Managing Affective-learning THrough Intelligent atoms and Smart InteractionS

D.2.2 Full Scenarios for all Use Cases

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Abstract:	This deliverable will provide details for the use cases and the specific scenarios that will run throughout the lifespan of the MaTHiSiS project.
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List of Acronyms

Abbreviation / acronym	Description
ASC	Autistic Spectrum Case
ASD	Autistic Spectrum Disorder
CGDLC	Career Guidance Distance Learning Case
CT	Computational Thinking
DoW	Description of Work
DSS	Decision Support System
EOPPEP	EOPPEP is the National Organisation for the Certification of Qualifications and Vocational Guidance in Greece
FMD	Fondazione Mondo Digitale
HCI	Human Computer Interaction
ID	Intellectual Disability
ITC	Industrial Training Case
IWB	Interactive White Board
JYCL	Consejería de Educación Junta de Castilla y León
KPI	Key Performance Indicator
LCDS	La Cometa del Sud
LA	Learning Action
LAM	Learning Action Materialisation
LG	Learning Graph
LM	Learning Material
LO	Learning Objective
MEC	Mainstream Education Case
NTU	Nottingham Trent University
Obj	Objective
PA	Platform Agent
PC	Personal Computer
PE	Polo Europeo della Conoscenza
PMLDC	Profound and Multiple Learning Disabilities Case
QoE	Quality of Experience

QoS	Quality of Service
RIX	RIX Research and Media
SEN	Special Education Needs
SLA	Smart Learning Atom
SO	Specific Objective
UI	User Interface
UoN	University of Nottingham
VET	Vocational Education and Training
WP	Work Package

Table 1: Definitions, Acronyms and Abbreviations

Project Description

The MaTHiSiS learning vision is to provide a novel advanced digital ecosystem for vocational training, and special needs and mainstream education for individuals with an intellectual disability (ID), autism and neuro-typical learners in school-based and adult education learning contexts. This ecosystem consists of an integrated platform, along with a set of re-usable learning components with capabilities for: i) adaptive learning, ii) automatic feedback, iii) automatic assessment of learners' progress and behavioural state, iv) affective learning, and v) game-based learning.

In addition to a learning ecosystem capable of responding to a learner's affective state, the MaTHiSiS project will introduce a novel approach to structuring the learning goals for each learner. Learning graphs act as a novel educational structural tool. The building materials of these graphs are drawn from a set of Smart Learning Atoms (SLAs) and a set of specific learning goals that will constitute the vertices of these graphs, while relations between SLAs and learning goals constitute the edges of the graphs. SLAs are atomic and complete pieces of knowledge [1] that can be learned and assessed in a single, short-term iteration, targeting certain problems. More than one SLA, working together on the same graph, will enable individuals to reach their learning and training goals. Learning goals and SLAs will be scoped in collaboration with learners themselves, teachers and trainers in formal and non-formal education contexts (general education, vocational training, lifelong training and specific skills learning).

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Executive Summary

The MaTHiSiS learning vision is to provide a product-system for vocational training and mainstream education for both individuals with an intellectual disability and non-diagnosed ones. It consists of an integrated platform, along with a set of re-usable learning components (educational material, digital educational artefacts etc.), which are composed into so-called learning graphs. These learning graphs, acting as a novel educational structural tool and associated with specific learning goals, will foster novel ways to guide how the different learning materials and artefacts can be deployed throughout a pre-specified learning scenario. The building materials of these graphs are drawn from a set of Smart Learning Atoms (SLAs), learning elements that carry stand-alone pieces of learning materials, targeting certain problems. The learning goals as well as the SLAs involved will be decided and pre-agreed based on common practices, goals derived from formal and non-formal education (general education, vocational training, lifelong training or specific skills learning) as well as learner's own goals (so as to equally serve in formal and informal educational contexts).

This document analyses and reports on the results of semi-structured interviews with representative stakeholders (teachers and learners) from the five Use Cases specified in the MaTHiSiS project proposal (Autistic Spectrum, Profound and Multiple Learning Disabilities, Mainstream Education, Industrial Training and Career Guidance Distance Learning). This process has produced two major outputs for later Work Packages, firstly, User Stories, derived from user characteristics, and technical, physical, social and environmental requirements, which specify user interaction with the system and will be used for developing system functionality. Secondly, Learning Experiences developed from the current learning activities described by teachers and trainers, which describe a set of learning scenarios in terms of SLAs and Learning Actions, and will be used to develop the initial learning materials used for piloting. Additionally, consideration has been given to accessibility of the platform, and relevant standards and guidelines have been reviewed and discussed.

Internally, this deliverable serves as a detailed frame of reference for the development and evaluation of the MaTHiSiS project pilots. For readers external to the project, this deliverable describes the process followed to elicit requirements, details of those requirements and their codification across the use cases the Use Cases, and the process of breaking learning materials down into SLAs and Learning Action for the MaTHiSiS platform can be approached.

1. Introduction

The objective of this deliverable is to develop “Full scenarios of all use cases”. This is the second deliverable of Task 2.1 – User, System and Ethics Requirements; the first deliverable, D2.1, established stakeholder groups for each of the five categories of use cases (Autism Spectrum Case, Profound and Multiple Learning Disabilities Case, Industrial Training Case and Career Guidance Distance Learning Case) to ensure their input into this deliverable. The use cases, already defined during the proposal preparation phase, will be extended in order to derive full scenarios. This deliverable will provide details for the use cases as well as the specific scenarios (pilots) that will run throughout the lifespan of MaTHiSiS project.

When the consideration of people with disabilities is included in the design process, it is usual to talk about "Design for all", "Universal Usability", or "Equitable Use", implying that the design should be useful and marketable to any group of users [1, 2]. Other researchers think this harder to achieve [3], and propose a "User Sensitive Inclusive Design" where inclusivity is more achievable than universal design. This approach has been particularly recommended for capturing individual differences related to disability, and in particular cognitive dysfunction [4].

At the heart of this process is understanding and specifying the context of use, and specifying user and organisational requirements, informed by established guidelines on user centred design, e.g. INUSE [5] and USERfit [6, 7, 8, 9]. When discussing the USERfit guidelines, researchers have described that its main objective is the capture and specification of user requirements. Its approach is not limited to users with specific physical, sensorial or cognitive characteristics [10]. The objective of these protocols is the collection, evaluation and development of information in order to construct a specification of the product.

In MaTHiSiS, we already have a vision of the system and so, in this report, we are interested in the guidance that USERfit gives in terms of specifying the user requirements arising from the five Use Cases, so that the MaTHiSiS architecture can be tuned to these requirements. A very simple way of specifying the context of use (used by all participants in WP2) is to follow the guidance of a precursor to USERfit - the RESPECT Handbook [6] that highlights a series of steps when first identifying user requirements for a new system. In MaTHiSiS we extended this methodology to include techniques derived from context of use analysis [11] and requirement prioritisation (e.g. MoSCoW [12]).

User, task and environmental analyses will all contribute to the requirements research concerning the context of use of the MaTHiSiS ecosystem, with domain experts in each Use Case extracting the user requirements arising out of each case. In this way, through analysis focussing on the needs of students with Profound and Multiple Learning disabilities, and those with Autism, as well as neuro-typical learners, a concrete range of user needs can be developed as requirements in the design of the MaTHiSiS architecture.

This document is divided into the following sections:

- Section 2 “Use Case Scenario Development”. – This section describes how the requirements analysis was performed, and how User Stories and Learning Experiences were derived.
- Section 3 “Use Cases”. – This section presents the Uses Cases as described in the MaTHiSiS project proposal.
- Section 4 “Stakeholder roles”. – A mapping between System roles defined in D2.3, Stakeholders identified in the interviews and the set of Personae defined in D2.1.

- Section 5 “Requirements and Learning Materials Derived from Stakeholders Interviews”. – A summary of the results of the requirements elicitation and learning materials definition, for each Use Case.
- Section 6 “User Stories Generated from Requirements”. – The requirements described in Annex 2 – User Requirements, refined and transformed into formal User Stories.
- Section 7 “Accesibility”. – A review of the usability and accessibility issues and guidelines pertinent to the MaTHiSiS platform development. All details are included in Annex I.
- Section 8 “Outline Planning for Pilots”. – A set of points and issues arising out of the requirements process that should inform D2.5 – Evaluation Strategy and the pilots (WP8 Pilots in Education and WP9 Pilots in Industrial Training and Career Guidance).
- Annex 1 “Accesibility Guidelines”: Detailed Accessibility requirements.
- Annex 2 – User Requirements, which will inform D2.5 – Evaluation Strategy, and will have important consequences for WP3 Smart Learning Atoms and Graph Tools, WP4 Affective and Natural Interaction Instruments, WP5 Platform Agents, WP6 Collaboration and Decision Support System & WP7 System Integration.
- Annex 3 – MaTHiSiS Learning Experience Examples, that feed into WP3

This is a public facing document, and intended to be read by those involved in mainstream and special needs education, as well as vocational and industrial training.

2. Use Case Scenario Development

A scenario must describe the user group characteristics, the technical environment, the physical environment and the social and organisational environment. It must also describe the learning materials to be delivered in the grammar of the MaTHiSiS project.

2.1 Stakeholder Interviews

This task involved a series of interviews with stakeholders (primarily teachers or trainers) in order to specify the user requirements and to develop the Smart Learning Atoms (SLAs). To formalise this process, an interview schedule was devised in three parts. The first prompted the interviewees to provide information on their role, their learners, the technology they use and their initial reactions to the description of the MaTHiSiS system. The second prompted them to specify the user requirements. The third prompted them to specify the Smart Learning Atoms that would be relevant to their learners.

2.2 Requirements Framework

Using the information gathered from stakeholder interviews, Phase 1 (User Context and Early Design) from the RESPECT handbook [6] has been followed to elicit requirements. Each of these steps will produce a set of user requirements for each use case, and then a final set of requirements can be collated and agreed by the WP2 working teams.

The stages followed are:

1.1 Summarise project

This consists of recording details the initial project requirement and design context. This has been fully addressed in the MaTHiSiS Description of Work (DoW).

1.2 Identify users and stakeholders

Maguire describes two different groups of users groups – primary users (e.g., learners) and secondary leaners (e.g., installers/maintainers). For each of the five use cases, requirements should be identified for users and stakeholders for each case, their user characteristics, the technical environment, physical environment and social and organisational environment. This information is based on real field research as opposed to more early elicitation of user requirements working with personae.

1.3 Specify user characteristics

Maguire gives guidance on how to consider the user characteristics of the populations in each use case and how to derive user requirements from these.

1.4 Describe technical environment

Within this section, Maguire describes how information is collected about the technical characteristics of the system (and in the case of MaTHiSiS, this is known before hand).

1.5 Describe physical environment

This will include the physical environment in which the teaching or industrial training will take place. It captures all relevant environmental characteristics, defined by Maguire as '*the visual, thermal, auditory and atmospheric environments, as well as environmental stability'.*

1.6 Describe social and organisational environment

Maguire defines this as the *'characteristics of the social environment (e.g. organisational aims, staff and management structure, performance monitoring, group working) and possible future requirements are recorded.'*

1.7 Learning Experiences and SLAs

Maguire terms this Stage "Identify user goals and tasks" and goes on to describe the activity as *'User goals for the system are listed. Where there is a current system in place, user tasks to achieve each goal are identified*.' This covers the emergent user requirements arising out of the Learning Experiences, definition of the SLAs and interaction with the platform agents to achieve these SLAs. Decomposition and elaboration of Learning Materials to achieve this, will be discussed in more detail in section 2.3 The MaTHiSiS Learning Experience.

1.8 Collation of User Requirements list

The final step is the collation of user requirements within each use case, and the between each use case. Requirements at this stage might be simplified, combined (same requirement emerging from 2 or more cases) and prioritised (in order of importance as there may not be the time to address all in the architecture.)

Information from the first section of each interview has been summarised for each Use Case. When summarising the information collected, we have applied adapted versions of two approaches used by other designers/developers:

1. The MoSCoW classification [12, 13] for prioritisation of the User Requirements, used to help developers make decisions not just about what is easy to do but what is essential.
2. A Test Driven Development (TDD) approach [14] used as a method for defining functional requirements as User Stories to enable testing of software code during development.

The process also identified key issues that must be addressed in preparation for the first round of (driver) pilots. These key factors are outlined in Section 8.1, Requirements Impact upon Testing & Evaluation.

MATHISIS is evaluated in three phases. Two initial Pilot phases followed by a Real-Life phase. The pilot phases consider evaluation from a formative perspective aiming to capture relevant information that can be used to enhance the operation and performance of the system. The third phase focuses on developing a summative evaluation that reflects on how the project objectives have been met.

In all these phases, the Quality of Experience (QoE) is closely linked to the Quality of Service (QoS). Naturally, technical faults or low system performance affect user experience. Close monitoring of QoS measurement will provide very useful insights into interpreting the QoE feedback. A set of specific metrics has been defined to enable measurement of QoS (WP7).

Deliverable D2.5, the Evaluation Strategy, maps out the details of the key evaluation criteria and how they are to be measured for the three different Phases of the project. Specifically, Use Case Leaders are guided to define what and how the effectiveness of the system is to be evaluated for each phase of the evaluation. They also link the measures to the KPIs that are used to determine the QoS Pilot design and Requirements and will be fed forward to Task 2.3 - Evaluation Planning, where information specific to each use case will be scoped.

2.2.1 MoSCoW Classification

Use Case leaders were tasked with applying the MoSCoW prioritisation technique, which describes how requirements can be assigned to one of four categories:

- **Must Have.** These requirements are non-negotiable, if the system does not have these the project is a failure. As an example: "Must be able to operate without an internet connection" will be assigned "M".
- **Should Have.** Important but not vital. May be painful to leave out, but the solution is still viable. As an example: "Brighter, clearer, high contrast displays should be used." will be assigned "S".
- **Could Have.** Wanted or desirable but less important. Less impact if left out (compared with a Should Have). As an example: "It could run on the following operating systems: iOS, Android, Windows Phone and as a desktop application." will be assigned "C".
- **Won't Have** this time but will be nice to consider for future approaches.

2.2.2 User Stories

Interviews with stakeholders across the five use cases produced a lengthy set of requirements, listed in Annex 2 – User Requirements. The interviews and requirements are summarised briefly for each Use Case, and a short description of each participating educational site is given. The requirements in Annex 2 – User Requirements must be analysed to extract User Stories, which have the following form:

As a <role> I want to <action> in order to <value/benefit>

e.g. *As a teacher, I want to* use the system with more than one learner *in order to* enable collaboration between students.

The initial set of User Stories for MaTHiSiS has been compiled by the technical partners in Task 2.2 – System Architecture, in order to define the core functionality of the platform and its components. That list will be further updated and enriched with the User Stories resulting from this requirements elicitation.

2.2.3 KPIs

The main project goal is broken down into Objectives (Objs) which target specific innovation areas. Specific objectives (SOs) are drawn up for each Obj to provide a detailed view on the aims of MaTHiSiS. Each objective is monitored and measured through a set of Key Performance Indicators (KPIs). The initial list of KPIs related to the platform components is identified in the Description of Action, part B. The list will be expanded after finalising the user requirements in this work package.

KPIs related to each release of the MaTHiSiS platform, are initially defined in WP7 – System Integration a) based on the contents of the Description of Action document as well as on the evaluation strategy developed in Task 2.3 – Evaluation Planning and b) assisted by technical WP leaders. The KPIs will measure in particular, system response time, ease of use for tutors developing material through the MaTHiSiS framework, number of Platform Agents synchronously or asynchronously collaborating.

The KPIs addressing the platform's technical features will be evaluated with each release before the pilots. KPIs related to user interaction – derived from this exercise – will be assessed during the pilots.

2.3 The MaTHiSiS Learning Experience

The MaTHiSiS Learning Experience facilitates *learning/training that takes place based on a specific MaTHiSiS-induced learning scenario.* A Learning Scenario is "an a priori description of a learning

situation, independently of the underlying pedagogical approach. It describes its organization with the goal of ensuring the appropriation of a precise set of knowledge, competences or skills"[1]. Within MaTHiSiS, a learning scenario *ensures the assimilation of a specific Learning Graph (LG) through the deployment of appropriate Learning Actions (LAs)*.

