DATA-READY

Empowering Education through Data Literacy Integration in Compulsory Education

DATA READY

Project's Reference Number: 101195801

D4.1 Experimentation Protocol

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1. Introduction

The project “Empowering Education through Data Literacy Integration in Compulsory Education” (DATA-READY) focuses on enhancing data literacy skills among students in compulsory education (primary and secondary education) across Europe. The DATA READY project is grounded in the belief that fostering Data Literacy from an early age can have far-reaching benefits. It can nurture critical thinking, problem-solving, and decision-making abilities in students, empowering them to make informed choices in their personal and professional lives. Moreover, data-literate citizens are better equipped to participate in democratic processes, understand complex issues, and contribute to evidence-based policymaking. To achieve this goal, the DATA READY project will develop a standardized framework for data literacy education—defining key domains, learning outcomes, and learning progressions—while simultaneously strengthening teachers’ capacity to integrate data literacy into classroom practice through targeted training and professional development

Implemented by a multidisciplinary consortium of organizations from five EU countries (Greece, Portugal, Germany, Poland, and Cyprus), the project combines cross-national expertise with research, analysis, and experimentation to generate evidence-based recommendations that inform sustainable data literacy policies and practices at both national and European levels. To achieve these objectives, WP2 will develop and validate a standardized framework defining the key data literacy competencies required by teachers, which will then inform WP3’s design and implementation of context-sensitive initial and continuing teacher education programmes—including training courses, lesson plans, educational resources, pilot testing, and assessment tools—tailored to the educational systems of each partner country and refined through teacher participation during the piloting and experimentation phases.
Additionally, Work Package 4 (WP4: Experimentation Phase) will develop a comprehensive experimentation protocol detailing procedures, methodologies, and criteria for evaluating the effectiveness of the interventions. The focus of this phase is to rigorously assess the impact of the framework and related interventions on students’ data literacy skills, providing robust evidence to inform future educational policies and practices.

2. The Data Literacy Framework

The proposed framework comprises seven interrelated domains that collectively define data literacy competence for students in compulsory education. This model builds upon and extends a substantial body of prior scholarship in the field of data literacy, synthesizing foundational insights while adapting them to contemporary educational contexts.

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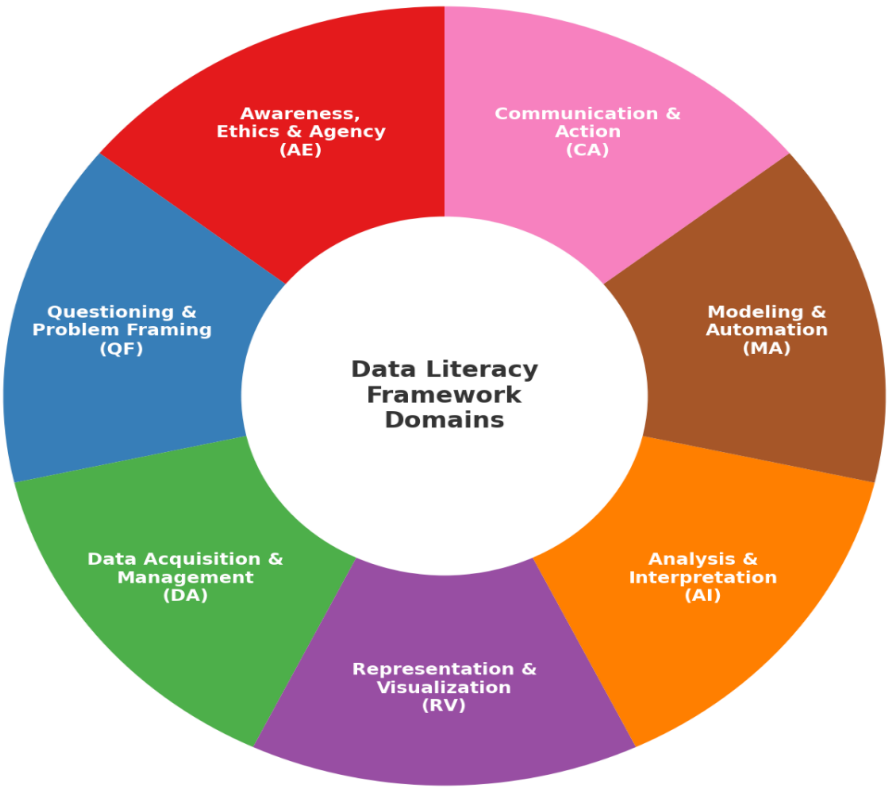
Earlier conceptualizations of data literacy emphasized core dimensions such as accessing, interpreting, and utilizing data for informed decision-making, alongside ethical and critical engagement with data sources and outputs. Subsequent frameworks developed specifically for educators further highlighted the essential role of pedagogical knowledge and reflective practice in transforming raw data into actionable knowledge. Collectively, these contributions established that data literacy encompasses not merely technical proficiencies but also the capacity to formulate meaningful questions, to curate and preserve data responsibly, and to critically evaluate the outcomes of data-informed decisions.

