection through automated tools and the ways in which the evaluation data will be used to validate the interpretation of the data collected via the automated tools; and to review approaches used to gain informed consent and assent following the project's technical and research developments. This is reported in D9.2.

Status of Deliverables and Milestones due at M18

D9.1 (M8) submitted. D9.2 (due M18 has been submitted in M19). The minor delay was agreed with the PO. It does affect the progress of the project and is not further reported as a deviation.

Deviations and Corrective Actions

There are no deviations. Work is progressing as planned.

4. Update of the Plan for Exploitation and Dissemination of Results

WP8 has submitted two deliverables D8.1: Dissemination and Exploitation Plan (M6), and D8.2 Dissemination and Impact Report 1 (M18). The former details the project’s plan for exploitation and dissemination of results towards the start of the project. The latter provides an update on the status of these at M18 and briefly covers the plans for the remaining 18 months of the project.

5. Impact

As detailed in D8.2 impact is reviewed on a monthly basis, during the Operational Management Team project meetings. In the meetings, each project partner provides updates regarding progress on each work package, and the impact of the project activities on teachers, students and other stakeholders in each country. At the end of the first year of the project, an evaluation with teachers and students was carried out to assess the impact of the project’s approach on students’ learning and teachers’ professional development, enabling the development of a shared understanding of the potential opportunities, barriers, accessibility issues and risks of using emerging technologies for teaching and learning. Evaluation insights helped the project team to develop a design thinking model for use in secondary education, coined as the Exten.(D.T.)² Digital Design Thinking model (Figure 7).

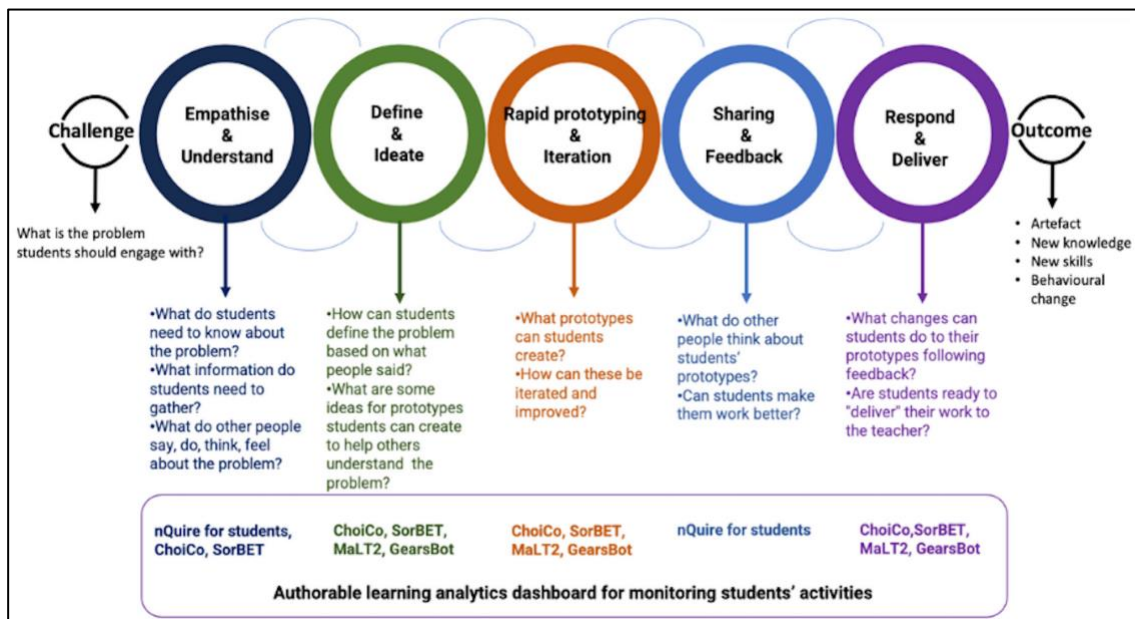


Figure 7: Digital design thinking model developed in Year 2.

Further, the evaluation informed the development of the extended versions of technologies. For example, the SorBET tool has been enhanced with augmented reality (gesture recognition), ChoiCo now uses geolocation enabling students to add game points on specific locations, MaLT2 is connected to 3D printing and nQuire for students enables provision of feedback by teachers to studies, filtering to identify classes, schools etc and upload of URLs of games such as ChoiCo for assessment by other students. Finally, the Year 1 evaluation informed the content, structure and delivery of teacher training workshops and resulted in an updated version of the activity template plan used to create lesson plans by teachers. Ongoing monitoring and reporting of the mentioned activities provide feedback for the development for the second version of the Extend.(D.T.)² Framework and Guidelines.