A Learning Graph (LG) consists of *learning content components* (i.e. learning goals and Smart Learning Atoms) *and relations between them*. Learning goals describe learners' skills or knowledge over a comprehensive overall learning objective (e.g. school or training course/subject). In essence, learning goals consist of the *particular competences the learners need to acquire in order to achieve a specific learning objective.* Smart Learning Atoms (SLAs) are atomic and complete pieces of learner knowledge, competence and/or skills, which can be learned and assessed in a single, short-term learning process iteration. SLAs essentially comprise *primordial learning goals, constituents of more advanced learning goals, which cannot be further reduced to more primitive notions*. Smart Learning Atoms can be drawn from the library of pre-existing SLAs developed by the MaTHiSiS project, modified with custom content or engineered from scratch by the teacher/trainer.

Figure 1 presents an example of a Learning Graph, depicting the learning goals and SLAs that comprise it as well as the interrelations between them. Those relations (weighted directed graph edges) essentially denote which learning components derive each learning goal. Their weight denotes how important each constituent learning component is to the fulfilment of the learning goal that they are related to. A learning goal can be derived directly from SLAs, or even from more simple learning goals. In that context, no interrelations can exist between SLAs, since they are atomic, therefore they cannot be further derived by any other learning component.

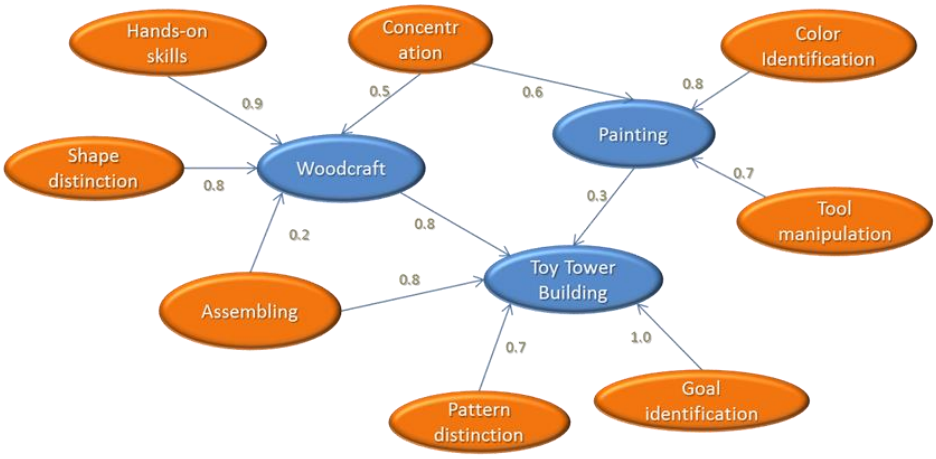

Figure 1: Example of Smart Learning Atoms (orange nodes) and learning goals (blue nodes), connected in a Learning Graph.

Learning Actions are *precise learning activities* to be deployed in the real world, *which each Platform Agent (PA) interprets in different ways and based on the learning materials available in different learning settings*. This definition indicates that Learning Actions are PA-agnostic, Learning Material (LM)-independent and context/environment-independent. Learning actions stimulate and convey the learning process for one or more specific pieces of primordial knowledge/skills (SLAs) to the learner. Therefore, in the MaTHiSiS Learning Experience design, one or more generic, materialisation-agnostic LAs are linked to the SLAs of a learning scenario. In term, in order to fulfil a Learning Action in the real world, each LA is attached to one or more Learning Action Materializations (LAMs), which are

[1] http://www.tel-thesaurus.net/wiki/index.php/Learning_scenario

exactly the *PA-specific and/or Learning Material-specific interpretations of Learning Actions for different learning settings* (e.g. classroom, factory, etc.). Figure 2 illustrates a graphical example of LAs linked to a SLA from Figure 1 and their subsequent materialisation on each of the MaTHiSiS PAs.

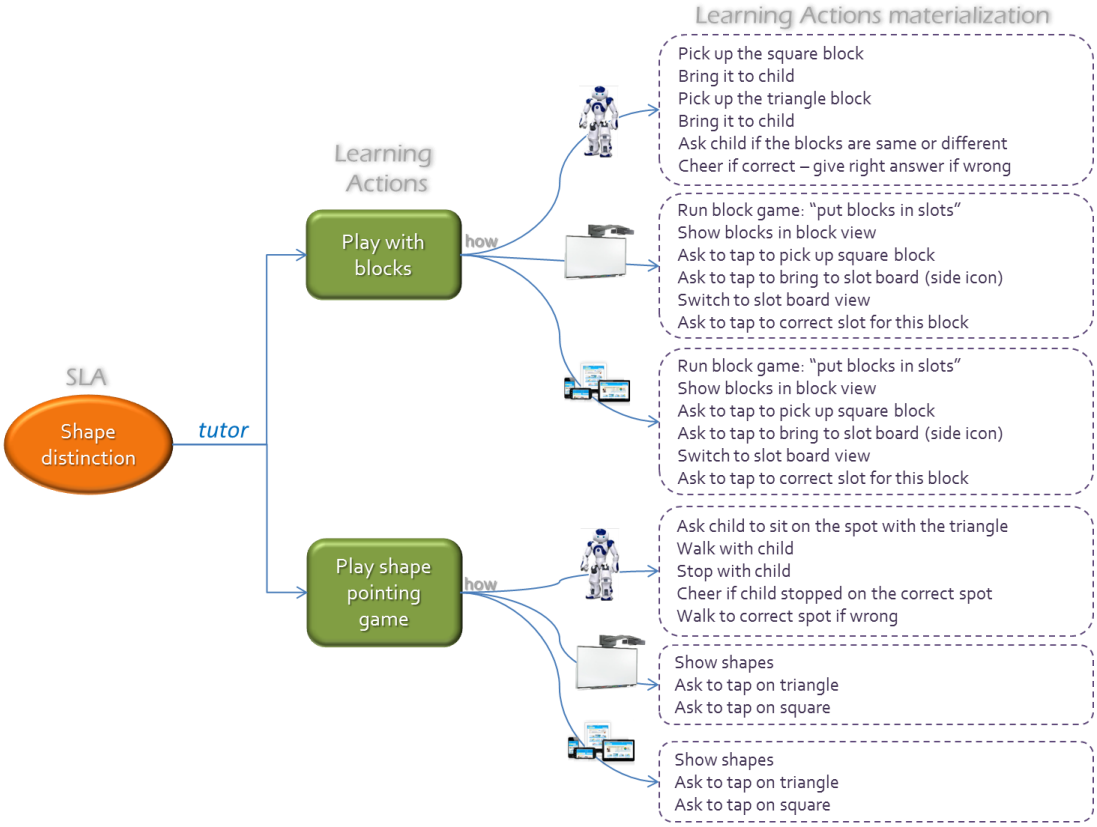

Figure 2: Example of generic Learning Actions linked to an SLA and subsequent PA-specific materialisations of each LA on each Platform Agent

In order to provide consistent and clear descriptions of learning materials, we adopt the convention of describing SLAs as nouns or noun phrases (denoting a specific skill/piece of knowledge), and Learning Actions as verbs or verb phrases (denoting what to do to acquire that skill/knowledge), wherever possible.

2.3.1 Guidelines used to design learning experiences using the MaTHiSiS concepts

The process of designing a learning experience using the MaTHiSiS concepts is presented in the following flowchart

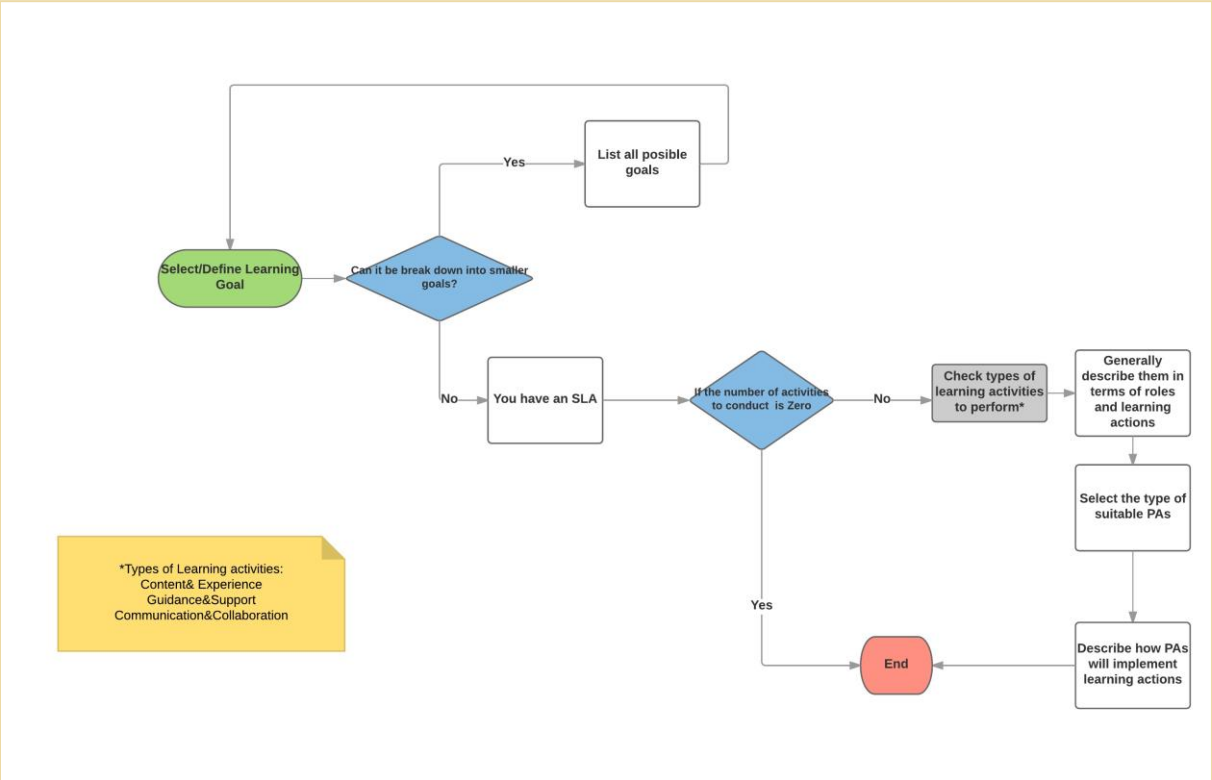

Figure 3: Flowchart to design SLAs, LGs, LAs and LAMs based on a learning goal

The whole process can be described as follows:

1. Transform the learning experience's overall expected outcomes into learning goals, which can be decomposed into smaller and atomic goals (SLAs)
2. For each SLA, it is necessary to define the different types of activities to be conducted in terms of participant's roles and general learning actions (LAs), which should be Platform Agent (PA) agnostic.

Once a set of LAs is defined for an LO, we can proceed to define their materializations including key moments of interaction and time thresholds.

3. We will need to define which could be the suitable PA for the particular Learning Action Materialisations (LAMs) that will actuate an LA. One or more LAMs might be designed for each LA, taking into consideration the set of PAs available in MaTHiSiS and in the specific learning environment e.g. PC, tablet, Smartphone, Robot, IWB.
4. Start describing a LAM with one of the PAs and completing with the rest of PAs in those cases where they materializations will be totally different. Further details about the Learning Material (LM) to be used should be provided.
5. Define the Key Moments of the learners' interactions for such materialization: which learner interactions will provide us with clues about his cognitive status and progress towards the achievement of the SLA.
6. What is the relationship of each key moment of interaction with the achievement of the SLA? How do each of these LA interactions contribute to achieve that SLA?
7. Define the time threshold: Do we need to consider any extra timing to check for the key moments of interaction? If the answer is yes, then we will need to set some value for that threshold.

Data defined for 5, 6 & 7 will serve as reference for T4.2 when defining the information needed to be tracked, the set of MaTHiSiS xAPI statements and the inputs to T4.3 for eliciting the affective behaviour of the user and her/his progress over the learning experience.

Furthermore, a template to help UC leaders in defining the possible interactions and implementations of the defined learning experience according to the MaTHiSiS concepts has been created and it is available at the project repository[2]

An SLA is composed of learning goals, each of which should be described with the headings in Table 2. There are likely to be more than one SLA, PA and Key Moment for each learning goal.

Table Heading	Description
SLA	List all possible SLAs related to the specified learning goal.
Learning Action	List possible learning actions that need to be conducted to reach the SLA described. *There should be at least 1 Learning Action per SLA.*
PAs	List of MaTHiSiS PAs that can be used to materialize the Learning Action per Learning Action Materialisation.
Materialization (LAM)	Describe how each PA will perform the materialization of the specified Learning Action.
Key Moments	Describe moments you, as facilitator/teacher, consider key to determining whether the learner is on course for reaching the specified level of the SLA.
Relation to Achievement	Describe how the specified interaction contributes to the achievement of the competence/skill defined by the SLA.
Time Threshold	Specify whether any time constraint should be active at this key interaction moment. This is particular useful for Autism, PMLD.

Table 2: Description of Learning Experience Components

These are elaborated for the learning materials compiled so far in Annex 3 – MaTHiSiS Learning Experience Examples.

Each Use Case has one or more worked examples, outlining the flow of activity in a narrative that follows the usability.gov Heavyweight use case [15]. Each of these worked examples has associated tables far in Annex 3 – MaTHiSiS Learning Experience Examples, which describe how Key Moments, Relation to Achievement and Time Threshold tie in to the use case flow.

[2] Template to define learning experiences according to the MaTHiSiS concept

3. Use Cases

3.1 MaTHiSiS Use Cases

For the purposes of this project, a use case refers to the personal, technical, institutional and pedagogic situation in which the technology and learning materials will be deployed. Within the MaTHiSiS project we have identified and defined five use cases: mainstream education, industrial training, career guidance distance learning and two areas of special education, autistic spectrum disorder and profound and multiple learning disability.

The following Use Case descriptions have been taken from the Description of Action, Part B.

3.1.1 Use Case 1: Autism Spectrum Case (ASC)

Autism (or "classical autism") is a neurodevelopmental disorder characterized by deficiencies in social interactions and communication skills, as well as repetitive and stereotyped patterns of behaviour. Autism is characterised by three distinctive types of behaviour – difficulties with social interaction, problems with verbal and nonverbal communication, and repetitive behaviour or narrow, obsessive interests. ASD can be associated with intellectual disability, sensory perceptual dysregulation (conventionally innocuous stimuli can be perceived as intense and aversive), difficulties in gross and fine motor coordination, attention deficit and emotional dysregulation. The impact of these can range from mild (e.g. Asperger syndrome in which communicative language itself is intact or superior but pragmatic social communication remains impaired) to profoundly disabling (total lack of speech, or of communicative use of speech). Autism arises as a spectrum of conditions, of which the most profoundly disabling are labelled as disorders by most people whereas the mildest merge into typical individual variation in cognitive profiles. Most cases of autism, and autism spectrum conditions, are idiosyncratic, having no known single biological cause. A minority of autism cases can arise comorbidly with known neurobiological disorders such as Fragile X syndrome. Other ASDs include Asperger's syndrome3, Fragile X Syndrome4, Landau-Kleffner Syndrome5, Childhood disintegrative disorder, and PDD-NOS6 (pervasive developmental disorder not otherwise specified).

Children with autism are deemed to have special educational needs as they have significantly learning difficulties – and also unconventional learning advantages that are often unexploited – than the majority of children of the same age, or a disability that prevents or hinders them from making use of educational facilities of a kind generally provided for children of the same. A statement of special educational needs means additional resources are delegated to schools to support their inclusion.

3.1.1.1 Who we address

Learners with ages between 5 and 18 years old with (1) 'low-functioning' autism without much communicative speech, (2) 'high-functioning' autism or Asperger syndrome and (3) people with autism spectrum conditions at all levels of functioning, with intense sensory perceptual sensitivities.