The present Framework integrates these foundational insights while tailoring them to the specific requirements of compulsory education, thereby ensuring that all learners develop a comprehensive, balanced, and future-oriented competence profile. Furthermore, the seven domains are deliberately aligned with established international standards and initiatives in digital and statistical education, as well as media and information literacy curricula.

Importantly, the Framework extends beyond existing models by placing heightened emphasis on three critical areas: ethical agency, interdisciplinary integration, and learner reflection. These dimensions are increasingly recognized as essential for preparing students to navigate and participate responsibly in a data-saturated society.



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The present Framework identifies the following seven key domains that together form the core of data literacy in compulsory education:

- Awareness, Ethics & Agency (AE) – privacy, bias, rights, and social use of data.
- Questioning & Problem Framing (QF) – posing data-driven questions.
- Data Acquisition & Management (DA) – collecting, cleaning, storing data.
- Representation & Visualisation (RV) – tables, graphs, maps, digital displays.
- Analysis & Interpretation (AI) – reasoning with data, recognizing patterns, uncertainty.
- Modelling & Automation (MA) – using algorithms, spreadsheets, simulations.
- Communication & Action (CA) – reporting, storytelling, applying data to decisions.

The Descriptor Matrices presented hereafter display the same learning expectations in a structured, two-dimensional format, organised according to progression band and proficiency level.

Primary 1 – Descriptor Matrix (Domains × Proficiency Levels).

Domain	Level 1 — Starting	Level 2 — Intermediate	Level 3 — Advanced
AE — Awareness, Ethics & Agency	Recognises that some data or information (e.g., name, photo) is personal and should be kept private.	Gives examples of personal data and explains simple ways to protect it (e.g., ask before sharing).	Explains why privacy matters and describes responsible sharing in everyday situations.
QF — Questioning & Problem Framing	Poses simple, curiosity-driven questions about familiar topics.	Suggests what information is needed and how it could be collected.	Refines a question to make it measurable and predicts what data would help.
DA — Data Acquisition & Management	Counts/sorts objects; records results with marks or pictures.	Collects data systematically and records it in a simple table.	Checks data for completeness/mistakes and keeps records organised.
RV — Representation & Visualisation	Reads simple pictographs or tables about class data.	Creates a pictograph or bar chart with correct labels.	Compares two displays and explains which is clearer and why.
AI — Analysis & Interpretation	Points out what happens “most” or “least” in a display.	Describes simple patterns or differences using “more/fewer.”	Uses data to answer a question and explains what the results show.
MA — Modelling & Automation	Follows step-by-step instructions to sort or group information.	Describes a simple rule/sequence (e.g.,	Creates or modifies a simple rule to classify new items or solve a problem.

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Domain	Level 1 — Starting	Level 2 — Intermediate	Level 3 — Advanced
		"If it's red, put it here").	
CA — Communication & Action	Says/shows findings, pointing to the chart/table as evidence.	Gives a short explanation linking results to the question.	Shares findings clearly (with visuals) and suggests what the results mean.

Primary 2 (Grades 4–6) – Descriptor Matrix.