The table below presents and quantifies the impacts from the project proposal. It details the activities carried out and monitored so far to support impact and beneficiaries who were impacted upon.

Table 1. Project impact and related activities

From the proposal	Activities contributing to impact	Beneficiaries
<p>Scientific impact: enhanced understanding about the process of digital DT and its application to school curricula, directly to participating teachers and indirectly to pre and in-service teachers through existing university courses offered by partners and networks with schools and educational policy makers; enhanced scientific knowledge of how to sustainably digitise education through DT to involved researchers, broader academic community and software developers; enhanced understanding of the benefits and barriers to using technologies in education, identifying ways to remove barriers by supporting teachers' professional development and school implementations.</p>	<p>Year 1 pilot activities at schools including co-design of activity plans, delivery of lesson plans, collection of data.</p> <p>An evaluation deliverable detailing impact on learning and production of the Exten.(D.T.)² digital design thinking model.</p> <p>Dissemination activities as listed in this deliverable.</p> <p>Literature review to identify best practices, challenges and requirements to enhance DT with ET followed by the creation of the framework and the guidelines.</p>	<p>Teachers, students, researchers</p>
<p>Economic: development of students' 21st Century skills facilitating future employability and adaptation in an ever-changing society, as well as contribution to solving societal challenges through DT processes.</p>	<p>Year 1 pilot implementation at schools showing early evidence of impact on students' development of 21st Century skills.</p>	<p>Students in participating countries</p>
<p>Societal: tackling inequalities and promoting social fairness and access to educational opportunities in students through an inclusive and sustainable approach to learning.</p>	<p>Ensuring all children take part regardless of their colour, background, race, etc.</p> <p>Creation of free to use technological tools accompanied by training in their use (workshops, Open Learn course).</p>	<p>Students Teachers</p>
<p>Environmental: new methods for monitoring and supporting and promoting students' learning from a distance that are sustainable to environmental threats; changes in educational practices or policies affecting the sustainable delivery of education.</p>	<p>The digital technologies used in the project are all web based, accessible by anyone at any time.</p> <p>An authorable learning analytics dashboard is under development that will enable teachers to "see" what students are doing when they are using technologies, enabling monitoring and support interventions from a distance.</p>	<p>Teachers, students</p>

6. Open Science

All technologies used in the project and supporting material are web-based, open access and free to use allowing access to anyone from any location and device, including teachers, schools and other stakeholders. These can be found at the project website²⁴. They are reviewed and updated as the project evolves and as new data are gathered. Also, all deliverables are public and available on the website, sharing best practices of reporting with other researchers.

The Data Management Plan (DMP) is a living document updated on a continuous basis to take into account the latest developments concerning GDPR and research ethics standards. The first version (D1.2) was submitted at M8 and an updated version (D1.3) at M18. The project's DMPs explain the type, standards and management of data sharing, and makes data findable, accessible, interoperable and reusable (FAIR). The project operates on the 'as open as possible, as closed as necessary' principle.

The project's DMP further addresses how non-personal/anonymized data and project results will be made available. Anonymized project data sets (quantitative and qualitative) for academics, teachers and policy makers will be shared following FAIR practices using fully funded repositories in the EU. Academic outputs will be made Open Access using either Green or Gold routes, as appropriate, to ensure all stakeholders can engage with the results. All reports, resources, results and anonymized data will be made Open Access via the Zenodo repository or other institutional repositories such as the ORDO for the OU.

²⁴ www.extendt2.eu

7. Deviations from Annex 1 and Annex 2

7.1 Tasks/Objectives

As reported under WP4 , SIMPLE has performed additional work than originally planned. This relates to the development of the ExtenDT2 platform to host the tools and technologies as it was not possible to do this on the nQuire platform as originally foreseen. nQuire is an established OU product and must comply with OU standards. In the first few months of the project it became apparent that it would not be possible to use nQuire as an experimental platform for implementing integrations with third party learning and other components as they did not comply with certain OU policies and standards. There will be a transfer of ca €31 000 (ca 7,5 PM) to SIMPLE for their work on the ExtenDT2 platform which was not foreseen at the project start. This will come from the EC beneficiaries involved in WP4, who had approximately the same budget to have worked on the nQuire platform. This therefore does not affect the overall budget or resources for the project.