[3] http://omim.org/entry/609954
[4] http://omim.org/entry/300624
[5] http://omim.org/entry/245570
[6] https://www.autismspeaks.org/what-autism/pdd-nos

3.1.1.2 Associated challenges, Goals and Example Scenarios

The very heterogeneity and cognitive variability within the autism spectrum, which so often have hampered the implementation of spectrum-wide educational strategies, are exactly what MaTHiSiS is designed for. In all these subcases, MaTHiSiS's flexibility of goal structure and content delivery is important in harnessing the prior interests and fascinations of autistic individuals so as to motivate learning using these interests. For instance, in the case of an autistic child with strong interest in aeroplanes, the icons, graphical symbols and spoken words in motor communication therapy, the characters and events in narrative therapy, or the sounds and sights encountered in sensory therapy could be tailored round people, places and things found in airports. Therefore, the goal of MaTHiSiS testing will be to provide an effective personalization and adaptation of the learning activities to ensure the engagement and eventually achievement of learning goals of the different types of Autism previously described.

3.1.1.3 Ubiquity setup

The hardware and other aspects of the mode of content delivery can be not only set in function of individual learning styles but also in function of institutional, economic and geographic constraints. Work on autism therapy in India, for instance Sampath et al. [16] and Belmonte et al. [17] have made use of Android mobile devices simply because they are so ubiquitous: even in regions without reliable electricity or fixed-line telephone service, mobile phones have become common. And of course interactions between different individuals' Learning goals and their verbal, visual, and motor learning styles will dictate different platforms for content delivery, for instance robots or virtual environments for teaching emotional and social skills, tablets for teaching graphical communication. The conception of MaTHiSiS platform agents had into account the flexibility as one of main design decisions to ensure the adaptation in a diversity of contexts. In this UC, different platform agents will be tested according to the characteristics of the learners involved and the contexts where their learning will take place.

3.1.1.4 Non-linearity

Each content-delivery device, in the school or clinic and in the home, will 'know' the learner's current developmental and educational level, and will be able to adapt its content for this level, producing an integrated feel even across distinct modalities of content delivery. For example, vocal and motor interaction with a social communicative robot in the school could be reinforced and augmented via facial emotion recognition training delivered on a mobile phone or tablet in the home

3.1.1.5 Re-usable content (Smart Learning Atoms)

Every person with autism experiences different levels of autism's motor, social and sensory symptoms; thus therapies tailored to individuals will incorporate different weightings of Smart Learning Atoms at each of these levels. For a person with Asperger syndrome a motor-control atom and emotion-perception and social perspective-taking atoms could pertain in the context of physical education for team sports, where rapid perception of the physical properties of the ball and of the intentions of other players are essential for successful performance.

3.1.1.6 Labour Skills and expected benefits

An especial tragedy of autism is that although autistic people often have intact or even superior skills with which to perform a job, they haven't the social perspective-taking skills to succeed at interview or to retain the job in a context in which expectations might be socially hinted rather than stated explicitly. Or they haven't the executive functioning skills to juggle and to prioritise many simultaneous tasks, or their sensory perceptual sensitivities make it impossible for them to work in a built space that has not been adapted for them to minimise sensory interference [18]. MaTHiSiS will

provide a framework to help such cases and to promote their labour skill since interaction with robots has been clustered as beneficial to increase social skills.

3.1.1.7 Evaluation procedure

Comparative analysis will be conducted. A set of interviews with learners and carers will be planned in order to measure how the assistance provided by MaTHiSiS contributes to the achievement of certain levels of the required labour skills taking into consideration the individuals´ initial level of such skills.

3.1.2 Use Case 2: Profound and Multiple Learning Disabilities case (PMLD)

3.1.2.1 Who we address

5 to 18 year olds with profound and multiple learning disabilities

3.1.2.2 Associated challenges, Goals and Example Scenario(s)

There is a variety of challenges associated to this UC, namely how to improve verbal communication or to navigate electric wheelchair independently. Many young people with profound and multiple learning disabilities have poor verbal communication. For those who can approximate a single word (or understand a single Makaton sign [19]) teachers and carers are keen to assist them to build on this skill to achieve i) clearer enunciation of the word ii) increase their vocabulary iii) combine words meaningfully iv) learn to take turns to enable two way communication. In this case, the goal of the MaTHiSiS testing will be to verify to which extent the ecosystem allows teachers, carers and learners to develop a set of skills that will allow them to improve their verbal communication.

3.1.2.3 Ubiquity setup

Learners with profound and multiple learning disabilities appreciate robots because they are predictable and have fewer channels of communication than a human thus reducing the chances that the learner becomes overloaded. Tablets/mobile devices will display Makaton symbols and using MP3 files will playback example of correctly enunciated word; play music the learner liked as a reward. The combination of these platform agents in various learning contexts will be a key factor to verify the ubiquitous support provided by MaTHiSiS.

3.1.2.4 Non-linearity

The learning activities will be planned and combined thanks to the Learning graph approach taking into account that each learner's capability would be known to the robot or dashboard in the classroom but, also, to his/her mobile device at home.

3.1.2.5 Re-usable content (Smart Learning Atoms)

The design of learning activities based on the SLA and Learning graph concepts will consider that basic learning atom would be cause and effect based (so they could associate an event that happened as a result of their utterance). Other SLAs would be sustained attention (long enough to learn something), clear enunciation, increased vocabulary (depending on what words were useful for the individual learner), combining words meaningfully, making a meaningful request and turn taking.

3.1.2.6 Labour Skills and expected benefits

Due to the severity of these cases no labour skills are envisaged to be learned through these pilots. But it is expected that learners' communication skills will be enhanced after being assisted by the MaTHiSiS educational eco-system

3.1.2.7 Evaluation procedure

Comparative analysis will be conducted. A set of interviews with learners and carers will be planned in order to measure how the assistance provided by MaTHiSiS contributes to the achievement of certain levels of the required communication skills taking into consideration the individuals´ initial level of such skills

3.1.3 Use Case 3: Mainstream Education Case (MEC)

3.1.3.1 Who we address

The focus is on Mainstream children in primary and secondary school education (5-14 years old).

3.1.3.2 Associated challenges, Goals and Example Scenario

Computational Thinking (CT) [20] is a movement that proselytizes on a mental orientation to formulating problems in an algorithmic fashion and to include thinking with many levels of abstraction, use of mathematics, and examining how well a solution scales across different sizes of problems. CT represents an applicable attitude and skill set that should be added to everyone's analytical abilities, and not just for computer scientists. It builds on computational methods and models that empower "the rest of us" to solve problems and design systems. It builds on the power and limits of computing processes, whether they are executed by a human or by a machine. CT involves solving problems and designing systems by drawing on the concepts fundamental to Computer Science, which, in turn, are rooted in Mathematics. Therefore, this UC will focus on the development of the Computational thinking skills as part of the Computing Curriculum Main goals of this UC will be:

- understand what algorithms are, how they are implemented as programs on digital devices, and that programs execute by following a sequence of instructions
- write and test simple programs
- use logical reasoning to predict the behaviour of simple programs
- organise, store, manipulate and retrieve data in a range of digital formats

The use of robotics will particularly provide a bottom-up approach to creating sequences which will enact the logical sequence and enable interaction with the robots. The activities of this pilot will be linked to the learning actions to be developed in the different educational institutions involved in MaTHiSiS and the design of the learning experiences supported by the MaTHiSiS will be conducted following the guidelines of the Computing programmes of Study in England in Key stages 1 to 4 [21].

3.1.3.3 Ubiquity setup

Linking directly to the primary and secondary Computing Curriculum there will be teaching algorithms and logic visual programming interfaces pulling behaviours onto a stage and linking them into a logical sequence of activities where the robot demonstrates the outcome of these activities. Use of mobile devices to teach all programming concepts, assess creation of programming will enable learners to experience programming in a variety of locations both within and beyond school.

3.1.3.4 Non-linearity

Each learner's capability would be known to the MaTHiSiS platform in the classroom but, also at home or elsewhere; these devices may be instructed to perform different tasks but they will all know the skill levels of the learner. This will enable learning beyond school.

3.1.3.5 Re-usable content (Smart Learning Atoms)

There is opportunity to re-use artefacts and assets throughout their compulsory schooling enabling a deeper level of learning and reflection on learning. For example, learners will learn to understand the

hardware and software components that make up networked computer systems, how they interact, how they affect performance thus developing their computational thinking skills.

3.1.3.6 Labour Skills and expected benefits

There are clear links to both Higher Education and employment through enabling higher level computing skills, knowledge and understanding. This is supported by the UK Government, see for example Gove's speech referenced earlier, and various reports referred to above. There is an increasing employment market for computing, including gaming, both in the Europe and globally. This will enable learners increased opportunity to develop key employment skills required for the future workforce for what has been a shrinking employee market, and enable expansion of these key industries aligned to computing.

3.1.3.7 Evaluation procedure

A set of evaluation sessions will be conducted on which learners will assess and reflect on the creative work they had carried out as they learned assisted by the MaTHiSiS educational ecosystem,

3.1.4 Use Case 4: Industrial Training Case

3.1.4.1 Who we address

Employers of big industries both normal and with an intellectual disability. The participants' ages range between 25 and 40 years old.

3.1.4.2 Associated challenges, Goals and Example Scenario(s)

To decrease the time of training for industrial training and to help people with an intellectual disability for further inclusion in the labour market. As an example scenario, can be deployed at an industry that need to update its technology and thus need to train its employees to the new technologies.

3.1.4.3 Ubiquity setup

Using MaTHiSiS platform along with mobile devices a continuous training process for the users will be established. Following the trainees all the time and advance their steps towards their respective goals. This is a great improvement also in the time spent from the industry to train its stuff.

3.1.4.4 Non-linearity

Each trainee will have its personal profile while non-linearity in training will be achieved by triggering the trainees when relative information is nearby. Nearby may be a physical place relative to its goal (through its mobile location service), or a virtual place (e.g., when she/he is searching the internet)

3.1.4.5 Re-usable content (Smart Learning Atoms)

This use case will try to convert the industrial training process, into a MaTHiSiS learning scenario. To do so, specific MaTHiSiS SLAs will be created based on the specific manual of learning that each pilot industry will provide.

3.1.4.6 Labour Skills and expected benefits

This use case will provide new labour skills to the industry's employers and will keep them at the edge of technological advances. It is expected that learners assisted by the MaTHiSiS ecosystem will acquire a set of specific skills required to perform their activities within the industrial environment selected for this UC.

3.1.4.7 Evaluation procedure

Comparative analysis will be conducted. A set of interviews with learners and their superiors will be planned in order to measure how the assistance provided by MaTHiSiS contributes to the achievement of certain levels of the required skills taking into consideration the individuals´ initial level of such skills.

3.1.5 Use Case 5: Career Guidance Distance Learning Case

3.1.5.1 Who we address

Career Guidance Stakeholders (career guidance counsellors, public and private career guidance services, social partners, employers etc.) and the general public that can benefit from distant training in career guidance (students, parents, unemployed people, various people at transition phases etc.). This audience is very broad and we intend to address two main target users: general public as final beneficiaries of MaTHiSiS and counsellors of career guidance that will use MaTHiSiS as experts to create SLAs and learning graphs as support of the learning experiences. In the first case, ages will range between 16-25 and 26-60 years old, meanwhile for the second one ages will be between 35-65.

3.1.5.2 Associated challenges, Goals and Example Scenario(s)

Knowing that career guidance is a very important aspect nowadays in a constantly changing world, facilitates access to career guidance is a must. As more tangible goals we have set: to promote innovative career guidance methods and educational materials, to develop career management skills, to create a framework for quality assurance in career guidance, to provide career guidance with the use of ICT, to use and interpret diverse career guidance educational materials, to promote and create new job search techniques, to elicit new trends and needs in labour market, to build career management skills, to define and recognize non-formal and informal learning in career guidance, to boost self-awareness and self-confidence, to create novel frameworks for learning to learn and create sources of career information. To do so, 2 example scenarios through several pilots are envisaged: 1) Distant Training of career guidance counsellors of the public and private sector, that will be adjusted to their personal needs and pace of learning and will contribute to their continuous professional development and 2) offer a distant career guidance services to the general public (students, parents, unemployed people, various people at transition phases etc.) in a personalized and non-linear learning way.

3.1.5.3 Ubiquity setup

MaTHiSiS, through mobile and PCs will provide a non-stop, everywhere learning process. CGDL case will exploit this functionality to the maximum since it will organize country level courses by distance.

3.1.5.4 Non-linearity

Non-linearity will be deployed through this use case by triggering the learner when something relative to each of own stated goal is nearby. This can be a physical place relative to its goal (through its mobile location service), or a virtual place (e.g., when she/he is searching the internet)

3.1.5.5 Re-usable content (Smart Learning Atoms)

Our partner (EOPPEP) has a long experience in career guidance and will transform their educational material into several SLAs that will be ingested to MaTHiSiS system.

3.1.5.6 Labour Skills and expected benefits

Running these pilots, we expect to provide people with the subsequent skills: 1) For Career Guidance Counsellors: counselling skills, ICT skills organizational skills, skills for professional development,

multicultural skills (skills to work with diversity and multicultural population) and 2) For the General public: career management skills, written and oral communication skills and decision making skills. The achievement of higher levels of such skills could have a direct impact on increasing the target audience's possibilities for employment.

3.1.5.7 **Evaluation procedure**

Comparative analysis will be conducted. A set of interviews with the participants in this UC will be planned in order to measure how the assistance provided by MaTHiSiS contributes to the achievement of certain levels of the required skills taking into consideration the individuals´ initial level of such skills.

4. Stakeholder Roles

The following is a high-level review of the stakeholder roles identified during the requirements data capture period:

Teacher or Tutor: those whose role is to instruct or teach students about a subject in accordance with a pre-defined curriculum.

Pedagogist: those whose role is to instruct or teach students with the responsibility for learning curriculum content, delivery, structure and evaluation.

Education Technician: those who work in an educational establishment such as a School or University whose role is to support those within a teaching role by preparing both equipment and materials. In some instances, they also aid with implementation of practical learning.

Educational Care Worker: those whose role is to assist students with accessing education. Assistance can encompass: self-care independence skills including eating, drinking washing, mobility and transport and the administration of medication.

Special Needs Teacher: a teacher specifically employed to work with children and young people who need extra support, or require an advanced programme of learning in order to reach their full educational potential. These teachers may work with individuals who have physical disabilities, sensory impairments (i.e. hearing or visual), speech and language difficulties, learning difficulties such as dyslexia, conditions such as autism, social, emotional and mental health needs, or have a combination of these difficulties.

Head Teacher: also known as a Head of School or Principal, a Head Teacher is the title of the senior manager of an educational establishment. Whilst some Head Teachers still do some teaching, more often their duties are managerial and pastoral.

Parent: the legal guardian and primary caregiver, with the responsibility to care for the personal and property interests of the student.

Student or Learner: those who attend an educational or training establishment in order to learn and obtain knowledge. Some learners will also have socialisation and personal development needs.

4.1 Review of MaTHiSiS System Roles

The following is a review of the role descriptors as described in MaTHiSiS deliverable D2.3 – Full system architecture.

Administrator (Super-admin - Pilot site admin): Users with this role will be able to:

- Configure MaTHiSiS eco-system using the Platform Configuration UI (MaTHiSiS User Management, Resources Management: selection of PAs, add Content repositories, Manage info about the Local Networks
- Manage Social Networking aspects of the learning environment (e.g. set Facebook, YouTube or other social networks used to support the communities working with the platform)
- Manage learning processes in case of need for initial testing. User with this role will be able to conduct all actions described for teacher role and learner roles.

Tutor: The main difference of this role with the Parent/Caregiver is that users with Tutor role will have pedagogical knowledge and skills that will allow them to:

- Setup a learning experience (define learning graphs, create SLAs, LOs, set initial and modify edge weightings, select supporting learning materials, define learners profile information)

- Manage a learning process through the assessment of the attainment of specified learning goals, monitor the performance of different learners during the experience and make modifications to such experience considering the recommendations proposed by the MaTHiSiS Decision Support System (DSS).

Parent / Caregiver: Users with responsibility for care of the student. They will be able to:

- Start a learning experience for the learner
- Select complementary resources from the list of resources provided in the LOs
- Visualize a learner performance information and profile

Learner: This role is the most important stakeholder in MaTHiSiS. There are two different types of learners:

1. Supervised learner for those learners who will need some type of supervision because either they have special learning needs or they are minors without special needs.
2. Independent learner for those who are advanced learners even when they are minors (advanced learners) or adult learners who are pursuing to improve certain set of competences/skills.