Domain	Level 1 — Starting	Level 2 — Intermediate	Level 3 — Advanced
AE — Awareness, Ethics & Agency	Identifies personal data in everyday contexts (forms, photos, profiles).	Explains why some data should be protected; follows class rules for safe data use.	Recognizes bias/unfairness in displays and suggests fairer ways to collect data.
QF — Questioning & Problem Framing	Asks specific, measurable questions answerable with data.	Identifies variables to measure and suggests simple ways to collect them.	Refines questions to compare groups or explore relationships.
DA — Data Acquisition & Management	Collects data carefully via surveys, measurements, or observations.	Organises data in a table/spreadsheet; checks for missing or duplicate entries.	Applies basic sampling ideas and explains how accuracy improves conclusions.
RV — Representation & Visualisation	Creates bar/line charts with correct labels and sensible scales.	Chooses an appropriate graph type and explains what it shows.	Compares two representations of the same data and judges which is clearer/more accurate.
AI — Analysis & Interpretation	Finds simple patterns (increase/decrease/clusters).	Calculates mean/median/mode and uses them to describe data.	Interprets with percentages/rates and discusses plausible reasons for trends.
MA — Modelling & Automation	Uses calculator or spreadsheet functions for basic calculations.	Creates simple formulas/rules to automate repetitive steps.	Modifies formulas or uses simple tools to explore "what if" changes and predict results.

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Domain	Level 1 — Starting	Level 2 — Intermediate	Level 3 — Advanced
CA — Communication & Action	Presents findings with clear evidence (text/oral/visual).	Explains results, links them to the question, and suggests conclusions.	Discusses meaning with peers and identifies improvements for a future attempt.

Lower Secondary (Grades 7–9) – Descriptor Matrix.

Domain	Level 1 — Starting	Level 2 — Intermediate	Level 3 — Advanced
AE — Awareness, Ethics & Agency	Describes personal vs public data and recognises sharing risks online.	Identifies bias, privacy, and consent issues and explains their importance.	Evaluates data practices for fairness/transparency and proposes responsible alternatives.
QF — Questioning & Problem Framing	Formulates clear, data-driven questions testable via collection/analysis.	Defines measurable variables and explains how they relate to the question.	Designs an investigable question with multiple variables/criteria and anticipates limitations.
DA — Data Acquisition & Management	Conducts small-scale collection (surveys/sensors/online) using basic ethics.	Applies sampling methods; records digitally; flags incomplete/inconsistent entries.	Plans a workflow (source→storage), justifies choices, and ensures accuracy/security.
RV — Representation & Visualisation	Constructs/interprets bar, line, or pie charts with appropriate scales/annotations.	Uses digital tools to create histograms or scatterplots; describes trends/patterns.	Designs multi-layered/comparative visuals and critiques misleading or biased graphics in media.
AI — Analysis & Interpretation	Describes relationships and simple trends in everyday language.	Applies mean, range, percentage, correlation; explains variability.	Draws evidence-based conclusions; distinguishes correlation vs causation; discusses uncertainty/errors.
MA — Modelling & Automation	Uses spreadsheet or basic coding tools to automate calculations/summaries.	Builds/modifies simple models or simulations for “what if” scenarios/predictions.	Analyses algorithmic processes (recommendations/classifications) and weighs benefits, risks, biases.

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Domain	Level 1 — Starting	Level 2 — Intermediate	Level 3 — Advanced
CA — Communication & Action	Presents results clearly using text/visual/digital media to explain what data show.	Produces short, evidence-based reports/presentations with clear conclusions.	Communicates for a specific audience, proposes actions, and evaluates fairness and impact.

3. Objectives and of the Experimentation Protocol

The DATA-READY experimentation protocol establishes a systematic and scientifically grounded methodological framework that will guide the implementation, monitoring, and evaluation of the experimentation phase in real educational contexts. Specifically, the protocol defines the procedures, methodologies, and evaluation criteria that will be used to assess the effectiveness and impact of the proposed interventions.

This structured approach, ensures consistency, reliability, and comparability of results across different educational contexts. The protocol is designed to generate robust, evidence-based findings that will support informed decision-making and contribute to the development of educational policies at both national and European levels. Through controlled field trials across five European Union member states (Greece, Portugal, Germany, Poland, and Cyprus), this protocol aims to produce empirical evidence supporting policy recommendations for mainstreaming data literacy in compulsory education. The experimentation protocol is designed to ensure scientific rigor and to generate reliable and valid results.