As reported under WP5 in order to follow the school year, which in most countries starts in September and ends in June, there has been a shift in the initial months planned for the interventions' preparation and implementation as follows: Intervention preparation and co-design: October 2022– January 2023, Implementation and data collection: February – June 2023. Thus, Cycle 1 took place during M2-M12, Cycle 2 will take place during M14-M22 instead of M9-M15, and Cycle 3 during M25-M33 instead of M18-M30. This deviation does not affect the overall progress in the project or the activities of other work packages.

7.2 Use of Resources

This section aims to provide an overview between actual and planned use of resources in Annex 1, including person-months per WP and financial costs by Partner and budget category. The aim of Sections 7.1 and 7.2 is to provide a general overview for the P1 review, and illustrate how resources utilised so far in the project are in line with the work and activities reported in Sections 1-6 of the Technical Report above. In Section 7.3 each of the six EC beneficiaries have provided details on their own respective financial reporting including any noteworthy deviations between its budgeted and actual costs.

NB: Detailed financial information is not provided in Table 2 below for OU and UCL who are associated partners funded by UKRI. They have provided information on the use of resources related to PM. They will report and provide further detailed information on their costs to UKRI.

7.2.1 Person Months

An overall summary of the Person Months (PM) Use of Resources is presented below in Table 2.

Table 2: M18 Summary of PM by WP and Partner

Partner Number and Acronym	WP1 (PM)			WP2 (PM)			WP3 (PM)			WP4 (PM)			WP5 (PM)			WP6 (PM)			WP7 (PM)			WP8 (PM)			WP9 (PM)			Total		
	Plan M1-M36	Actual M1-M18	% Used	Plan M1-M36	Actual M1-M18	% Used	Plan M1-M36	Actual M1-M18	% Used	Plan M1-M36	Actual M1-M18	% Used	Plan M1-M36	Actual M1-M18	% Used	Plan M1-M36	Actual M1-M18	% Used	Plan M1-M36	Actual M1-M18	% Used	Plan M1-M36	Actual M1-M18	% Used	Plan M1-M36	Actual M1-M18	% Used	Plan M1-M36	Actual M1-M18	% Used
1- LNU	18,0	10,21	57%	4,0	1,10	28%	4,0	0,73	18%	20,0	8,55	43%	8,0	1,52	19%	8,00	1,07	13%	4,0	0,81	20%	3,0	0,75	25%	0	0		69,0	24,74	36%
2- NKUA	1,0	0,54	54%	6,0	1,42	24%	9,0	3,38	38%	24,0	9,65	40%	15,0	8,27	55%	12,00	5,06	42%	6,0	1,29	22%	5,0	0,52	10%	0	0	n/a	78,0	30,13	39%
3- UGent	1,0	0,28	28%	6,0	0	0%	10,0	2,08	21%	0,5	0	0%	9,0	0,9	10%	17,00	9,15	54%	6,0	0,04	1%	4,0	0,31	8%	0	0	n/a	53,5	12,76	24%
4- NTNU	1,0	1,00	100%	16,0	9,59	60%	8,0	2,71	34%	8,0	4,35	54%	8,0	3,15	39%	8,00	2,66	33%	6,0	2,95	49%	3,0	0,41	14%	0	0	n/a	58,0	26,82	46%
5- TCD	1,0	0,50	50%	4,0	1,00	25%	2,0	1,00	50%	2,0	0,50	25%	5,0	0,5	10%	3,00	3,00	100%	12,0	7,00	58%	1,0	0,50	50%	0	1		30,0	15,00	50%
6- SIMPLE	-	-	n/a	-	-	0%	3,0	-	0%	12,0	10,00	83%	3,0	-	0%	-	-	n/a	-	-	n/a	-	-	n/a	-	-	n/a	18,0	10,00	56%
7- OU	1,0	1,3	130%	6,0	1,2	20%	16,0	6,3	39%	10,0	12,00	120%	8,0	1,10	14%	7,00	1,50	21%	5,0	1,20	24%	6,0	3,8	63%	0	0	n/a	59,0	28,40	48%
8- UCL	-	-	n/a	-	-	n/a	-	-	n/a	1,2	0,60	50%	-	-	n/a	-	-	n/a	0,6	0,20	33%	-	-	n/a	-	-	n/a	1,80	0,8	44%
Total	23,0	13,83	60%	42,0	14,31	34%	52,0	16,2	31%	77,7	45,65	59%	56,0	15,44	28%	55,0	22,44	41%	39,6	13,49	34%	22,0	6,29	29%	-	-	1	367,3	148,65	40%