Both types of learners will be able to follow a specified learning experience interacting with any of the PAs (mobiles, robot, IWB and desktop/laptop). The independent learner can start a learning experience selecting Learning Graphs according to his/her learning needs.

They will be able to select complementary resources; visualize their performance, accept recommendations for personalization and modify certain part of his/her profile (demographics, preferences, learning history)

In the case of a supervised learner, all previous actions will be conducted by their teacher/parent.

4.2 Mapping of Stakeholders to Roles

A variety of stakeholder roles has been elicited during the interview process. These need to be mapped to the categorical roles defined for the MaTHiSiS system. The following table provides a simple mapping of the stakeholders identified within the requirements gathering exercise against the roles as described within D2.3 – System Architecture. It is important to note that we are making a mapping between System roles, Stakeholders identified in the interviews and the set of Personae defined in D2.1 in order to help technical partners to properly identify the stakeholders' requirements when analysing the User Stories for validation and testing of the MaTHiSiS system. This is also relevant to the implementation of the learning materials to be used on the different pilots.

Table 3: Mapping of Stakeholders to Roles

MaTHiSiS System Role	Stakeholders	Personae defined in D2.1
Administrator	Technician Headmaster	N/A
Tutor	Headmaster Teacher Special Needs Teacher Pedagogist Trainer Speech therapist	N/A

	Mentor Physiotherapists Educational counsellor Youth worker Educational assistant	
Parent	Parent	N/A
Caregiver	Care Worker Special Needs Teacher Educational assistant Nurse	N/A
Learner	Student Trainee Employee Apprentice	Sam, Harry, Sara, Mohammad, Katje, Adele, Thomas, Andrea, Marco (PMLDC) Angel, Mohammad, Jake, Archie, Susanna (ASC) Sam, Yasmin, Jonas (MEC) Bill, Brenda (ITC) Alexandros (CGDLC)

5. Requirements and Learning Materials Derived from Stakeholder Interviews

5.1 Use Case 1: Autistic Spectrum Disorder

5.1.1 Stakeholder Interviews

Interviews have been conducted with teachers of primary and secondary school who work with learners with special needs as part of their mainstream classes, as well as with pedagogical experts of organisations providing support and educational services to children with autism diagnosis and their families.

At least 20 teachers/pedagogical experts have been interviewed. Focus groups – at least one per each of the 10 schools/organisations involved in the ASC pilot – have been organised by partners, involving teachers, supporting teachers, head-teachers, school psychologists and counsellors.

Three of the organisations selected to organise the pilot are specialist schools for pupils and students with autism diagnosis. Two of them are based in UK, one enrolling students from 3 to 19 years, one from 11 to 19 years; one is based in Spain and enrols children from 3 to 20 years old. Two of the selected organisations are associations providing support and educational services to children with autism diagnoses based in Italy; one enrols children approximately aged 10/11 and the other 3 to 19 years old. The remaining 5 organisations are mainstream schools that include autism-spectrum students: 1 Italian high school attended by 15-to-18-year-olds, 2 other Italian schools attended by 3-to-14-year-olds, and 1 school in Spain enrolling students from 3 to 12 years old.

The analysis of the interviews has highlighted that many benefits are perceived for the application of technologies to support special-needs students developing academic, social, and behavioural skills, while also providing greater access to a general curriculum integrating them within mainstream school settings.

Examples of the main challenges encountered by students with autism include difficulties achieving school demands; revealing behavioural difficulties linked to emotional control; difficulties with executive function such as paying attention and being able to generalize information to wider settings. Students with an ASD behave hyperactively and emotionally and manifest higher levels of anxiety than their peers. ASD students report difficulties in communication and social engagement, thus the relationship between ASD student and the teacher is fundamental for their successful learning path and the use of technologies should not disrupt this relationship. An inclusive school setting is essential to increase sense of self-worth and esteem that can reduce problematic behaviours. Technologies are perceived on one side as useful to develop cooperative-learning environments; on the other side could pose organisational problems (too much time to be allocated, availability of the devices or of the technical assistance and training, isolation of special needs students. Interviewers reported the topics in which the technology could help them in their work supporting ASD students' learning paths are communication and social interaction, emotional management, enhancement of short attention span, and learning goals that offer the opportunity for sensory integration (Ex. Combining pictures, verbal indications and fine motor action) within the learning path.

5.1.1.1 UK

5.1.1.1.1 Sutherland House (UoN)

1 teacher (5-19 y/o students)

Sutherland House is a specialist school for pupils and students with autism aged 3 to 19 years, providing the highest quality specialist education, addressing the specific needs of autism as well as the individuality of each pupil and his or her family. It employs a range of specialists including speech and language therapists, psychologists, music specialists and occupational therapists. The school premises include a dedicated IT suite although pupils will use mobile devices in other classrooms. The IT suite has roughly 16 desktops linked to their own network. It also has an interactive whiteboard.

5.1.1.1.2 Charlton Park Academy (RIX)

1 teacher (9-11 y/o students)

Charlton Park Academy is a Secondary Special Academy for students 11-19 with complex, low incidence special educational needs. The staff is trained working on special educational needs and it is constantly developing excellent facilities to support parents/caregivers. It disposes of a small residential unit for pupils admitted with complex care needs benefiting from extended educational provision. All students enrolled have a Single plan, EHC plan or Statement of Special Educational Needs appropriate for placement in the school. Existing technologies routinely used in the school include: iPads (over 100 iPads), Android Tablets, Whiteboards in each classroom, PC's, EyeGaze, 3D printers, Design Technology - Design Cuter, Sensory Guru Equipment, OMI interactive, Tomocco, personalised communication devices e.g. VOCA, Paphfinder and others. All staff are trained to use existing technologies and are experienced in using and supporting students to use existing hardware and software. Currently, there is no access to robots – so additional training will be required at the beginning of the pilot.

5.1.1.2 **Italy**

5.1.1.2.1 IC Rita Levi Montalcini School (FMD)

2 teachers (8-9 y/o students)

It is a primary and secondary first grade public school (students aged 3 to 14 years) known for the training of teachers linked to new technologies and initiatives related to innovative teaching. It counts on a professionally prepared staff, in particular regarding the education of students with special needs. The class of approximately twenty-one students selected to take part in the pilot enrols students aged 8/9 including 3 ASD. The school is equipped with interactive whiteboard, PC and 6 tablets.

5.1.1.2.2 Association FareABA (FMD)

3 psychologists (11-12 y/o students)

FareABA is an association of psychologists that deals with Autism and Pervasive Developmental Disorders that cooperates with schools and families, providing assistance to children with high functioning autism aged 10 and 11 years, two of them will participate in the ASC pilot. The staff is specialized in psychology, Clinical Childhood, Adolescence and Family Psychology.

5.1.1.2.3 IC Via Pasquale Stabilini (FMD)

2 teachers (8-9 y/o students)

It is a primary and secondary first grade public school enrolling ages 3 to 14 years. The school is well known for applying a student-centred pedagogical approach. It has been one of the first schools in Rome to introduce educational robotics within the curriculum. The class of approximately twenty students selected for the pilot enrols 3 students with ASD. The class is equipped with PCs and an interactive whiteboard available for use in the project.

5.1.1.2.4 ITC V. Arangio Ruiz School (FMD)

2 teachers (16-22 y/o students)

This is a commercial technical secondary second grade school (students aged 15-18 years) based in Rome. Electronics and informatics are part of the school curriculum and the school has access to the related equipped laboratories. One class has been selected to participate in the project, composed of twenty-two students aged 15 to 16 years. Among them, one student 16 years old reports Asperger Syndrome, and two students 18 and 22 years old have multiple learning disabilities. The class is equipped with interactive whiteboard, PCs, 5 tablets, and 1 iPad.

5.1.1.2.5 Il Mosaico – Società Cooperativa Sociale ONLUS (PE)

1 pedagogist (3-12 y/o students)

The social cooperative Il Mosaico is located in Marche region and provides educational services to students from 3 to 19 years old with social and educational needs reported by Social Assistance, Schools and Health Centres, or to private clients. 2 students 12 years old have been selected to take part in the pilot. The staff is composed of pedagogy specialists, psychologists, professional educators, teachers, youth workers and skilled operators with considerable experience, and theoretical competence. They also manage a Specialised Centre for Diagnosis and Empowerment for Learning Difficulties. The students are from families with several issues: drugs and alcohol addiction, low educational levels, crime, social exclusion, psychiatric disorders, and from immigrant families. One student reports autism spectrum disorder.

5.1.1.3 **Spain**

5.1.1.3.1 CEIP "JOAQUÍN DÍAZ" - Centro de Educación Infantil y Primaria "Joaquín Díaz" (JCYL)

2 teachers (6-12 y/o students)

It is an infant and primary school enrolling students from 3 to 12 years old, usually 25 per class 2 of the students with some disabilities or learning difficulties, one 6 years old and the other 12 years old will participate in the pilot. School teachers received training on smart boards for educative use, tablets and computers, management of ICT resources, and didactic blogs' design.

5.1.1.3.2 Centro Concertado de Educación Especial "El Corro" (JCYL)

El Corro is a Special Education Centre that belongs to the Valladolid Autism Association and provide psycho-educational response to children with autism. The school has twelve teachers (eight support teachers, three specialists in language, one vocational trainer), six educational assistants and two educational counsellors. They have received training on the educative use of smartboards. The centre has at least one whiteboard, computers and tablets that can be used for the project. The school applies specific methodological strategies: structured and predictable environments, learning without error and functional, chain back training methodologies, physical moulding, incidental learning, use of visual aids, alternative and Augmentative Communication Systems are used. El Corro will not take part in the first pilots.

5.1.1.3.3 Equipo de atención a alumnado con trastornos de conducta (JCYL)

The counselling team for students with behavioural disorders is composed of teachers that hold the speciality of Psychology and Pedagogy. They have a classroom where two teachers work with most difficult cases. Many of these most difficult cases are pupils with ASD. Both psychologist, pedagogist and teachers have received training on the educative use of PC and tablets. Pupils are allowed to bring their own tablets.

5.1.1.3.4 Centro de Educación Infantil y Primaria "Gonzalo de Berceo" (JCYL)

This is a medium size infant and primary school enrolling students from 3 to 12 years old, there are nearly 400 students and 32 teachers. One 10 years old pupil will participate in the pilot. School teachers received training on smart boards, tablets and computers educative use, management of ICT resources

5.1.2 Report on Requirements Framework

5.1.2.1 User Group Characteristics:

The age range of the users is from 8 to 18 years old, balanced in gender. All the final users can understand their national language (English, Spanish, Italian) and are not confident with the English language if it is not their mother tongue; some of them do not speak or do not use language communicatively and instead use pictograms. Since the educational systems are different in each country and each country applies different regulations related to the inclusion of students with special needs in the mainstream curriculum, it is not possible to identify a common educational level. Generally, the system must be adaptable to different levels of abilities and provide learning activities personalised based on the different impairments of the students taking in consideration the principles of inclusive education.

The system should facilitate teaching and learning personalisation, taking into consideration the cognitive, perceptual and motor profiles of special-needs students that require stimulation to capture, to direct and to sustain attention, repetition and predictability, and breakdown of sequential tasks and related indications, multisensory or idiosyncratically unisensory approaches and positive reinforcements. The sensors must be able to gather data from users with limited verbal communication and hyperactive behaviour in the context of a class.

The system should be simple and easy to use, reliable and quick to set up. Most of the teachers are not confident using technologies for teaching, thus training must be provided in order to support them introducing the system within their classes. In order for the system to be considered useful and applicable in the context of education, it must not require additional workload, and it must be applicable in inclusive and cooperative learning classroom.

5.1.2.2 Technical Environment

It is essential to equip the schools based on the system technical requirements, considering schools limitations such as highly restrictive firewall security, obsolete technical equipment and limited Internet connectivity. The system should be user-friendly; technical training and assistance should be provided. Centralised management and access with restricted profiles are needed in accordance with ethical issues. Sensors should be of sufficient fidelity to be able to collect information from students who may not be able to establish or maintain gaze or to gesture consistently. The system should be able to gather information from different users working collaboratively on one and the same device.

5.1.2.3 Physical Environment

The system should be usable in a noisy classroom environment, considering both output (e.g., sufficient volume control on mobile devices) and input (e.g., for audio sentiment analysis). At the same time, the system should allow easy and quick disabling of individual elements of the interface, so as to accommodate users with sensory hypersensitivity who might find high-amplitude (loud) or high-contrast (e.g. shrill or grating sounds, for example servomotors on a robot) aversive.

Sentiment/pose analysis should be able to be performed from sensor data collected from users in many different, non-orthodox positions.

5.1.2.4 Social and Organisational Environment

The teachers need adequate technical training and assistance, as well as some rehearsal and practice sessions in order to be able to use the system in an educational context. They require a system that can be used in a cooperative learning environment, implying that one and the same PA should be usable at the same time by different users.

The system must ensure data protection: individual students' data needs to be stored securely and parents, teachers and students should have different access rights, must be informed of the data collection a priori so that informed consent and informed assent, as appropriate for each user's legal level of competence and each country's legal and regulatory requirements, can be obtained.

Tables of the requirements can be found in Annex 2 – User Requirements, Section 12.1.

5.1.3 Learning goals, Smart Learning Atoms and Learning Atoms

Examples of Learning goals, SLAs and Learning Actions		
Age 8-9		
Learning goal	**SLA**	**Learning action**
Motor Skills	Motor sequencing	Repeat/imitate a sequence (Table 39)
	Spatial coordination	Repeat/imitate a sequence
	Motor coordination (arm and leg coordination, hand-eye coordination)	Manage motor coordination
Cognitive Skills	Literacy improvement	Enrich vocabulary
		Compose words/sentences
		Combine picture and word
	Language comprehension	Visualise the content
		Predict the sentence
		Make connections
Communication/Socialisation Skills	Conversation	Engage in dialogue
		Reply to a question
High functioning autism age 11-12		
Motor skills	Motor coordination (arm and leg coordination, hand-eye coordination)	Imitate a movement
		Manage spatial coordination
Cognitive skills	Decision-making abilities enhancement	Make a choice
	Executive functions enhancement	Match items
	Memory planning enhancement	Repeat a sequence of tasks part of an action
Communication/Socialisation Skills	Functional communication enhancement	Repeat a word
		Shape the word
Age 8-9		
Emotional identification and expression (emotional traits)	Visual attention	Visually track pictures (focusing)
		Look at pictures for a time
	Hearing attention	Focus on a sound
		Hearing a sound for a time
	Visual discrimination	Find differences between two facial expressions
		Match two identical pictures
	Hearing discrimination (prosodic elements)	Find differences between two sounds of emotional trait

		Match two identical emotional sounds
	Eye contact	Make eye contact with an animated target
		Make eye contact with different facial expression
	Imitation	Imitate facial expressions
		Imitate body gestures
	Parts of the face (cognition)	Match part of the face (eyes, noses, cheeks...)
		Make puzzles with facial parts
	Parts of the body (cognition)	Match part of the body (leg, arms...)
		Touch different parts of the body
	Basic emotions (cognition)	Say emotions
		Classify emotions
	Basic emotions recognition	Deduce basic emotions from different body gestures
		Deduce basic emotions from different social situations.
	Basic emotions expression	Virtual role playing (children without movement possibilities)
Language spontaneity (improvement)	Imitation	Imitate gestures in a song/story
		Imitate onomatopoeia in a song/story
	Spontaneity in asking questions	Guess where is one object/person
		Play “Veo-veo” / “I-Spy”
	Description	Guess and describe an object
		Describe a picture

Table 4: Learning goals, SLAs and LAs (ASD)

5.1.4 Worked Example 1

Mark is a male aged 8 with fragile X syndrome. Due to some particular characteristics of the syndrome during growth (large head, large ears, joint hypermobility and flat feet, prominent forehead) he faces some fine motor skills difficulties. Associated hyperactivity, anxiety and attention disorders sometimes have consequences for gross motor abilities and movement coordination. He is not completely autonomous in his daily tasks. He also has severe intellectual disability. He has particular difficulties in sequential processing and short-term memory deficits manifesting particularly as weakness in arithmetic. In spite of the reported decline in IQ test scores with age typical of the syndrome, adaptive behaviour seems to bring improvements with appropriate training. He needs motivation and assistance to accomplish tasks, possibly reinforcing his understanding of a concept by applying different senses (voice, images). It is very difficult for him to concentrate, he manifests attention disorders, hyperactivity, anxiety, language-processing problems, speech and language delay. Sometimes he sings to express himself. He is able to express his feelings when given yes or no questions. He likes people speaking in a quiet voice. When socialising, he is only

comfortable being close to people he likes, and with whom he knows he can play as he likes. He tends to be solitary, so needs others to positively find and involve him.