The added value of the experimentation protocol lies in its integrative and transferable nature. By combining theoretical coherence, empirical evidence, and practical applicability, it offers a robust tool for advancing data literacy education across Europe. The deliverable supports informed policy decision-making, enhances teaching and learning practices, and contributes to the development of data-literate learners capable of critically engaging with data in academic, professional, and civic contexts.

The experimentation phase focuses on the systematic planning, coordination, and implementation of the Data Literacy Skills Framework within authentic educational settings. This phase is designed to ensure that the framework is enacted under controlled yet ecologically valid conditions, allowing for a rigorous evaluation of its effectiveness while respecting the realities of school-based practice (Riley-Tillman, T. & Burns, 2009, Phye, Robinson, & Levin, 2005).

The implementation phase involves the delivery of data literacy lessons by trained teachers to participating students, following the randomized allocation of participants to experimental and control groups. Teachers will implement the intervention in strict accordance with the predefined instructional sequence, learning objectives, and

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pedagogical principles of the framework. Any deviations from the protocol will be systematically documented to support subsequent interpretation of the findings.

Evidence generated during the experimentation phase will be systematically collected and analyzed using both quantitative and qualitative methods. The resulting evidence will inform the finalization and iterative refinement of the Data Literacy Skills Framework, ensuring that the final model is empirically grounded, pedagogically robust, and responsive to implementation realities.

4. Research Questions

The main research questions are:

- Does the DATA-READY framework, including its associated lesson plans and teacher training programmes, improve students' data literacy skills in compulsory education compared to standard curricular practices?
- Are there statistically significant differences in the effectiveness of data literacy interventions across different grade levels and educational contexts when comparing experimental and control groups within a quasi-experimental design?
- How effective are the teacher training programmes in enhancing pre-service and in-service teachers' competencies and self-efficacy for integrating data literacy concepts into classroom practice?
- How do students and teachers perceive, experience, and engage with the data literacy interventions implemented during the experimentation phase?.

5. Experimentation research design

The Protocol employs a robust quasi-experimental, mixed-methods research design combining quantitative and qualitative approaches. This methodological choice is predicated on the necessity of balancing internal validity ensuring that the intervention is evaluated within the authentic, complex constraints of functioning educational systems (Creswell & Plano Clark, 2018, Creswell, 2014, Shadish, Cook, & Campbell, 2002). Experimental sessions will involve the delivery of data literacy lessons by trained teachers to participating students, following the randomized allocation of experimental and control groups. To ensure a comprehensive evaluation, the research design integrates quantitative and qualitative strands in a convergent parallel approach.

- Quantitative methods, including pre-test (ex-ante) and post-test (ex-post) assessment tools, are utilized to measure learning outcomes among students, HE students, and in-service teachers. IDEC will design and develop an online assessment tool that effectively measures the data literacy skills of higher

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education (HE) students, in-service teachers, and students in compulsory education (Task 4.2).

- Qualitative methods (semi-structured interviews, reflection sheets, teachers' diaries) are employed to explicate the "how" and "why" behind quantitative outcomes. This qualitative strand captures implementation fidelity, pedagogical challenges, and the influence of local contextual variables.

Through methodological triangulation, findings from both approaches will be synthesized to validate results and reduce measurement bias. Furthermore, this multi-site design, implemented across five distinct European educational contexts, supports the assessment of external validity and the scalability of policy recommendations.

6. Participants

The experimentation phase of the project will involve three distinct participant groups:

- **Students in compulsory education (primary 1, primary 2 and lower secondary levels):**
  At least one (1) school per participating country will be involved. Within each school, a minimum of three (3) experimental groups and three (3) control groups will be established, with each group comprising at least fifteen (15) students. This structure ensures sufficient sample size to allow for reliable comparative analysis of intervention outcomes across different educational contexts.

- **In-service teachers (trained in WP3):**
  In-service teachers who have participated in the pilot training (WP3) will be engaged in the experimentation phase. A dedicated training course will be delivered for twenty (20) in-service teachers per country, ensuring their active involvement in both the pilot training and subsequent experimentation activities. This participation will support the implementation of data literacy lessons and facilitate the assessment of teacher competencies in applying the DATA-READY framework.