- There are some deviations reporting PMs at individual WP level for all partners. This is due to almost all partners being involved in all WPs with many meetings and activities overlapping and covering a range of different but complementary WPs. This has resulted in difficulty in allocating time precisely between WPs.
- SIMPLE has performed additional work than originally budgeted in WP4. This relates to the development of the ExtenDT2 platform for hosting the tools (as it was not possible to do this on the nQuire Platform as originally foreseen). Other partners, namely those in WP4 partners, will transfer some of their financial resources to compensate SIMPLE for the additional work on this, so this does not affect the overall budget or resources for the project.
- The deviations reported above (and that associated with the timing of the interventions – see Section 7.1) have not affected the overall work and progress of the project as evidenced from the technical part of the reporting. The deviations are therefore not a cause for concern.

7.2.2 Financial Costs

A summary of the declared eligible costs is presented in Table 3 below and discussed at the overall project level.

Table 3: M18 Summary of PM and Financial Costs by Partner and Budget Category

Partner Number and Acronym	Person Months (PM)			Total Costs (€) *			Direct Costs (€) excl 25% overheads											
	Plan M1-M36	Actual M1-M18	% Used	Plan M1-M36	Actual M1-M18	% Spent	Personnel (€)			Travel & Subsistence			Equipment			Other Goods and Services		
							Plan M1-M36	Actual M1-M18	% Spent	Plan M1-M36	Actual M1-M18	% Spent	Plan M1-M36	Actual M1-M18	% Spent	Plan M1-M36	Actual M1-M18	% Spent
1 - LNU	69,0	24,74	36%	743 089	237 378	32%	528 671	172 742	33%	55 800	10 821	19%	5 000	-	0%	5 000	6 339	127%
2 - NKUA	78,0	30,13	39%	517 858	198 878	38%	347 287	132 840	38%	48 000	19 746	41%	10 000	4 791	48%	9 000	1 725	19%
3 - UGent	53,5	12,76	24%	356 846	174 683	49%	248 877	134 012	54%	21 600	3 223	15%	-	-	N/A	15 000	2 511	17%
4 - NTNU	58,0	26,82	46%	499 574	196 661	39%	373 659	155 586	42%	15 000	1 743	12%	-	-	N/A	11 000	-	0%
5 - TCD	30,0	15,00	50%	353 100	168 720	48%	261 480	126 536	48%	20 000	8 440	42%	500	-	0%	500	-	0%
6 - SIMPLE	18,0	10,00	56%	114 668	62 088	54%	55 734	41 452	74%	12 000	4 699	39%	22 000	3 084	14%	2 000	435	22%
7 - OU	59,0	28,40	48%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8 - UCL	1,8	0,80	44%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	367,30	148,65	40%	2 585 135	1 038 408	40%	1 815 708	763 168	42%	172 400	48 672	28%	37 500	7 875	21%	42 500	11 010	26%

* = direct costs + 25% overheads

Overview

- At M18, 40% of the budget has been utilised both for PMs and the declared spent eligible Total Costs.
- This is in line with PMs utilised and Personnel costs declared (40% and 42% respectively) which form the largest and most significant part of the financial budget.
- Exten.(D.T.)² runs on three Cycles over the 36 months of the project which are not linear. In terms of allocation of PM and associated costs. Cycle 1 has been completed. In both Cycles 2 & 3 more work is concentrated on the second half of each Cycle. This is the main reason for the deviations, i.e., more work is planned in P2 (M19-M36), including travel and presentations at conferences etc.
- For partners UGent and SIMPLE deviations between PMs and total personnel costs spent are larger and are explained further below under their respective individual partner use of resources and costs associated information.

Personnel costs

- These form the largest part of the budget. Of the total budgeted direct costs (€2 068 108), ca. 88% of this relates to budgeted personnel costs (€1 815 708).
- At M18 of the total declared direct costs (€832 588), 92% of this comprised of declared personnel costs (€763 168).
- There is no significant deviation therefore in the overall split of spending between the budget categories.