5.1.4.1 Stakeholders

- Primary Actor - primary school teacher who works with Mark
- Actor - Mark (student with fragile X)
- Other actors – Support teacher.

5.1.4.2 Learning Experience Example

Mark uses the system with his primary school teacher and support teacher to practice motor sequencing and spatial coordination through repeating/imitating a sequence of actions, where the platform agent (a robot) demonstrates a sequence of gestures or pictures and asks the children to repeat them while providing hints as support if needed.

5.1.4.2.1 Example 1: Motor sequencing

- PA: Robot
- Learning goal: Motor skills
- SLA: Motor sequencing
- LA: Repeat/imitate a sequence

See Annex 3 – MaTHiSiS Learning Experience Examples, Section 13.1.1 for Learning Experience outline.

Learning Experience Flow

1. The teacher sets up the system and starts the LA “Repeat/imitate a sequence” exercise.
2. The robot attracts the student’s attention.
3. The robot shows a sequence of gestures to the student.
4. The robot asks the student to repeat the sequence of gestures.
5. The student repeats the sequence of gestures.
6. The robot gives feedback to the student.
7. Repeat from 3. until the student is able to repeat the sequence of gestures properly.

Termination outcome: the student performs the sequence of gestures properly.

Alternative Flow 5A

5A1. The student becomes frustrated.
5A2. The activity terminates.

5.1.5 Worked Example 2

Sylvie is a female aged 8 with attention deficit in comorbidity with specific learning disabilities. She has proper gross and fine motor control, but she has difficulties repeating procedures, she needs vocal repetition of instructions or pictures/signals guiding her during the task.

She has some cognitive impairments: she breaks words, reverses the letters, expresses herself in simple language, she needs a spell checker to write. She cannot follow the procedures without vocal guidance at each stage, or by breaking up the sequence and providing supporting indications at each step. Example of task: in a text, highlight the adjectives in red and the names in yellow – indications and support needed: “take the red highlighter pen and highlight the adjectives in the text” once that task is completed, we go on to tell her “take the yellow highlighter pen”, once she has the correct pen in her hand, we tell her “highlight the names in the text in yellow”. Visual reinforcement is also needed for her to memorize a name or a concept, or to understand the synonyms. She has difficulties solving problems and mathematics, she needs to visualize in order to elaborate information (e.g. 5 cats + 5 dogs: suggest that she pictures 5 dogs and 5 cats). She draws very well

and she is able to capture fine detail. She is very committed to overcoming her difficulties. She is very emotional; she uses few words but she is able to express her feelings. She is egocentric, needs recognition and wants to stand out, taking advantage of her condition to be the centre of attention.

5.1.5.1 Stakeholders

- Primary Actor – primary school teacher that works with Sylvie
- Actor – Sylvie (student with attention deficit)
- Other actors – Support teacher.

5.1.5.2 Learning Experience Example

The student uses the system together with her primary school teacher and support teacher. The goal is to enhance her communication and socialisation skills of express feelings and social perspective taking through the learning action of engaging in a dialogue.

5.1.5.2.1 Example 2: Dialogue Engagement

- PA: Robot
- Learning goal: Communication/Socialisation Skills
- SLA: Conversation
- LA: Engage in dialogue

See Annex 3 – MaTHiSiS Learning Experience Examples, Section 13.1.1 for Learning Experience outline.

Learning Experience Flow

1. The teacher sets up the system and starts the LA "Engage in dialogue" exercise (set end condition as a period of time or number of exchanges, possibly chooses conversation topic or writes the questions – this is another use case).
2. The robot attracts the student's attention.
3. The robot says "Hi, I am [robot name]" to the student and asks the student her name.
4. The robot waits for the student's reply.
5. The robot poses another question.
6. Repeat from 4.

Termination outcome: the student engages in dialogue until end condition set in 1. has been reached.

Alternative Flow 4A

4A1. The student's attention wanders.
4A2. The robot uses a predetermined action designed to attract student's attention and poses another question.
4A3. Go to 4.

Alternative Flow 4B

4B1. The student does not reply.
4B2. The robot repeats the question.
4B3. Go to 4.

5.2 Use Case 2: Profound and Multiple Learning Disabilities

5.2.1 Stakeholder Interviews

Interviews were conducted with primary and secondary school teachers who work directly with learners with special needs or who have them in their mainstream classes, with a speech therapist

and with a clinical pedagogist. The subjects taught are various, from maths to geography, from coding to compulsory basic education. The interviews cover almost all the range of ages considered by this requirement capture exercise (3 to 19 years old students).

We consider a learner with profound and multiple learning disabilities to be a pupil who has two or more of the following: physical disability, intellectual disability, hearing impairment, visual disability, very significant communication and language disorders, severe personality disorders, other disabilities. The range of disabilities involved in the study is wide: tetra-paresis, cerebral palsy, sensory and physical impairments, from moderate to severe mental disability, learning disability, limited verbal communication, attention deficit hyperactivity disorder (ADHD), memory and learning deficits, behavioural disorders, no proper gross or fine motor skills. Many of the pupils have significant communication problems.

A part of the interview was about the use of the technology, and how it is perceived by the students and the teachers. Technology is useful to keep the students' attention and some are quite autonomous with a supervisor while others need one to one assistance. The majority of the students have never experienced the use of robots before. Only in I.C. Lorenzi and Oak Field School are NAO robots sometimes used as learning mediators or in cooperative working; in the I.C. Beni Montresor, the teachers use small robots for their activities. IWBs are used to present, write, interact, show video, access resources and in brainstorming activities. However, not all the schools have them (for example Arangio Ruiz School and the private centre Il Mosaico). Mobile devices are frequently used with learning objectives, as visual tools to support curriculum, for developing cause and effect perception, for sharing and encouraging turn taking, for establish routines. If the school does not have mobile devices, the students are invited to bring their own (I.C. Lorenzi).

All the teachers felt that the technology could be useful to almost all students (both in mainstream education and in special schools) due to its potential for engagement, and considered it potentially useful for a range of different topics, from the understanding of theoretical concepts to the practice of daily or basic skills. According to the interviewees, the topics in which the technology could help them in their work with PMLD learners are: communication and social interaction, emotional management (emotions recognition in oneself and in others), enhance the short attention span or the understanding of concepts like numbers or geometry.

Some of the interviewees answered questions about the possible pros and cons of the system. They indicated organisational problems (for example too much allocated time), technical problems (for example the availability of the devices or of the technical assistance) or doubts (for example isolate the students with special needs from the class with different activities). Their main concern is that the system could represent an additional workload and the majority of them expressed the need for specific future training on the use of the platform.

The teachers also pointed to positive aspects such as the possibility of sharing content and information with other colleagues or working across the school/home barrier; the new tool is seen as a way to engage the students in a playful way and to focus on their needs.

When reviewing the information from the interviews, and the Requirements Framework for the Profound and Multiple Learning Disabilities use case, it is difficult to identify a common structure: the educational level and the characteristics of the users are complex. Besides that, the contexts of use are different too: mainstream classes (Italy and Spain) and schools or centres for special needs students (UK and Spain).

Six partners from three different countries (UK, Italy and Spain) have been involved in the interviews for PMLD cases: Nottingham Trent University (NTU), University of Nottingham (UoN), RIX Research and Media (RIX), Polo Europeo della Conoscenza (PE), Fondazione Mondo Digitale (FMD), Consejería de Educación – Junta de Castilla y León (JCYL).

In total 16 people were interviewed: each partner interviewed at least one teacher or professional from different stakeholders.

5.2.1.1 UK

5.2.1.1.1 Oak Field School (NTU)

4 teachers (3-19 y/o students)

The aim of the Oak Field School is "to ensure that all pupils access the very best in educational opportunities, taking their rightful place within their community". The school has very active links with both local Universities from which pupils benefit by being involved in the very latest in research. They wish to harness the very latest in technologies, which will enhance the skills and learning of the young people.

In 2008, the school assumed Sports College Status, with ICT as a second subject. The school holds the International School Award, Youth Sport Trust Gold, Ability Nottingham, Basic Skills Award, Healthy Schools Gold, eTwinning Award, Let's Get Cooking Accredited and Arts Mark Gold.

Students aged 9-17 years old at the Oak Field School will be involved in the project. These students have a range of severe, profound and complex learning and/or physical disabilities.

5.2.1.1.2 Charlton Park Academy (RIX)

1 teacher (14-15 y/o students)

Charlton Park Academy is a Secondary Special Academy for students with complex (11-19 years), low incidence special educational needs based in the London Royal Borough of Greenwich, UK. These school places primarily are for pupils for whom a special education setting is required. All students applying must have a Single plan, EHC plan, or Statement of Special Educational Needs appropriate for placement in the school. They have a small residential unit for pupils admitted with complex care needs benefiting from extended educational provision.

Charlton Park Academy have friendly and experienced staff who are familiar with working with a wide range of young people with special educational needs – most of the staff have specialist qualifications and experience. The school trains and mentors all of their staff continuously to improve upon their standards of provision.

The school has fully adopted the unique multimedia advocacy approach developed by RIX Research & Media. The School uses RIX Wikis for all 240 of its pupils and this year's Ofsted Residential Inspection Report has highlighted how the use of Wikis has enabled very effective person-centred planning.

5.2.1.1.3 Foxwood Academy (UoN)

1 speech and language therapist, 1 systems manager (3-19 y/o students)

Foxwood Academy is a special school lying to the west of Nottingham. It caters for children aged between 3-19 years of age with a wide range of needs and abilities. The school commissions support from other professionals who provide speech and language therapy, occupational therapy and physiotherapy to support students in all areas of their life. All students have inclusive access to a curriculum and additional services that prepare them very effectively for life.

The school has specialist status for applied learning and technology and is committed to promote excellence in Technology, Applied Learning and Life Skills for young people and adults with special educational needs regardless of background and starting points and encouraging greater inclusiveness into a society of independent citizens. The school has approximately one hundred pupils on its roll at any one time. Many pupils have additional communication, sensory needs, physical needs or specific medical needs including epilepsy.

5.2.1.2 Italy

5.2.1.2.1 Istituto Comprensivo Lorenzi (PE)

1 teacher (10-14 y/o students)

Istituto comprensivo Lorenzi includes about 1000 students from 3 to 14 years old. It is a public school network consisting of 10 different schools in a mountain area around Verona. There are about 20 students with a Learning Disability at various levels (Cerebral Palsy, Downs Syndrome and Autistic Spectrum) and about twenty special need teachers to support them.

5.2.1.2.2 Istituto Comprensivo Don Milani (PE)

1 teacher (10-14 y/o students)

Istituto comprensivo Don L. Milani includes about 1400 students from 3 to 14 years old. It is a public school network consisting of 5 different schools (3 preschools, 5 primary schools, 3 middle schools) in the hill area around Verona. There are about 26 students with a Learning Disability at various levels (Cerebral Palsy, Downs Syndrome, Autistic Spectrum) and about twenty special need teachers to support them.

5.2.1.2.3 Istituto Comprensivo Da Vinci (PE)

2 teachers (5-10 y/o pupils)

Istituto comprensivo Leonardo da Vinci includes about 2000 students from 3 to 14 years old. It is a public school network consisting of 9 different schools (5 preschools, 3 primary schools, 1 middle school) in a high plain and hilly area around Verona. There are about 69 students with a Learning Disability at various levels (Cerebral Palsy, Downs Syndrome, Autistic Spectrum, and about 30 special needs teachers to support them.

5.2.1.2.4 Coop. Soc. Il Mosaico (PE)

1 pedagogist (12-18 y/o students)

The social cooperative Il Mosaico is located in Marche region and provides educational services to students (3 to 19 years old) with social and educational needs reported by Social Assistance, Schools and Health Centres, or to private clients.

The staff are composed of pedagogy specialists, psychologists, professional educators, teachers, youth workers and skilled operators with considerable experience, and theoretical competence. They also manage a Specialised Centre for Diagnosis and Empowerment for Learning Difficulties officially recognised by the region Marche.

5.2.1.2.5 ITC V. Arangio Ruiz School (FMD)

1 teacher (15-18 y/o students)

This is a commercial technical secondary second grade school (students aged 15-18 years) based in Rome. Electronics and informatics are part of the school curriculum and the school has access to relevantly equipped laboratories. Their involvement in the project is relevant for both the teachers and the students in terms of additional training opportunities.

One class has been selected to participate in the project, composed of twenty-two students aged 15 to 16 years. Among them, one student has Asperger Syndrome, and two students have multiple learning disabilities, one is 18 years old and the other 22 years old. One in service teacher, one support teacher for students with special needs, two psychologists and one teacher with high-level experience in educational robotics will be involved.

5.2.1.3 Spain

5.2.1.3.1 Centro de Educación Especial nº 1 (JCYL)

1 teacher (9-16 y/o students)

Special Education Centre, with seventy-five pupils, forty-nine of whom have profound and multiple learning disabilities. The school has twenty-four teachers (twenty-two support teachers and three specialists in language, fourteen educational assistants, three physiotherapists and two nurses.

5.2.1.3.2 Centro de Educación Especial "San Juan de Dios" (JCYL)

1 teacher (14 y/o students)

"Centro San Juan de Dios" is a non-profit organisation associated with the Hospitaller Order of St. John of God. The aim of this Special School "San Juan de Dios" is to develop students' abilities and competences oriented to practical knowledge and daily living skills to promote their social and professional integration.

Pupils receive personalised education, based in a respectful and flexible environment. More than seventy pupils are catered for ranging from 12-23 years old. The school has thirteen teachers (eight support teachers, one speech therapist teacher, and four vocational trainers), two physiotherapists, thirteen educational assistants and one educational counsellor.

5.2.2 Report on Requirements Framework

5.2.2.1 User Group Characteristics:

The age range of the users is from 3 to 22 years old, balanced in gender. All users can understand their national language (English, Spanish, Italian) but some of them do not have verbal language and use pictographic languages. Since the laws and modes of practice are different in each country and the users have different degrees of disability, it is not possible to identify a common educational level. Generally, the system must be adaptable to different levels of complexity, even for the same exercise, and consider small incremental steps in the learning process.

The system should accommodate trial and error and calibration to be truly personalised and responsive for various needs. Users with Profound and Multiple Learning Disabilities have cognitive impairments that require shorter exercises with a slower speed of response, linked to their daily experience and, the possibility to have interruptions. The sensors must be sensitive enough to gather data from users with limited verbal communication.

The system must also give information on both visual and auditory channels, since the users may have sensory impairments. The platform agents must have appropriate sensors to gather data from students whose body movements, gaze, speech content and tone are decoupled from their internal states. It is important that platform agents are compatible with standard assistive technologies.

No additional workload should arise for the teachers from using the system, so it must be simple and easy to use, reliable, quick to set up, well tested before introducing into the classroom. The teachers need good training and support (initially in person on site), user guides, opportunities to trial and error to learn how to use it.

5.2.2.2 Technical Environment

The hardware should be robust and fitted with a protective case, but it should be easy to interact with it. It is necessary to consider the school's limitations (firewall security for the download, obsolete technical equipment). The centralised device management and access with restricted profiles are needed. Sensors should be of sufficient fidelity to be able to collect information from students who may not be able to maintain gaze, or gesture consistently, hold the device themselves,

be at a greater distance than usual from the mobile device. All platform agents must communicate with/receive input from the assistive technologies. The system should be able to gather information from different users on the same device.