7. Quasi - Experimental Method

To rigorously assess the effectiveness, scalability, and transferability of the DATA-READY framework, the experimentation protocol adopts a quasi-experimental design comprising both treatment (intervention) and control (comparison) groups across primary and lower secondary education levels (Balanskat et al., 2014). This design enables a robust counterfactual evaluation by systematically comparing outcomes derived from the DATA-READY policy approach with those emerging from existing curricular practices. To reduce selection bias, participating schools and classes are

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selected to ensure demographic and contextual comparability, including similarities in socioeconomic profile, school size, and technological infrastructure.

The experimentation phase is implemented in at least one (1) school per participating country. Within each school, a minimum of three (3) experimental groups and three (3) control groups are established, each comprising at least fifteen (15) students, and corresponding to lower primary (primary 1), upper primary (primary 2), and lower secondary education. Experimental groups implement the DATA-READY data literacy lesson plans developed under Work Package 3 (WP3) and delivered by teachers who have completed the project's professional development program. Participating schools are expected to have basic ICT access, sufficient instructional time within the regular timetable, and institutional support to facilitate implementation.

Across countries, at least thirty (30) structured lesson plans per country are implemented, following a progressive learning sequence aligned with students' developmental stage and grade level. Control groups, by contrast, continue with the standard national curriculum, without access to DATA-READY training, materials, or digital resources during the experimentation period. To strengthen internal validity, experimental and control classes are matched at the same grade level, and, where feasible, random assignment within grades is applied (e.g. one experimental and one control class per grade). Additional controls include, if possible, shared school infrastructure (classrooms and ICT equipment), comparable class size, common subject areas, and, where possible, teaching by the same teacher across conditions or by teachers within the same school with similar professional qualifications and teaching experience. These indicative measures are designed to minimise confounding variables and enhance the precision of causal inferences regarding the impact of the DATA-READY intervention on students' data literacy outcomes.

The treatment condition constitutes a holistic, systemic intervention that extends beyond the delivery of discrete curricular content. It involves the integrated deployment of the DATA-READY ecosystem, including teacher capacity building, structured pedagogical frameworks, and active, inquiry-based data-driven learning activities. In contrast, the control condition represents a business-as-usual baseline, enabling the study to account for maturation effects and broader external influences, such as concurrent national or regional digital education initiatives. In line with ethical principles of educational equity, control schools may be granted access to DATA-READY training and resources following the completion of data collection, under a wait-list arrangement. All participating groups undertake ex ante (pre-test) and ex post (post-test) assessments to measure changes in data literacy competencies over time. The paired group design allows for within-level comparisons across educational stages, supporting differentiated analysis by school level and contributing to the formulation of nuanced, evidence-based policy recommendations that reflect the distinct developmental trajectories and curricular constraints of primary 1, primary 2 and lower secondary education.

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Table 1. Organisation of the Experiment

Group	Educational Level	Condition	Description of Intervention / Condition	Minimum Sample Size
Treatment Group1	Primary 1 Education	Experimental	Implementation of the DATA-READY data literacy framework through age-appropriate lesson plans; instruction delivered by teachers trained under WP3; use of structured data literacy activities aligned with the seven framework domains	≥15 students
Control Group1	Primary 1 Education	Control	Continuation of the standard national curriculum with no exposure to the DATA-READY framework, lesson plans, teacher training, or digital resources during the experimentation phase	≥15 students
Treatment Group2	Primary 2 Education	Experimental	Integration of DATA-READY data literacy lesson plans across curricular subjects using inquiry-based and project-based learning approaches; systematic engagement with data collection, representation, and interpretation activities supported by digital and non-digital resources	≥15 students
Control Group2	Primary 2 Education	Control	Continuation of the standard national curriculum without implementation of DATA-READY data literacy activities or access to project resources	≥15 students
Treatment Group3	Lower Secondary Education	Experimental	Implementation of subject-specific and cross-curricular DATA-READY data literacy modules; use of digital tools for data analysis, modelling, and visualisation; instruction delivered by in-service teachers who have completed advanced DATA-READY professional development	≥15 students
Control Group3	Lower Secondary Education	Control	Continuation of the standard national curriculum with no participation in DATA-READY training, lesson plan implementation, or digital assessment tools	≥15 students