Travel and subsistence costs

- Travel and subsistence costs form a small part of the budget. Of the total budgeted direct costs (€2 068 108), ca 8% relates to budgeted travel costs (€172 400). At M18, 28% of the overall budgeted costs for 36 months had been utilised.
- The main reason for the deviation is that more of such costs will occur in the second part of the project when, for example, there are more results to disseminate at conferences and other events.
- The costs for the P1 Review will also be charged to P2 as will the third six-monthly partner meeting which was moved to M20 instead of M18. The rationale for this was that it was more economic and efficient for this to concur at the same time as the Period 1 EC review (M20: April 2024). Additionally it would provide the opportunity for the younger researchers to participate or be an observer in the P1 review, and thus support them in their career development.

Equipment

- Equipment represents a small part of the budget. Of the total budgeted direct costs (€2 068 108), <2% of this relates to budgeted equipment costs (€37 500). At M18, 21% of the overall budgeted costs for 36 months had been utilised.
- Further explanations are provided by individual partners who have budgeted equipment in Section 7.3 below.

Other goods, works and services

- Other goods, works and services form a small part of the budget. Of the total budgeted direct costs (€2 068 108), ca 2% of this relates to other goods, works and services (€42 500). At M18, 26% of the overall budgeted costs for 36 months had been utilised.
- Further explanations are provided by individual partners who have budget in this category in Section 7.3 and have incurred costs under P1.
- Two main deviations are detailed under this budget category as they were unforeseen at the project start, and currently charged/to be paid by LNU. The PO has been informed of these:
 - (i) Purchase of Amazon Web Services (total estimated cost for project duration €4 500: of which has €1 798 been charged up to M18.
 - (ii) Remuneration for an Independent Ethics Advisor as part of the Ethics Task (Total expected cost for partners receiving EC contribution = €3 960). The accounting for this, to be in accordance with EC eligibility and national rules is being resolved and will be reported in P2. No costs are charged in P1.
- Further details of both deviations are under LNU's costs and explanations of deviations below. The costs and their apportionment of both have been formally agreed to be shared between the partners.

Transfer of Cost Categories

In P2 the EC beneficiaries will shift some of their budget to LNU (ca. €220 - €1 950 per partner). This may come from any of the categories (Personnel, Travel and subsistence, Equipment and/or Other goods, works and Services) and is to compensate for the two unforeseen costs in the project described above (AWS and Independent Ethics Expert) and which will/are to be reported under LNU who has/will make the payments. LNU's overall reported costs under the budget category Other goods, works and services will also increase to take this into account. This apportionment of AWS and the Independent Ethics Advisor costs

has been formally agreed and transfers between partners and will be done in P2 when figures are more accurate. The total sum for both unforeseen costs is <€10 000.

There will also be a transfer of ca €31 000 (ca 7,5 PM) to SIMPLE for their work on the ExtenDT2 platform which was not foreseen at the project start as explained above. This will come from the EC beneficiaries involved in WP4 (LNU and NKUA) and may come from any of their budget categories (Personnel, Travel and subsistence, Equipment and/or Other goods, works and services).

The transfers above between partners during P2 for AWS, the remuneration of the Ethics Independent Expert and SIMPLE's work on the ExtenDT2 platform will be fully disclosed in the P2 and the final reporting. None of the budget transfers require an amendment.

7.2.3 Use of Resources Per Partner

LNU: 1 September 2022 – 29 February 2024 (M1-M18)

Person Months (PM)			Personnel (€)			Travel and subsistence (€)			Equipment (€)			Other goods, works & services (€)		
Plan M1-M36 PM	Actual M1-M18 PM	% used	Plan M1-M36 €	Actual M1-M18 €	% used	Plan M1-M36 €	Actual M1-M18 €	% used	Plan M1-M36 €	Actual M1-M18 €	% used	Plan M1-M36 €	Actual M1-M18 €	% used
69	24,74	36%	528 671	172 742	33%	55 800	10 821	19%	5 000	0	0%	5 000	6 339	127%

LNU's declared purchase costs do not exceed the 15% of the declared personnel costs.

Explanation of deviations are nevertheless provided where the “% used” at M18, is < than 40% or > 60% for any of the five headings (i.e., deviations are reported below using 20% as a threshold between straight line budgeted v actual reported costs at M18).