5.2.2.3 Physical Environment

System should be usable in a noisy classroom environment, considering both output (e.g., sufficient volume control on mobile devices) and input (e.g. for audio sentiment analysis).

Sentiment/pose analysis should be able to be performed from users in many different, non-conventional positions.

5.2.2.4 Social and Organisational Environment

The teachers need adequate training in the form of direct help, by email, FAQ, helpline or similar tools. They require a system that can be used in a collaborative way such that the same PA could be used at the same time by different users.

The system must ensure data protection: individual students data needs to be stored securely and parents, teachers, students should have different access rights.

Tables of the requirements can be found in Annex 2 – User Requirements, Section 12.2

5.2.3 Learning goals, Smart Learning Atoms and Learning Actions

Examples of Learning goals, SLAs and Learning Actions		
Learning goal	**SLA**	**Learning Action**
Vocabulary (improvement)	Colour vocabulary cognition	Name primary colours
		Name secondary colours
	Speech enunciation	Show and name (object/action/colour)
		Repeat spoken word (object/action/colour)
	Pronunciation (improvement)	Show and name (object/action/colour)
		Repeat spoken word (object/action/colour)
	Object recognition	Repeat spoken word (object/action/colour)
		Match name to picture
		Group objects
	Word recognition	Identify visualisation of spoken word: actions
		Match written word to picture: actions
		Identify visualisation of spoken word: descriptors
		Match written word to picture: descriptors
	Sentence building	Identify classes of words
		Pair object and descriptor word
		Pair object and action word
Maths (improvement)	Quantity comparison	Play with quantity
		Identify more or less quantity
	Number-quantity correspondence	Associate a number with a quantity
	Number-name association	Repeat a number
		Identify a number
	Sequencing	Identify the missing number
		Sort numbers
		Put objects in the right order

	Number composition	Compose the numbers over ten
		Name numbers over ten
Attention span (increase)	Sequence reproduction	Reproduce a sequence of numbers
		Reproduce a sequence of pictures/sounds
		Reproduce a sequence of actions
Telling time on an analogue clock	Clock numbers cognition	Identify numbers 1 to 12
		Correctly identify numbers by matching them to numbers of objects
		Arrange numbers in ascending order
	Clock face numbers identification	Find position of 4 clock face numbers
		Find position of all 12 clock face numbers
	Hour hand recognition	Identify at what time activities take place e.g. start and finish school
		Place hour hand in correct place in response to verbal prompts e.g. "one o'clock"
	Minute hand recognition	Imitate positions of hour and minute hand for half past
		Imitate positions of hour and minute hand for quarter past
		Imitate positions of hour and minute hand for 5-minute intervals
Navigation	Left-right cognition	Identify left and right (own/object)
		Recognise left and right direction
		Turning left and right
	Area recognition	Match name or symbol to different rooms
		Identify places' location on map/model

Table 5: Learning goals, SLAs and LAs (PMLD)

During the interviews, the teachers identified other possible learning goals and SLAs that need further analysis for their correct materialisation: sequencing, make purposeful choices, identify emotions, strengthen the fine motor skills, recognise and use similarities, establish conceptual networks, categorizing.

5.2.4 Worked Example

Andrea is 19 years old; he has tetra-paresis as a result of his cerebral palsy, and moderate-to-severe intellectual disability. He attends the sixth year of secondary education in a mainstream class with the help of an assistant teacher and an educator for the majority of the school time. He uses a wheelchair and depends on others to move around. He uses his right hand to hold pens and objects. He has little movement in his left hand and problems with his fine motor skills, there are some actions he can do alone, like: eat a sandwich, drink from a bottle, use the computer. Andrea has a visual impairment: he is able to have the right sight only of big, well clear-cut and with sharp outlines images.

Andrea has no cognitive strategies. He looks for the help of the adult, but he is beginning to do some actions autonomously in the personal and social areas. He can produce short full sensed sentences, quite correctly (he has a limited vocabulary linked to his daily activities). He can understand simple messages linked to concrete experiences. He grasps the meaning of simple texts catching on the main elements.

Andrea has a limitation in the memory abilities: to learn information, he needs long time, reiterate repetitions and daily reinforcements, moreover he is not able to keep attention for a long time on the same subject and he gets tired easily.

Strongly motivated by the relationship with the others, especially his peers, he looks for situations in which he can have contact and exchange.

Andrea in going to use the system with the help of his pedagogist and his special needs teacher, to improve his vocabulary (to help him in the social interactions), his attention skills and his basic competence in maths.

5.2.4.1 Stakeholders

- Teacher – Special Needs Teacher that works with Andrea
- Learner - Andrea (PMLD student)
- Other actors – Special Needs Teacher; Headmaster, Parents

5.2.4.2 Learning Experience Examples

Andrea needs to develop his vocabulary to enable him to sustain a short conversation and mathematical skills (count to 20), and work on improving his attention span (he can usually stay on a task for 5 minutes)

- Improve vocabulary
- Improve maths
- Increase attention span

5.2.4.2.1 Example 1: Object recognition

- PA: Tablet
- Learning goal: Vocabulary (improvement)
- SLA: Object recognition
- LA: Show and name (object)

See Annex 3 – MaTHiSiS Learning Experience Examples, Section 13.2.1 for Learning Experience outline.

Learning Experience Flow

1. The pedagogist sets up the system (target number of objects to display, scope/range/theme of objects to display) and starts the LA “Show and name (object)” exercise on the tablet.
2. An object appears on the screen.
3. A recorded voice asks, “What is this object?”
4. Andrea names the object correctly.
5. The tablet gives positive feedback to Andrea’s response.
6. Repeat from 2. for as many of the objects as the system has determined to be suitable for Andrea’s affect state.

Termination outcome: All objects presented have been recognised by Andrea.

Alternative Flow 4A

4A1. Andrea is not able to name the object (hesitant, “um” & “er”, “I’m not sure”, “don’t know”).
4A2. The tablet gives him a prompt.

Alternative Flow 4B

4B1. Andrea does not respond once or twice.
4B2. Go to 3. (The tablet repeats the question.)

Alternative Flow 4C

4C1. Andrea does not respond three times.
4C2. The system changes object.
4C3. Go to 3.

Alternative Flow 4D

4D1. Andrea responds with the wrong name.
4D2. A vocal message corrects him.
4D3. The system changes object.
4D4. Go to 3.

Alternative Flow 6A

6A1. Andrea's affect state falls below a threshold.
6A2. The system informs the pedagogist.
6A3. The pedagogist pauses or terminates the exercise.

5.2.4.2.2 Example 2: Quantity correspondence

- PA: Tablet
- Learning goal: Maths (improvement)
- SLA: Quantity correspondence
- LA: Associate a number with a quantity

See Annex 3 – MaTHiSiS Learning Experience Examples, Section 13.2.1 for Learning Experience outline.

Learning Experience Flow

1. The pedagogist sets up the system (target number of numbers to display) and starts the LA "Associate a number with a quantity" exercise on the tablet.
2. A random quantity of dots appears on the screen.
3. A recorded voice asks "How many dots are there?"
4. Andrea answers correctly.
5. The tablet gives positive feedback to Andrea's response.
6. Repeat from 2. for as many of the numbers that the system has determined as suitable for Andrea's affect state.

Termination outcome: All objects presented have been recognised by Andrea.

Alternative flow 4A

4A1. Andrea is not able to name the number (hesitant, "um" & "er", "I'm not sure", "don't know").
4A2. The tablet gives him a prompt showing 3 alternatives.

Alternative flow 4B

4B1. Andrea does not respond once.
4B2. A recorded voice asks "Are there (random number)?"
4B3. Andrea responds correctly.
4B4. Go to 3.

Alternative flow 4C

4C1. Andrea does not respond twice.
4C2. The system changes the number.
4C3. Go to 3.

Alternative flow 4D

4D1. Andrea respond with the wrong number.
4D2. A vocal message corrects him.
4D3. The system changes the number.
4D4. Go to 3.

Alternative flow 6A

6A1. Andrea's affect state falls below a threshold.
6A2. The system informs the pedagogist.
6A3. The pedagogist pauses or terminates the exercise.

5.2.4.2.3 Example 3: Sequence reproduction

- PA: Tablet
- Learning goal: Attention span (increase)
- SLA: Sequence reproduction
- LA: Reproduce a sequence of pictures/sounds

See Annex 3 – MaTHiSiS Learning Experience Examples, Section 13.2.1 for Learning Experience outline.

Learning Experience Flow

1. The pedagogist sets up the system (target number of repetition to display, scope/range/theme of objects to display) and starts the LA "Reproduce a sequence of pictures/sounds" exercise on the tablet
2. The tablet shows a set of pictures
3. A recorded voice says, "Pay attention to the sequence and then repeat it"
4. The tablet lights up two of the pictures in sequence
5. Andrea answer correctly.
6. The tablet gives positive feedback to Andrea's response.
7. Repeat from 4 adding one more picture each time for as many of the repetitions that the system has determined as suitable for Andrea's affect state.

Termination outcome: All sequences have been completed by Andrea.

Alternative flow 5A

5A1. Andrea makes a mistake during the repetition.
5A2. A recorded message says "Try again".
5A3. Go to 4.

Alternative flow 5B

5B1. Andrea does not respond once.
5B2. A recorded message says "Try again".
5B3. Go to 4.

Alternative flow 5C

5C1. Andrea does not respond twice.
5C2. A recorded message says "Try again".
5C3. Go to 4, to the previous number of items.

Alternative flow 7A

7A1. Andrea's affect state falls below a threshold
7A2. The system informs the pedagogist.
7A3. The pedagogist pauses or terminates the exercise.

5.3 Use Case 3: Mainstream Education

5.3.1 Stakeholder Interviews

Using information from the interviews and the Requirements Framework for the Mainstream Education Case:

It is difficult to identify a common structure for this use case due to the broad range in ages (4 years up to 18 years). The educational levels are also varied among similar age groups, particularly when a year group is streamed. Other characteristics of the cohort are also complex in that some groups contain children with special educational needs, sensory and physical impairments, and non-native language speakers.

Interviews were conducted with teachers of primary and secondary school who work directly with learners with in mainstream classes, subjects taught are various, from maths to geography, from coding to compulsory basic education. The interviews cover teachers of a wide range of age groups from 4-18 years.

A part of the interview was about the use of the technology and how it is perceived by students and teachers. Technology has been described as a desirable and useful tool, which holds the student's attention. The majority of these mainstream classes have not experienced robots in the classroom, but are familiar with mobile technologies. Interactive White Boards are frequently used, but mainly to display slides, videos and images.

Most teachers interviewed agreed that technology is useful for all students in Mainstream Education, because it can engage them in different topics: from the understanding of theoretical concepts to the practice of daily or basic skills.

The topics in which the technology could help more according to the interviewees are: communication and social interaction, emotional management (emotions recognition in oneself and in others), enhance short term attention span or the concepts like numbers or geometry.

Some of the interviewees answered questions about the possible pros and cons of the system. Their main concern is that the system could represent an additional workload and the majority of them expressed the need for a specific training on the use of the platform, and the need for a dedicated helpline.

Five partners from three different countries (UK, Italy and Spain) have been involved in the interviews for Mainstream cases: Nottingham Trent University (NTU), Polo Europeo della Conoscenza (PE), Fondazione Mondo Digitale (FMD), Equipo de Atención a Alumnos con Transtorno de Conducta. Consejería de Educación – Junta de Castilla y León (JCYL), and Imotec.

5.3.1.1 **UK**

5.3.1.1.1 Bluecoat Academy (NTU)

Years 7-13 (Ages 11-18)

Most groups have a range of SEND learners such as physical impairment, learning delays, emotional behaviour difficulties, autism, dyspraxia, visual impairment. Two members of teaching staff interviewed. Main subject taught Computing.

5.3.1.1.2 The Nottingham Emmanuel School, C of E Academy (NTU)

Years 7-13 (Ages 11-18)

SEND students with range of SEND learners such as physical impairment, learning delays, emotional behaviour difficulties, autism, dyspraxia, visual impairment. A great deal of visual learning modelling and computational concepts. One computing teacher interviewed.

5.3.1.2 **Italy**

5.3.1.2.1 Istituto Comprensivo Lorenzi (PE)

1 teacher (10-14 y/o students)

Istituto comprensivo Lorenzi includes about 1000 students from 3 to 14 years old. It is a public school network consisting of 10 different schools in a mountain area around Verona.

There are about 20 students with a Learning Disability at various levels (Cerebral Palsy, Downs Syndrome, Autistic Spectrum) and about twenty special need teachers to support them.

5.3.1.2.2 Istituto Comprensivo Don Milani (PE)

1 teacher (10-14 y/o students)

See 5.2.1.2.2 for details of this school

5.3.1.2.3 Istituto Comprensivo Da Vinci (PE)

2 teachers (5-10 y/o pupils)

See Istituto Comprensivo Da Vinci (PE) 5.2.1.2.3 for details of this school

5.3.1.2.4 IC Rita Levi Montalcini School (FMD)

2 teachers (8-9 y/o students)

It is a primary and secondary first grade public school (students aged 3 to 14 years) known for the training of teachers linked to new technologies and initiatives related to innovative teaching. It counts on a professionally prepared staff, in particular regarding the education of students with special needs. The class of approximately twenty-one students selected to take part in the pilot enrols students aged 8/9 including 3 ASD. The school is equipped with IWB, PC and 6 tablets.

5.3.1.2.5 IC Via Pasquale Stabilini (FMD)

2 teachers (8-9 y/o students)

It is a primary and secondary first grade public school enrolling aged 3 to 14 years old. The school is well known for applying a student-centred pedagogical approach. It has been one of the first schools in Rome to introduce educational robotics within the curriculum. The class of approximately twenty students selected for the pilot enrols 3 students with ASD. The class is equipped with PCs and an interactive whiteboard available for use in the project.

5.3.1.2.6 ITC V. Arangio Ruiz School (FMD)

2 teachers (16-22 y/o students)

It is a commercial technical secondary second grade school (students aged 15-18 years) based in Rome. Electronics and informatics are part of the school curriculum and the school has access to the related equipped laboratories. One class has been selected to participate in the project, composed of twenty-two students aged 15 to 16 years. Among them, one student 16 years old reports Asperger Syndrome, and two students 18 and 22 years old have multiple learning disabilities. The class is equipped with interactive whiteboard, PCs, 5 tablets, and 1 iPad.

5.3.1.3 **Spain**

5.3.1.3.1 CEIP Joaquín Díaz (JCYL)

4 teachers (3-12 y/o students)

It is an infant and primary school based in La Cisterniga (Valladolid). Every classroom has IWBs available during pilots, they also count with 3 tablet and PCs. Among the students, there are pupils with ASD, cerebral palsy and/or visual impairments.

5.3.1.3.2 CEIP Miguel de Cervantes (JCYL)

3 teachers (4-5 y/o students and 10 y/o students)

It is an infant and primary school based in Valladolid. Every classroom has IWB and PC available during pilots. Teachers have been trained in the educational use of IWBs and tablets. Among the students, there are pupils with physical disability and others with learning difficulties.

5.3.1.3.3 Centro de Educación Infantil y Primaria "Gonzalo de Berceo" (JCYL)

This is a medium size infant and primary school enrolling students from 3 to 12 years old, there are nearly 400 students and 32 teachers. Classroom have IWB, PC and 3 tablets available during pilots. Teachers received training on smart boards, tablets and computers educative use, management of ICT resources. Among students, there are pupils with intellectual disabilities and others with learning difficulties.

5.3.1.4 **Lithuania**

One teacher was interviewed from each of the following 3 schools:

5.3.1.4.1 Lyceum of Engineering of Kaunas University of Technology (Imotec)

Informatics teacher, who is teaches grades 4 - 8 and III (grade 11) - V (grade 12) high school classes. It is a specialized (engineering education) school, where the majority of pupils do not have special educational needs.

5.3.1.4.2 Lithuanian Health Sciences University Gymnasium (Imotec)

Informatics teacher who currently teaches information technology (ICT) in grades 5-12 (students' age: 10-18 years, boys and girls, ~ 280 students); there are no students with special education needs.