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8. Data Collection

The partner IDEK will be responsible for the design and development of an online assessment tool to validly and reliably measure data literacy competencies among higher education (HE) students, in-service teachers, and students in compulsory education. The assessment instruments will be explicitly grounded in the Data Literacy Skills Framework developed under Work Package 2 (WP2). Distinct assessment tools will be developed for each target group and proficiency level, ensuring age- and context-appropriate measurement. Project partners will select and implement suitable assessment methods and item formats to accurately capture multiple dimensions of data literacy, in alignment with the learning objectives and competency descriptors defined in the framework. This approach enables a comprehensive and coherent evaluation of participants' data literacy skills across educational levels and contexts. The protocol includes the following quantitative assessment tools:

a) Assessment tools for students (Pre-test and Post-test questionnaires)

The primary objective of the student assessment tools is to design and develop comprehensive questionnaires that effectively measures and evaluates the data literacy competencies of students in compulsory education (Task T4.2). Assessment tools will be systematically calibrated to accommodate three distinct proficiency levels, appropriately adapted to students' grades. The assessment tool will employ pre-test and post-test methodology to capture baseline data literacy levels and measure skill development over time, enabling robust evaluation of educational interventions and learning outcomes. Item progression will be strategically scaffolded to align with the hierarchical structure of the data literacy skills framework established in Work Package 2 (WP2). To this end, a total of nine pre-test instruments and nine post-test instruments will be developed, namely one for each grade level of compulsory education. As indicated by the project's framework, IDEC will need to implement nine versions of the test, covering the 3 bands × 3 levels = 9 groups of indicators, specifically including nine pre-tests and nine post-tests.

b) Assessment tool for In-service Teachers (Pre-test and Post-test questionnaires)

The primary objective of in-service teachers assessment tools is to design and develop online questionnaires that effectively measure the data literacy skills of in-service teachers. The assessment tool will be designed based on the framework for Data literacy skills developed in WP2.

- Pre-test and post-test questionnaire for In-service Teachers regarding the CPD course.
- Pre-test and post-test questionnaire for In-service Teachers regarding the implementation of the lesson plans.

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The piloting training course for HE students and the CPD course for in-service teachers will facilitate the refinement and adaptation of the training programmes to more adequately address the needs of the target populations. Subsequently, an experimentation phase will be implemented to assess the effectiveness of the developed interventions within authentic educational settings. This phase will yield empirical data regarding the impact of the interventions and will identify best practices for instruction in this domain. Furthermore, the resulting findings will provide an evidence base to inform policy recommendations.

Notes:

1. Each assessment tool will incorporate diverse question types and formats to comprehensively evaluate multiple dimensions of data literacy competencies.
2. Comprehensive user manuals and instructional guides will be developed for both student participants and test administrators, ensuring seamless implementation and standardized assessment procedures across diverse educational contexts.
3. All assessment tools are available online through the project website, based on defined requirements and specifications.
4. Automated scoring mechanisms will be embedded within the platform to generate immediate feedback and detailed performance reports, facilitating timely insights into individual and cohort-level achievement.

The online tool will also include manuals, and FAQs for administrators and participants.

To complement the quantitative data and provide in-depth insights into implementation processes and participants' experiences, the DATA-READY experimentation employs a set of qualitative research methods. Qualitative data collection is conducted in parallel with quantitative phases, including:

a) Semi-Structured Interviews

Semi-structured interviews are conducted with to obtain in depth, contextualized accounts of the DATA-READY intervention. This method allows for consistency across countries while retaining flexibility to explore locally specific issues and emergent themes. Interviews are conducted with:

- Students (n=at least 2 students per participated group)
- In-service teachers after the CPD course (n= at least 2 in-service teachers per course)
- In-service teachers following the implementation of the lesson plans (n= at least 3; specifically, those who delivered instruction as part of the intervention group)