- Personnel costs are lower than budgeted, but in line with the budgeted PM rate. This will be compensated in P2 when two more employees will join the current team to work in Cycle 2 & 3 of the project, as numbers of students and teachers involved in school interventions are ramped up, for LNU.
- Travel and subsistence costs are low due to the Kick-Off meeting being at LNU which meant no flights or large travel costs, and virtually no hotel or subsistence costs. Other deviations are generally in line with what is described in the overall use of Resources Financial Section 7.2.1 and 7.2.2 above.
- The budget for Equipment for LNU is relatively small and will be utilized in Years 2 and 3.
- The budget for Other goods, works and services (€5 000) relate to audit costs. The charge in P1 includes mostly LNU as coordinator hosting / paying for some costs related to project meetings e.g., Kick-off. It is more appropriate to include under this category rather than Travel and subsistence as originally budgeted under; and (€1 798) for Amazon Web Services which were unforeseen and which the EC was informed. In P2 this budget category will also include an unforeseen cost related to payment of the Independent Ethics Advisor.
 - i. AWS: The Exten.(D.T.)² project is developing a platform to host an ecosystem of diverse web-based learning applications that will enable the deployment of digital design thinking activities for schools and other educators. As part of the technical development, the meta data and other data produced by the users needed to be stored in Amazon Server Cloud (this is standard) or something similar. At the project start the cost was estimated to be €4 500 over the project duration.
 - ii. Following the EC ethics review of the project, issues related to children, data and AI were flagged, and the project was required to have an Ethics Board. For its composition the consortium proposed to have one independent member and two internal members to keep costs down and have some independence. In line with EC remuneration rates for experts a reasonable rate of €450 per day was agreed (ca 11 days work over the project duration who was approved by the EC. This cost will be split between the partners including OU, who received its funding from UKRI. (Total expected cost for partners receiving EC contribution = €3 960). LNU is making the payments on behalf of the other EC beneficiaries. The accounting for this, to be in accordance with EC eligibility and national rules is being resolved and will be reported in P2.

LNU will transfer in P2 some of its financial resources to SIMPLE for its unforeseen work on the ExtenDT2 platform. This is expected to come from LNU's Personnel and Travel and subsistence budgeted costs (see Section 7.2.2 Transfer of Cost Categories above).

NKUA: 1 September 2022 – 29 February 2024 (M1-M18)

Person Months (PM)			Personnel (€)			Travel and subsistence (€)			Equipment (€)			Other goods, works & services (€)		
Plan M1-M36 PM	Actual M1-M18 PM	% used	Plan M1-M36 €	Actual M1-M18 €	% used	Plan M1-M36 €	Actual M1-M18 €	% used	Plan M1-M36 €	Actual M1-M18 €	% used	Plan M1-M36 €	Actual M1-M18 €	% used
78	30,13	39%	347 287	132 840	38%	48 000	19 746	41%	10 000	4 791	48%	9 000	1 725	19%

NKUA’s purchase costs exceed 15% of its personnel costs.

The largest cost items (€6 336 required to be explained; € 6 735 explained) are detailed in NKUA’s Financial Statement.

Explanation of deviations are further provided below where the “% used” at M18, is < than 40% or > 60% for any of the five headings (i.e., deviations are reported below using 20% as a threshold between straight line budgeted v actual reported costs at M18).

- Personnel costs and PMs are slightly lower than budgeted since Year 1 and the first half of Year 2 involved a lower number of school interventions associated mainly with WP5. This will be compensated in P2 when NKUA personnel will have increased PMs, as numbers of students and teachers involved in school interventions and Professional Development will be significantly higher, particularly for Cycle 3.
- The deviations for Travel and subsistence and Equipment is not significant and in line with budgeted costs explained for NKUA in the DoA.
- The budget utilised in P1 for Other goods, works and services covered printing material and expenses for hosting one of the six monthly partner meetings in Athens (27-29 March 2023). Part of the remaining budget (€5 000) relates to audit costs. The rest includes consumables for 3D printing most of which will be needed in Cycle 3 interventions.

NKUA will transfer in P2 some of its financial resources to LNU for unforeseen AWS costs (its proportion estimated to be €958,50) and its share for the unforeseen remuneration of the independent ethics advisor (€990). See Section 7.2.2 Transfer of Cost Categories above. These are expected to be transferred from NKUA’s Other goods, works and services budget and Equipment budget respectively.

NKUA will also to transfer in P2 some of its financial resources to SIMPLE for its work on the ExtenDT2 platform. This may come from any of NKUA’s budget categories above (see Section 7.2.2 Transfer of Cost Categories above).