5.3.1.4.3 Vilnius Engineering Lyceum (Imotec)

Teacher of informatics, engineering and physics. 6-7th grade and 11-12th grade (17-18 years). Lego EV3 - from primary classes 1-2nd grade up to 8th grade, sometimes also 11-12th grade (programming directly with Robot C programming language). Arduino programming in 7th grade.
There are no students with defined special needs.

5.3.2 Report on Requirements Framework

5.3.2.1 **User Group Characteristics:**

The age range of the users is from 8 to 22 years old, balanced in gender. All the final users can understand their national language (English, Spanish, Italian and Lithuanian). Some capacity for foreign language learning would be useful, and some students in mainstream classes do not have verbal language and use pictographic languages. Since the educational systems are different in each country and each country applies different regulations related to the inclusion of students with special needs in the mainstream curriculum, it is not possible to identify a common educational level. Generally, the system must be adaptable to different levels of abilities and provide learning activities personalised based on the different impairments of the students taking in consideration the principles of inclusive education.

The system should facilitate teaching and learning personalisation taking in consideration the broad range of abilities present in mainstream education, some students have cognitive impairments

requiring attention stimulation, repetition and break down of tasks and related indications, multisensory approach and positive reinforcements, whereas others will require entertainment, stimulation and challenge in order to maintain engagement. Sensors must be able to gather data from users with limited verbal communication and hyperactive behaviour in the context of a class.

The system should be simple and easy to use, reliable and quick to set up. Most of the teachers are not confident using technologies for teaching, thus training must be provided in order to support them introducing the system within their classes. In order for the system to be considered useful and applicable in the context of education, it must not require additional workload, it must be applicable in the inclusive and cooperative learning class.

5.3.2.2 Technical Environment

It is essential to equip the schools based on the system technical requirements, considering schools' limitations such as firewall security for the download, obsolete technical equipment, limited internet connectivity. The system should be user friendly, technical training and assistance should be provided. Centralised management and access with restricted profiles are needed in accordance with ethical issues. Sensors should be of sufficient fidelity to be able to collect information from students who may not be able to maintain gaze or gesture consistently. The system should be able to gather information from different users working collaboratively on the same device.

5.3.2.3 Physical Environment

System should be usable in a noisy classroom environment, considering both output (e.g., sufficient volume control on mobile devices) and input (e.g., for audio sentiment analysis).

5.3.2.4 Social and Organisational Environment

The teachers need adequate technical training and assistance, as well as some rehearsal and practice sessions in order to be able to use the system in an educational context. They require a system that can be used in a cooperative learning environment, which means that the same PA should be used at the same time by different users.

The system must ensure data protection: individual students data needs to be stored securely and parents, teachers, students should have different access rights and must have been informed of the data collection providing their consent.

Tables of the requirements can be found in Annex 2 – User Requirements, Section 12.2.

5.3.3 Learning goals, Smart Learning Atoms and Learning Atoms

Examples of Learning Goals, SLAs and Learning Actions		
Learning goal	**SLA (n)**	**Learning action (v)**
Age <8 (Infant school and 1st & 2nd grade)		
Mathematical competences: numbering	Subitizing & counting	Count and identify small amounts of objects
	Number-amount association	Make relations with numbers and a set of objects
	Discrimination of greater than/less than	Put numbers in order (ascending/descending)
		Identify the largest / smallest number between two numbers.
Age 8		
Motor Skills	Motor sequencing	Repeat/imitate a sequence

		Spatial coordination	Fit shapes together (jigsaw)
			Build a model from a plan
		Motor coordination	Dance (arm and leg coordination)
			Use body language to communicate
		Coordination of different motor schemes	Repeat a sequence
		Combination of different motor schemes	Use body language to communicate
Cognitive skills	**Primary level math** *(secondary learning goal)*	Addition	Counting on
			Start with the largest (commutative property)
			Number bonds
			One, two or more
			Adding zero
			Using doubles
			Near doubles
			Five and ten
			Making ten
			Addition notation
			Column addition (carrying)
		Subtraction	TBD
		Multiplication	TBD
		Division	TBD
		Attention span preservation in math	Maintain attention to the mathematical problem (in case the problem is read by the device or by the teacher)
			Perform active listening
		Number-value cognition	Name every object once and only once with one unique tag
			Count from 1 to 10
			Point to an object while saying the (cardinal) number
			Count the number of objects and indicate the cardinal value of that display.
		Mathematical Composition/Decomposition	Discern actions (join, remove… objects)
			Keep separate items which have been already counted from those remaining to be counted
		Problem solving	Solve problems of semantic structure of “change” with (virtual) objects (addition).
			Solve mathematical problems with semantic structure of “change” (addition in our case but we could choose a subtraction problem too): e.g. John has 5 marbles and buys 3

			marbles. How many marbles has he now?
	Primary level language *(secondary learning goal)*	Basic literacy	Read out loud
			Write simple descriptive text
			Write simple text related to daily activities (diary)
		Reading comprehension	Read a text
			Demonstrate understanding of the text
			Summarise the text
		Basic vocabulary	Identify synonyms
			Identify categories
Communication/Socialisation Skills		Social perspective taking	Engage in a dialogue
		Emotional awareness	Identify emotional facial expressions
			Demonstrate understanding of different emotions
			Respond appropriately to different emotions
Age 16			
Motor skills		Coordination of different motor schemes	Repeat a sequence
		Combination of different motor schemes	Repeat a sequence
Cognitive skills		Reading comprehension	Read a text
			Demonstrate understanding of the text
			Summarise the text
		Concepts elaboration (improvement)	Develop contents using different sources
Communication/Socialisation Skills		Social perspective taking	Engage in a dialogue
Literacy (improvement)		Improve vocabulary	Investigate actions
Social skills (improvement)		Social conversation	Engage in a dialogue
Programming skills (improvement)		Computational thinking	Create sequences of robot actions
			Play programming skills game
		Programming	Create sequences of robot actions
			Play programming skills game
		Algorithms	Create sequences of robot actions
			Play programming skills game
		Sequencing	Sort cards into logical order
			Create sequences of robot actions

	Simple flow control	Develop a simple flowchart
	Flow control	Develop a mimic flowchart

Table 6: Learning goals, SLAs and LAs (ME)

5.3.4 Worked Example

Sam is an 11-year-old boy who is in his first year at secondary school (year 7), having been to a mainstream primary school since he was 4. Sam has a high level of cognitive ability and has always been in the top 5% of his class. Sam needs to be challenged in class otherwise he can become bored, disengaged with learning and has the potential to be disruptive. Sam needs to be set high expectations. He is used to working on his own and needs to be encouraged to work collaboratively.

Sam has used a range of technology in his primary school: tablets, PCs, IWBs and Interactive TV. He has created games in primary school using Scratch and is used to online quizzes for tests of knowledge development and for homework. He is confident in using 2 programming languages, but needs to take these to higher levels in his secondary school computing lessons. He uses the school's Virtual Learning Environment for in class and out of class work and will use email to ask his teachers for help when needed.

The key challenge for Sam is to encourage him to develop his work to higher levels. He responds well to high expectations, and can become disruptive if not sufficiently challenged in the level of tasks set.

Sam dislikes working with children he considers are working at a lower level. He has no patience with helping others to achieve. He enjoys having clearly defined tasks that enable him to problem-solve and work on his own. He particularly responds well to case study type activities. He is much happier working on his own.

5.3.4.1 Stakeholders

- Primary Actor - Teacher
- Actor – Sam (student)
- Other actors –Headmaster, Parents

5.3.4.2 Learning Experience Examples

Sam is working on developing his computing skills, knowledge and understanding. Computing is a National Curriculum subject in the UK. The subject is taught from pre-school through to post-16. Sam has therefore had some experience of computing in primary school, however as this is a new subject in the UK, being introduced in September 2014 as an optional subject, then from September 2015 as a compulsory subject, his experience is limited. He is starting a module that will introduce him to Flowol a computer control software that he has not used before.

Sam needs to be able to:

- Order cards into correct sequence for zebra crossing
- Develop a control flowchart solution for a simple problem
- Identify control flowchart symbols and understand how they are used to break down problems

5.3.4.2.1 Example 1: Sequencing (sorting)

Order cards into correct sequence for zebra crossing

- PA: PC
- Learning goal: Programming skills (improvement)
- SLA: Sequencing (sorting)

- LA: Sort cards into logical order

See Annex 3 – MaTHiSiS Learning Experience Examples, Section 13.3 for Learning Experience outline.

Learning Experience Flow

1. Teacher sets up the system (target number of cards in random order to sort out the correct order of a zebra crossing) and starts the LA "Sort cards into logical order" exercise.
2. Cards appear on the screen in random order.
3. Student is instructed to drag and drop cards into correct sequence.
4. Student moves cards into correct order.
5. Student receives congratulations message on PC.

Termination outcome: cards are presented in correct sequence by Sam.

Alternative Flow 4A

4A1. Sam is not able to sequence the cards correctly.
4A2. PC gives him a prompt.
4A3. Go to 3.

Alternative Flow 4B

4B1. Sam does not respond.
4B2. Go to 3 (The PC repeats the instruction).

Alternative Flow 4C

4C1. Sam does not respond X times
4C2. The system informs the teacher.
4C3. The teacher pauses or terminates the exercise.

5.3.4.2.2 Example 2: Simple flow control

Develop a control flowchart solution for a simple problem

- PA: PC
- Learning goal: Programming skills (improvement)
- SLA: Flow control
- LA: Develop a simple flowchart

See Annex 3 – MaTHiSiS Learning Experience Examples, Section 13.3 for Learning Experience outline.

Learning Experience Flow

1. The teacher sets up the system and starts the LA "Develop a simple flowchart" exercise.
2. A video of a zebra crossing is displayed on the PC screen.
3. Different symbols for a simple flow chart appear on the screen.
4. Sam is instructed to drag the symbols into the correct order for a zebra crossing.
5. Sam orders the symbols correctly.
6. A video explains how to add a start symbol and link it to an output symbol with an arrow to turn lights on and off.
7. Sam drags an output symbol into the correct place in the flow chart and adds an arrow to turn lights on and off.
8. The PC displays the sequence using Sam's flow chart.

Termination outcome: Sam has set up the correct sequence.

Alternative flow 5A

5A1. Sam does not put the symbols into the correct order.
5A2. Go to 5.

Alternative flow 7A

7A1. Sam drags an incorrect symbol so the lights will not turn on and off.
7A2. Go to 6.

5.3.4.2.3 Example 3: Flow control

Identify control flowchart symbols and understand how they are used to break down problems

- Learning goal: Programming skills (improvement)
- SLA: Flow control
- LA: Develop a mimic flowchart

See Annex 3 – MaTHiSiS Learning Experience Examples, Section 13.3 for Learning Experience outline.

Learning Experience Flow

1. The teacher sets up the system.
2. The PC displays flow chart symbols and explains what each symbol is for.
3. Sam watches a video clip, displayed on the screen, showing a Zebra crossing mimic: http://www.flowol.com/Secondary3DMimicPack1.aspx
4. Sam creates a flow chart to mimic the Zebra crossing.

Termination outcome: Sam runs his flow chart to ensure it mimics the Zebra crossing.

Alternative flow 4A

4A1. Sam creates an incorrect flow chart.
4A2. A message appears on the screen 'Try again'.
4A3. Go to 4.

Alternative flow 4B

4B1. Sam uses the wrong symbols for his flow chart.
4B2. The PC displays flow chart symbols and explains what each symbol is for (Step 2).
4B3. Go to 4.

5.4 Use Case 4: Industrial Training

5.4.1 Stakeholder Interviews

Interviews were conducted with 3 different companies.

- **IDGEO**: an SME providing professional training to other industrial companies or individuals in the field of geoinformation and space data. The company will provide training that teaches use of geoinformation and space data in solving classical industrial problems and developing services. The interviewed team is composed of 4 trainers, all skilled geoinformation analysts.
- **Company A** (has been anonymized as it later declined to participate in the project) is a large industrial group operating in the aerospace sector. The interviewed person was in charge of training in the department dedicated to client support and services.
- **Company B** (has been anonymized as it later declined to participate in the project) is a large industrial group operating in the aerospace sector. The interviewed person was in charge of the training policy of one industrial site as a whole.

A more thorough methodology has been used with IDGEO, which will run the tests of the solution during the Industrial Training pilot. In total 6 persons have been interviewed.

In this use case, all types of learners will be addressed, although most of them will be adults aged 18-65, industrial workers without major disabilities or learning impairments, thus mirroring the overall industrial European workforce as it stands today. However, it has been noted by interviewees that learners with disabilities such as hearing impairment or specific learning needs could be addressed at a later stage, requiring the development of specific training materials. These elements have been taken into account in the feedback provided to technical partners, although such cases will probably not be addressed in the pilot themselves, or at least not during the first stage.

Regarding the use of technology and how it is perceived by employees getting into training, trainers highlighted the importance of developing solutions based on new technologies and more specifically on adaptive learning and personalized pedagogy. They expressed the lack of such solutions and therefore the interest in a product such as the one proposed by MATHISIS. This feedback has been particularly given by IDGEO and Company A. If both expressed an interest for working with laptops, PCs, tablets, smartphones and IWBs, the interest for robots has remained more limited. IDGEO, because of the digital nature of the training it provides, declined to use robots in the first stages of the pilots, until a suitable use for such platform agents could be found. However, some possibilities have been envisioned, notably concerning Company A, regarding trainings involving more 'material actions' and physical interactions between the platform and the factory environment. For such training, the interest for robots and more precisely for TurtleBots has been perceived.

Interviewees pointed out possible pros and cons of the systems, particularly the overall complexity of the process of drafting SLAs and integrating them in the platform, as well as the reactivity and user-friendliness of the platform itself while in training. They perceived MATHISIS as a way to potentially work more efficiently once the pedagogical content developed and adapted to the platform, although they also feared this would constitute a burden at the early stage of "training conception". They expressed the need to be assisted in the adaption of contents and in the handling of the platform itself. The main interest points highlighted during the interviews were the following:

- The possibility to conduct distance training or remote training sessions
- The possibility to add up some modules to be completed independently by the learner out of the training session
- The possibility to increase interest and individualization of such training and therefore to build a competitive advantage for the company using them.

5.4.2 Report on Requirements Framework

Collecting user requirements has allowed identifying a group of target learners as adults aged 18-65 working in the industrial sector and more generally participating in the European workforce. Most of them will be non-diagnosed adults. One of the main aspects emphasized by interviewees here was the importance of providing new training solutions, using IT to bring added-value to existing training methods without replacing trainers and without necessitating too much of an additional effort for them, so that training is in turn more interactive, more attractive and more efficient.

Regarding the technical aspect of the user requirements, the interviewees showed interest in working with their own content, which has already been partly developed and digitalized, and therefore asked for the platform to be able to reuse content in existing formats (.ppt, .pdf, .mp4, etc.). Compatibility of the platform with a large variety of brands of platform agents and with already established LMS has also been identified as a key advantage to be taken into consideration.

The physical environment in which the pilot will be organized at IDGEO will rather be a classical one: 'in-class' training paired up with 'remote training sessions' and 'out of training session modules'. No major difficulties should be expected in that regard. However, it has been stressed by other interviewees, including Company A, that the platform could be used in a more 'factory-like' environment in which some constraints would have to be integrated at the technical level (changing levels of noise and luminosity, equipment and notably safety equipment of learners, etc.).

Finally, regarding the logistics of the pilot, interviewees stressed the importance of being assisted by technical partners, with a physical presence on-site for the first pilot, as well as an online remote presence for the later stages of the pilot. The possibility to organize remote sessions and to develop pedagogical modules to be used on personal device out of the training session has also been emphasized

Tables of the requirements can be found in Annex 2 – User Requirements, Section 12.4.