The interview protocols are guided by a common thematic framework and are designed to explore participants' perceptions, experiences, and perspectives

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regarding the training activities (WP2) and the implementation of lesson plans derived from the data literacy framework.

b) Teachers' diaries/Reflections Sheets

Participating teachers are invited to maintain structured diaries or reflection sheets throughout the experimentation phase, recording observations, reflections, and critical incidents related to the delivery of data literacy lessons. Diaries or reflections sheets typically include entries that capture:

- descriptions of lesson implementation (content covered, activities used, time allocation);
- observations of student engagement, understanding, and interaction with data-related tasks;
- reflections on pedagogical choices, instructional strategies, and classroom dynamics;
- challenges, constraints, and unexpected issues encountered during implementation;
- adaptations made to lesson plans in response to contextual or learner-specific needs;
- reflections on teachers' own professional learning and evolving confidence in teaching data literacy.

As a qualitative method, teachers' diaries and reflections sheets provide rich, situated insights into instructional practices and contextual factors that influence the effectiveness of the interventions. They are particularly valuable for examining implementation fidelity, pedagogical decision-making, and the interaction between the DATA-READY framework and real classroom conditions. Moreover, diaries and reflection sheets enable the capture of temporal dynamics and developmental changes that are difficult to observe through one-off interviews or questionnaires. In addition to their evaluative function, teachers' diaries and reflection sheets support reflective professional practice by encouraging educators to critically examine their teaching experiences and learning processes

9. Data Analysis

To evaluate the impact of the DATA-READY framework on student and teachers competencies, a systematic quantitative analytical strategy will be employed. The analysis will progress from descriptive characterization of the data to increasingly complex inferential statistical modelling, ensuring both analytical rigor and interpretive transparency.

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Initially, descriptive statistics will be computed to summarize the main characteristics of the dataset. Measures of central tendency (means, medians), dispersion (standard deviations), and distributional properties will be examined for all study variables. This stage will provide an overall profile of student competencies and teacher self-efficacy scores across measurement points and participant groups.

To examine group differences and intervention effects, comparative statistical analyses will be conducted. Independent samples *t*-tests will be used to assess baseline equivalence between the intervention (treatment) and comparison (control) groups prior to implementation. Post-intervention comparisons will also be performed to identify statistically significant differences attributable to participation in the DATA-READY framework. Where appropriate, one-way or factorial Analyses of Variance (ANOVA) will be applied to explore differences across multiple groups or conditions, as well as potential interaction effects. Effect sizes will be reported alongside significance tests to provide a more comprehensive interpretation of the magnitude of observed effects.

Qualitative data derived from semi-structured interviews, focus groups, and open-ended survey responses will be analyzed using Reflexive Thematic Analysis (RTA), following the six-phase analytic protocol articulated by Braun and Clarke (2006, 2019). This approach is grounded in an interpretivist epistemology and adopts an inductive, data-driven orientation, allowing analytic themes to emerge organically from the dataset rather than being constrained by a priori theoretical frameworks. At the same time, RTA explicitly acknowledges the active, reflexive role of the researcher in the construction of meaning and knowledge. The analytic process will proceed through the following iterative and recursive phases: (1) Familiarization with the Data, (2) Initial Coding, (3) Theme Generation, (4) Theme Review and (5) Theme Definition and Naming. Themes will be further refined, clearly defined, and named to capture their central organizing concepts and analytic significance in relation to the research questions. The final phase will involve the production of a coherent and analytically grounded narrative, supported by illustrative data extracts. The analysis will move beyond description to interpretation, linking the findings to broader theoretical and empirical discussions.

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10. Timeline of the Experimentation Phase

A detailed implementation timeline is developed to guide the experimentation process.