UGent: 1 September 2022 – 29 February 2024 (M1-M18)

Person Months (PM)			Personnel (€)			Travel and subsistence (€)			Equipment (€)			Other goods, works & services (€)		
Plan M1-M36 PM	Actual M1-M18 PM	% used	Plan M1-M36 €	Actual M1-M18 €	% used	Plan M1-M36 €	Actual M1-M18 €	% used	Plan M1-M36 €	Actual M1-M18 €	% used	Plan M1-M36 €	Actual M1-M18 €	% used
53,5	12,76	24%	248 877	134 012	54%	21 600	3 223	15%	0	0	n/a	15 000	2 511	17%

UGent’s declared purchase costs do not exceed the 15% of the declared personnel costs.

Explanation of deviations are nevertheless provided where the “% used” at M18, is < than 40% or > 60% for any of the five headings (i.e., deviations are reported below using 20% as a threshold between straight line budgeted v actual reported costs at M18).

- Personal costs for UGent are slightly higher than budgeted but show a discrepancy with the reported PMs. This is explained by the fact that, due to pregnancy and maternity leave, in P1 UGent recruited more senior level of staff to work on the project instead of the people foreseen when the budget was submitted. As these people were more experienced, they were able to deliver the work assigned to UGent in less PM, but at a higher PM and therefore cost. Another factor is that, in Belgium, wages automatically increase when the index number exceeds 2%. During P1 there were several so-called “index jumps” which led to a total increase of budgeted personnel costs of approximately 20%. In P2, the more experienced and senior staff will be replaced by the originally foreseen staff, leading to more PM and lower wages. As the most challenging work (development of materials, modules, pilot PD implementations and school interventions) has been done in P1, the staff will be able to complete the work, assigned to UGent within the Exten.(D.T)² project during P2.
- UGent expects to use the budget allocated to travel and subsistence mainly in Year 2 and Year 3. The budget will be used for attending conferences presenting the results during P1, travel to the six-monthly partner meetings and the P1/P2 review meetings.
- The budget utilised in P1 for Other goods, works and services covered expenses for hosting one of the six monthly partner meetings in Ghent (27-29 September 2023). The rest includes consumables for the PD sessions and school interventions. The remaining budget will be used in P2 for organizing (non) academic PD activities and for school interventions.

UGent will transfer in P2 some of its financial resources to LNU for unforeseen AWS costs (its proportion estimated to be €657) and its share for the unforeseen remuneration of the independent ethics advisor (€990). See Section 7.2.2 Transfer of Cost Categories above. These are expected to be transferred from UGent’s Other goods, works and services budget.

NTNU: 1 September 2022 – 29 February 2024 (M1-M18)

Person Months (PM)			Personnel (€)			Travel and subsistence (€)			Equipment (€)			Other goods, works & services (€)		
Plan M1-M36 PM	Actual M1-M18 PM	% used	Plan M1-M36 €	Actual M1-M18 €	% used	Plan M1-M36 €	Actual M1-M18 €	% used	Plan M1-M36 €	Actual M1-M18 €	% used	Plan M1-M36 €	Actual M1-M18 €	% used
58	26,82	46%	373 659	155 586	42%	15 000	1 743	12%	0	0	n/a	11 000	0	0%

NTNU’s declared purchase costs do not exceed the 15% of the declared personnel costs.

Explanation of deviations are nevertheless provided where the “% used” at M18, is < than 40% or > 60% for any of the five headings (i.e., deviations are reported below using 20% as a threshold between straight line budgeted v actual reported costs at M18).

- The deviation in Person Months/Personnel cost is not significant and the explanation is in line with that provided under Section 7.2.2 Financial Costs - Overview.
- NTNU is expected to use the budget allocated to Travel and subsistence mainly in P2. This will include attendances at conferences presenting the results and outcomes of work that concurred in in P1 and planned to occur in P2, travel to the P1 and P2/final review meeting and the remaining six-monthly partner meetings.
- Other goods, works and services budget includes mainly the cost for an audit and possible costs associated with holding one of the six monthly partner meetings.

NTNU will transfer in P2 some of its financial resources to LNU for the unforeseen AWS costs (its proportion estimated to be €715,50) and its share for the unforeseen remuneration of the independent ethics advisor (€990). See Section 7.2.2 Transfer of Cost Categories above. These are expected to come from NTNU’s Travel and subsistence budgeted costs and /or Other, goods, works and services budgeted costs.

TCD: 1 September 2022 – 29 February 2024 (M1-M18)

Person Months (PM)			Personnel (€)			Travel and subsistence (€)			Equipment (€)			Other goods, works & services (€)		
Plan M1-M36 PM	Actual M1-M18 PM	% used	Plan M1-M36 €	Actual M1-M18 €	% used	Plan M1-M36 €	Actual M1-M18 €	% used	Plan M1-M36 €	Actual M1-M18 €	% used	Plan M1-M36 €	Actual M1-M18 €	% used
30	15	50%	261 480	126 536	48%	20 000	8 440	42%	500	0	0	500	0	0%

TCD's declared purchase costs do not exceed the 15% of the declared personnel costs.

Explanation of deviations are nevertheless provided where the “% used” at M18, is < than 40% or > 60% for any of the five headings (i.e., deviations are reported below using 20% as a threshold between straight line budgeted v actual reported costs at M18).

- PMs and Personnel costs are in line with planned budget.
- The Chair of the EAB in WP9 is the PI from TCD. As the EAB was unforeseen at the project start approx 2 PM will be shifted in total for TCD from WP2 to WP9 over the project duration. Of this in P1, 1PM has been utilised in WP9.
- The deviation for Travel and subsistence is not significant. Costs are in line with budgeted costs explained for TCD in the DoA.
- The budget for Equipment and Other goods, works and services is small (€500 each respectively) and is expected to be utilised in P2. This will cover budgeted costs detailed in the DoA such as 3D printer, audio/video recording equipment, printing costs for posters and teaching materials and possibly costs for hosting a six-monthly partner physical meeting.

TCD will transfer in P2 some of its financial resources to LNU for the unforeseen AWS costs (its proportion estimated to be €369) See Section 7.2.2 Transfer of Cost Categories above. This may come from any of TCD's budget categories above.

SIMPLE: 1 September 2022 – 29 February 2024 (M1-M18)

Person Months (PM)			Personnel (€)			Travel and subsistence (€)			Equipment (€)			Other goods, works & services (€)		
Plan M1-M36 PM	Actual M1-M18 PM	% used	Plan M1-M36 €	Actual M1-M18 €	% used	Plan M1-M36 €	Actual M1-M18 €	% used	Plan M1-M36 €	Actual M1-M18 €	% used	Plan M1-M36 €	Actual M1-M18 €	% used
18	10	56%	55 734	41 452	74%	12 000	4 699	39%	22 000	3 084	14%	2 000	435	22%

SIMPLE's purchase costs exceed 15% of its personnel costs.

The largest cost items (€2 000 required to be explained; €2 571 explained) are detailed in SIMPLE's Financial Statement.

Explanation of deviations are further provided below where the “% used” at M18, is < than 40% or > 60% for any of the five headings (i.e., deviations are reported below using 20% as a threshold between straight line budgeted v actual reported costs at M18).

- In P1 all SIMPLE's PMs have been charged to WP4. This is in line with the reasons detailed under Section 7.2.1.
- The deviation in Personnel costs is due to SIMPLE, after discussions among project partners, designing and developing the ExtenDT2 platform. This is the ecosystem that hosts the core project technologies and allows easy deployment for the school interventions, and as explained above in the deviations Section 7.1, was not foreseen in the project proposal. SIMPLE worked 8 PMs in order to make the platform available before school interventions. In addition SIMPLE designed and developed, multiple times, the technical infrastructure to enable both development as well as deployment of the ExtenDT2 platform on the cloud.
- The deviation for Travel and subsistence is not significant. Costs are in line with budgeted costs explained for TCD in the DoA. The small deviation is due to one of the six-monthly project meetings taking place in Athens. Participants from SIMPLE travelled by car as there was no need to book flights. This reduced the cost.
- The deviations in Equipment and Other goods, works and services are explained as follows: SIMPLE was in the process of buying the necessary equipment as detailed in the DoA but this had to be postponed. This was due to extreme weather conditions and a resulting flood in Thessaly, Greece where SIMPLE is physically based. The flooding severely affected the premises as well as the existing technical equipment. The equipment is planned to be bought early in P2 and will be available in time for the associated school interventions.

SIMPLE will transfer in P2 some of its financial resources to LNU for the unforeseen AWS costs (its proportion estimated to be €220,50) See Section 7.2.2 Transfer of Cost Categories above. This is expected to come from SIMPLE's Equipment budget.

There is also one further change of cost category related to SIMPLE. It was agreed with the PO in the first few months of the project that SIMPLE would declare and claim its personnel costs under A4 i.e., as unit costs - and not under A1: personnel costs, as budgeted at the start of the project. This change is related to the status of SIMPLE under Greek law. It does not require an amendment.