Task Code	Task Title	Months (Project Timeline)	Calendar Period	Responsible Partner(s)	Key Outputs / Deliverables	Indicators / Milestones
T4.1	Design of the Experimentation Protocol	M9 – M11	November 2025 – January 2026	AQAPSE	Comprehensive experimentation protocol defining research design, sampling strategy, procedures, ethical guidelines, and evaluation criteria	• Experimentation protocol drafted and internally reviewed • Alignment with WP2 & WP3 frameworks confirmed
T4.2	Development of an Online Assessment Tool for HE Students, In-service Teachers, and Students (Data Literacy Skills)	M9 – M18	November 2025 – August 2026	IDEC	Online assessment platform including pre-test and post-test instruments for students, pre-service teachers, and in-service teachers; user manuals and automated scoring	• Functional online tool developed • Grade- and group-specific instruments completed • Pilot-ready version available
T4.3	Validation of the Experimentation Protocol and Assessment Tools	M15 – M20	May 2026 – October 2026	AQAPSE	Validated experimentation protocol and assessment instruments, incorporating feedback from piloting and expert review	• Content and construct validity established • Revisions completed based on pilot feedback • Validation report finalized
T4.4	Recruitment of the Experimentation Sample	M20 – M23	October 2026 – January 2027	All Partners	Confirmed sample of participating schools, teachers, and student groups (experimental and control) across partner countries	• ≥1 school per country recruited • ≥3 experimental & ≥3 control groups per school • ≥15 students per group

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T4.5	Organisation and Implementation of the Experimentation Phase*	M22 – M32	December 2026 – October 2027	All Partners	Implementation of DATA-READY interventions; collection of quantitative (pre/post) and qualitative data (interviews, reflection sheets, diaries)	• Ex ante & ex post assessments completed • Lesson plans implemented as planned • Qualitative data collected across all sites

*The timeline will be aligned with the academic calendars of participating schools and institutions and will take into account contextual and organizational factors that may influence the timing, pacing, and duration of the intervention.

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11. Ethical Considerations

The DATA-READY experimentation is committed to the highest standards of research ethics and integrity, adhering strictly to the principles outlined in the Declaration of Helsinki and the European Code of Conduct for Research Integrity. Given the involvement of vulnerable populations (minors) and the systemic nature of the intervention, a multi-layered ethical clearance strategy will be implemented prior to the commencement of any field activities. This process ensures that the rights, well-being, and dignity of all participants are protected throughout the project lifecycle.

The DATA-READY project is designed and implemented in full compliance with European and international ethical standards governing educational research, particularly research involving minors. Ethical considerations are embedded across all phases of the experimentation to safeguard participants' rights, dignity, wellbeing, and data privacy, while ensuring the scientific integrity and societal responsibility of the research.

Prior to the commencement of any research or intervention activities, the DATA-READY consortium will secure all necessary ethical and administrative approvals through a multi-level governance process. This ensures legal compliance, institutional legitimacy, and ethical oversight across all participating countries.

Ethical approval shall be obtained from:

- Institutional Review Boards (IRBs) / Research Ethics Committees of the coordinating and partner organizations in each participating country, responsible for evaluating the scientific validity, ethical soundness, and risk profile of the research protocol.
- National and/or Regional Educational Authorities, such as Ministries of Education or competent public bodies, to authorize the implementation of the intervention within compulsory education systems and ensure alignment with national legislation and policy frameworks.
- School Governing Bodies and School Leadership, including principals and school boards, acting as institutional gatekeepers responsible for safeguarding the interests of students, staff, and the wider school community.
- No data collection or intervention activities will commence until formal approval has been granted by all relevant authorities within each national context.

The DATA-READY project adheres strictly to the principle of informed and voluntary participation. All participants will be provided with clear, comprehensive, and accessible information regarding the purpose, procedures, risks, and benefits of the research. Specifically:

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- Written informed consent will be obtained from all adult participants, including teachers, school administrators, and policymakers.
- Parental or legal guardian consent will be required for the participation of students, in accordance with national legal requirements.
- Age-appropriate assent will be sought from student participants, ensuring that children understand the nature of their participation in a manner suitable to their age and cognitive development.
- Participants will be explicitly informed of their right to decline participation or to withdraw at any stage without any negative consequences or impact on their educational or professional standing.
- Consent and assent procedures will be documented, securely stored, and reviewed as part of ethical compliance monitoring.

12. Data Protection and Confidentiality

All data processing activities within the DATA-READY project will comply fully with the General Data Protection Regulation (GDPR) (EU) 2016/679 and relevant national data protection legislation. Data protection is treated as a core ethical obligation and a legal requirement.

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