5.4.3 Learning goals, Smart Learning Atoms and Learning Atoms

Examples of Learning goals, SLAs and Learning Actions		
Learning goal	**SLA**	**Learning action**
Searching geo-data sets	Understanding how the catalogue works	Follow presentation of the catalogue module (e.g. video, powerpoint presentation, narrative, etc.)
		Take catalogue understanding quiz
	Searching datasets on Terrahub	Access the web platform (login)
		Access the catalogue module
		Make a keyword-based search query on Terrahub (example: climate change)
		Refine a keyword-based search query on Terrahub (example: reduced the search to La Reunion La reunion)
		Follow presentation of information on how to use a Terrahub data set
		Read metadata from the dataset
	Searching datasets on the web	Make a keyword-based search query on the web (google)
		Visit recognized international web geodata portals
	Getting information about the data sets	Follow presentation of why metadata are so important
		Follow presentation on details about metadata (what is a metadata, European directive INSPIRE)

		Filter datasets according to certain characteristics
Data visualization and manipulation	Data visualization: spatial navigation	Zoom in/out
		Zoom to the layer
	Data visualization: displaying attributes	Get information from a feature (identify tool)
		Open the attribute table
		Navigate on the attribute table
	Layer manager manipulation	Manage the order of the layers overlay
		Identify options related to a layer
	Style manager manipulation	Modify the style of the layer
		Export style layer
		Import style layer
	Query manager manipulation	Make SQL queries
		Display features using queries
	Data edition	Modify geometry / draw new features
		Modify attributes on the table

Table 7: Learning goals, SLAs and LAs (IT)

5.4.4 Worked Example

Learners will be trained to use TerraHub, a tool aiming at collecting, processing and using space and geomatic data. The objective of the training is for learners to be able to use such a platform independently in order to develop services and products using space and geomatic data.

Each training session will take place in a specific room, in a venue to be determined and that may vary from pilot to pilot. It is anticipated to have 7-10 leaners per session, possibly more in the latest phases of the pilot. Each learner will be given a PC with a webcam. The room should also be equipped with a video-projector in order to display some common materials to all learners. Learning materials for this training will mainly consist in demonstrations (in the form of videos) and exercises (in the form of games and quizzes).

In this document, only the first steps of the training will be presented, the training being developed and tested parallel to the completion of this deliverable.

Person A is a male, aged 25, working as a Computer Science Engineer for an IT firm, and has been charged by his hierarchy to develop a mobile application using space data and geomatics aiming at helping agricultural professionals to manage the watering process of their crops. Person A has a significant experience with IT tools but has never been previously exposed to space data and geomatics.

5.4.4.1 **Stakeholders**

- Primary Actor: trainer responsible for the training session
- Actor: Person A
- Other actors: None

5.4.4.2 **Learning Experience Example**

5.4.4.2.1 Example: Training Quiz

- PA: PC
- Learning goal: Searching geo-data sets
- SLA: Understanding how the catalogue works
- LA: Follow presentation of the catalogue module
- LA: Take catalogue understanding quiz

See Annex 3 – MaTHiSiS Learning Experience Examples, Section 13.4.1 for Learning Experience outline.

Learning Experience Flow

1. The trainer sets up the system and assigns the learning goal "Searching geo-data sets"
2. If needed, the LA "Follow presentation of the catalogue module" presents information in the form of a short video
3. The platform starts the LA "Take catalogue understanding quiz" and displays the first question of the quiz
4. The platform waits for the learner's reply
5. The learner replies correctly
6. The platform goes to the following question
7. Repeat from 4.

Alternative Flow 5A

5A. The learner does not answer correctly
5B. The platform will display a demonstration in the form of a video;
5C. Repeat from 4.

5.5 Use Case 5: Career Guidance

5.5.1 Stakeholder Interviews

Two interviews with prompts were delivered by the stakeholders of the MaTHiSiS project, more specifically the Life Long Learning Centers (KDVMs), Hellenic American College and Techniki Ekpedeftiki S.A. Interviews were taken on 22 July and 28 July 2016. Interviewer was Mr Dimitris Gaitanis, Head of Scientific Support of Career Guidance Counsellors and Services Dpt. of EOPPEP

Interviewees in both cases were trained career guidance counsellors with professional experience in this field.

The career guidance stakeholders currently provide career guidance services to:

- University students
- University graduates
- Unemployed persons
- Employers
- Employed people
- Entrepreneurs

Some unemployed people have disabilities (mostly movement disabilities) and learning disabilities (dyslexia etc.)

Main career guidance services provided are:

- Employment counselling for (re)integration into the labour market
- Career education to understand pathways and take decisions etc.
- Preparation - liaison - networking with the labour market etc.

Concerning the part of the query about technology both career guidance stakeholders have fully equipped PC labs as they are also accredited computer training schools. OS: windows 8, Microsoft Office 10. All PCs have cameras, microphones, speakers, connection to internet etc. Special keyboards and mice for people with special needs are also available by one stakeholder. Generally speaking, clients are familiar with modern technology (PCs, tablets, smart phones, social networks and the internet). However, some older clients above 45 years old may need more training and support on this. Teaching assistant is more needed concerning the use of MaTHiSiS platform. None of the stakeholders use robots or IWBs.

Clients use also very well mobile devices (smart phones and tablets) as they are very popular.

The career guidance counsellors think technology is very useful for all disciplines/topics and for all clients and especially for unemployed people because it can help them to get informed about new opportunities and to engage more with learning and training in order to enter the labour market. They also think unemployed people over 45 years are the most challenging to teach, but simultaneously technology could help them the most because they face more difficulties to finding employment due to mismatch between their qualifications and the labour market. Technology could help a lot through:

- Networking
- Awareness of opportunities
- Training for professions using new technologies

Topics include:

- Career decision making
- Knowledge of labour market

- Information about opportunities in the labour market
- Digital marketing
- Interpretation
- Business
- IT technologies

The stakeholders think that the most important problems/barriers in using a system such as MaTHiSiS with their learners could be the difficulty in collecting affective information and the potential of the technology to disrupt the relationship between the counsellor and the client.

On the other hand, they think that MaTHiSiS could have some positive outcomes such as:

- increase engagement of clients
- enable them to be more independent in their learning
- allow counsellor to support more clients
- increase the access for people to career guidance, especially people with limited time or people living in remote areas
- multiply information given to the client
- assess progress of the client in an automatic way

However, this can be a fact only if the counsellors and their clients receive adequate training about the operation of the MaTHiSiS platform through:

- regular face to face support
- help line
- list of Frequently Asked Questions

5.5.2 Report on Requirements Framework

5.5.2.1 User Group Characteristics:

Age range of users is between 16 to 65 years old (university students to retirement years). Users include unemployed persons belonging to 3 distinct age groups (18-29, 30-45, 45 and above) (Some unemployed people have disabilities, mostly movement disabilities), Employers, Employed people, Entrepreneurs, University students, University graduates, Students with special needs (they include learning disabilities like dyslexia etc.) Users are also the Career Guidance Counsellors working at public or private career guidance services of the education-training/employment/social sector.

System must be presented in Greek. However, due to an increasing number of immigrants and refugees in Greece, English should be an alternative second language. The system should support the career needs of all different education groups e.g. the needs of university graduates who seek their self-awareness are different than unemployed professionals who lost their jobs due to the financial crisis.

People with soft cognitive impairments, who can work in simple jobs (e.g. gardening), may also need career guidance. This is often neglected in the career guidance field. These people also need specific information that can be given through MaTHiSiS: Which professions are in demand by the labour market? Where can they work? How can they be trained for these jobs? The system should be able to collect user data by analysing client answers in career guidance exercises, questionnaires etc. not only facial and skeleton motion analysis.

We must be sure that the system is easily understandable and that the interaction with the platform is as user friendly and works in an automated way. To be friendly to young people it should use games, have colourful interface etc.

In any case, appropriate training must take place for both counsellors and clients before we ask them to use the platform.

The system should take into consideration regular face-to-face contacts between counsellor and clients, as career guidance cannot be provided without human contact – human assessment. At the same time, it should also be used remotely, with a trainer being in one physical place and learners being in a different place.

In order for the users who will participate at the pilots to have strong motives, real career gains must be provided (e.g. action plan, psychometric test results, portfolio, career network, career opportunities etc.). Finally, ethical matters should be given extra care e.g. all personal data must be very well protected by the platform.

5.5.2.2 Technical Environment

The MaTHiSiS platform must be compatible with all kinds of PCs and tablets (even older models). Although we plan to hold most career guidance sessions at the PC labs of the stakeholders, which are equipped with modern technology, it could be possible that some clients may want to log in from their houses, where their PCs are not equipped with a modern OS.

5.5.2.3 Physical Environment

Audio output should be available at home and when travelling, as well as in the classroom. Audio and video should be clear. As far as user interaction, it should be possible to choose between different modes of input, not just text / keyboard (chosen by the counsellor).

5.5.2.4 Social and Organisational Environment

Assistance should include training about the operation of the MaTHiSiS platform, through regular face-to-face support, helpline, list of frequently asked questions. The system will have to be useable remotely, with the trainer being present in one physical space and the learners being in another physical space.

Tables of the requirements can be found in Annex 2 – User Requirements, Section 12.5.

5.5.3 Learning goals, Smart Learning Atoms and Learning Actions

Examples of Learning goals, SLAs and Learning Actions		
Learning goal	**SLA**	**Learning action**
E-career portfolio creation	Mother language skills	Follow a tutorial on demonstrating mother language skills in e-portfolio
		Take a mother language skills validation test in e-portfolio
		Create an example demonstrating mother language skills in e-portfolio
	Foreign language skills	Follow a tutorial on demonstrating foreign language skills in e-portfolio
		Take a foreign language skills validation test in e-portfolio
		Create an example demonstrating foreign language skills in e-portfolio
	Numeric skills	Follow a tutorial on demonstrating numeric skills in e-portfolio
		Take a numeric skills validation test in e-portfolio
		Create an example demonstrating numeric skills in e-portfolio
	Digital literacy (computer skills)	Follow a tutorial on demonstrating computer skills in e-portfolio
		Take a computer skills validation test in e-portfolio

		Create an example demonstrating computer skills in e-portfolio
	Lifelong learning skills	Follow a tutorial on demonstrating lifelong learning skills in e-portfolio
		Take a lifelong learning skills validation test in e-portfolio
		Create an example demonstrating lifelong learning in e-portfolio
	Flexibility skills	Follow a tutorial on demonstrating flexibility skills in e-portfolio
		Take a flexibility skills validation test in e-portfolio
		Create an example demonstrating flexibility skills in e-portfolio
	Communication skills	Follow a tutorial on demonstrating communication skills in e-portfolio
		Take a communication skills validation test in e-portfolio
		Create an example demonstrating communication skills in e-portfolio
	Problem-solving skills	Follow a tutorial on demonstrating problem-solving skills in e-portfolio
		Take problem-solving skills validation test in e-portfolio
		Create an example demonstrating problem-solving skills in e-portfolio
	Creativity skills	Follow a tutorial on demonstrating creativity skills in e-portfolio
		Take creativity skills validation test in e-portfolio
		Create an example demonstrating creativity skills in e-portfolio
	Teamwork skills	Follow a tutorial on demonstrating teamwork skills in e-portfolio
		Take teamwork skills validation test in e-portfolio
		Create an example demonstrating teamwork skills in e-portfolio
	Initiative and entrepreneurship skills	Follow a tutorial on demonstrating initiative and entrepreneurship skills in e-portfolio
		Take initiative and entrepreneurship skills validation test in e-portfolio
		Create an example demonstrating initiative and entrepreneurship skills in e-portfolio
	Professional (hard) skills	Follow a tutorial on demonstrating professional (hard) skills in e-portfolio
		Take professional (hard) skills validation test in e-portfolio
		Create an example demonstrating professional (hard) skills in e-portfolio
Draft your Europass CV	Personal details (comprehension)	Follow a tutorial on how to complete the personal details section of a Europass CV
		Take a test on completing the personal details section of a Europass CV
		Complete the personal details section of a Europass CV
	Application type (comprehension)	Follow a tutorial on how to complete the application type section of a Europass CV
		Take a test on completing the application type section of a Europass CV
		Complete the application type section of a Europass CV
	Educational history (comprehension)	Follow a tutorial on how to complete the educational history section of a Europass CV
		Take a test on completing the educational history section of a Europass CV
		Complete the educational history section of a Europass CV
	Professional experience (comprehension)	Follow a tutorial on how to complete the professional experience section of a Europass CV
		Take a test on completing the professional experience section of a Europass CV
		Complete the professional experience section of a Europass CV
	Personal skills (comprehension)	Follow a tutorial on how to complete the personal skills section of a Europass CV

		Take a test on completing the personal skills section of a Europass CV
		Complete the personal skills section of a Europass CV
Present yourself well at an interview	Types of interviews (understanding)	Follow a tutorial on the various types of interviews
		Take a test on the various types of interviews
	Interview target (job position, education program etc.) preparation	Follow a tutorial on preparing for a type of interview (job position, education program etc.)
		Take a test on the preparing for a type of the interview (job position, education program etc.) quiz
	Answering interview questions preparation (comprehension)	Follow a tutorial on preparing for interview questions
		Take a test on preparing for interview questions
		Play a role-play simulation on answering interview questions
	Asking questions in an interview preparation (comprehension)	Follow a tutorial on preparing to ask questions in an interview
		Take a test on preparing to ask questions in an interview
		Play a role-play simulation on asking questions in an interview
	Body language (awareness)	Follow a tutorial on using the right body language
		Take a test on using the right body language
		Play a role-play simulation about using the right body language in an interview

Table 8: Learning goals, SLAs and LAs (CGDL)

5.5.4 Worked Example

John needs to enter the labour market. To select a professional sector and find an available job position that is suitable per his characteristics he must know how to prepare for the labour market, to have self-awareness and to manage his career

5.5.4.1 Stakeholders

- Primary Actor – Counsellor that works with John
- Actor – John, unemployed person 30 years' old
- Other actors – Employers, Vocational Trainers

5.5.4.2 Learning Experience: Learning goal – Create an e-career portfolio

Given the practical nature of the Career Guidance learning, a common design approach has been used to define the details of SLAs and Learning Actions for all learning goals of this UC promoting active learning. Thus, the description of the learning experience flow for each SLA of this learning goal will be very similar and so the following section presents one illustrative worked example of the learning experience flow for the first SLA "Mother language skills validation" included in the Table 8.

5.5.4.2.1 Example 1 Mother language skills validation

- PA: PC/Tablet/Smartphone
- Learning goal: Create an e-career portfolio
- SLA: Mother language skills validation
- LA: Follow a tutorial about proving mother language skills in e-portfolio
- LA: Take a mother language skills validation test in e-portfolio
- LA: Create an example of mother language skills for your e-portfolio

See Annex 3 – MaTHiSiS Learning Experience Examples, Learning goal: Create an e-career portfolio.

Learning Experience Flow

1. The counsellor sets up the system and assigns to John the learning goal "Create an e-career portfolio"
2. The PA asks John "Do you know how to prove your mother language skills?"

3. John answers “No” or “Not sure” or “I have some ideas but would like to be more sure”
4. The PA shows to John a tutorial about proving mother language skills in e-portfolio
5. John follows the tutorial or pauses it half way through
6. PA asks John to take a quiz to assess whether he can prove his mother language skills in e-portfolio
7. John starts the multiple-choice questionnaire and selects the correct answer from the list of possible answers
8. PA asks John to create an example of his mother language skills for his e-portfolio
9. John correctly creates his mother language skills information.

Termination outcome: John is more confident about how to prove his mother language skills in e-portfolio.

Alternative Flow 3A

3A1. John answers yes
3A2. Proceed with 6

Alternative Flow 7A

7A1. John does not select the correct answer or does not select any answer at all
7A2. John is transferred to another query containing only 2 possible answers, right and wrong
7A3. John selects the correct answer
7A4 Proceed with 8.

Alternative Flow 7B

7B1 John does not select the correct answer
7B2. Counsellor calls John at a counselling interview to give him personal advice

Alternative Flow 9A

9A1. John does not create a correct example of language skills for his e-portfolio
9A2. Counsellor calls John at a counselling interview to give him personal advice

5.5.4.3 Learning Experience: Learning goal Draft your Europass CV

As a common design approach has been used to define the details of SLAs and Learning Actions for all learning goals of this UC promoting active learning. The description of the learning experience flow for each of SLA of this learning goal will be very similar and that is why the following section presents one illustrative worked example of the learning experience flow for the SLA “Filling in personal details category” (comprehension) which is included in the Table 8.

5.5.4.3.1 Example 1 Filling in personal details category (comprehension)

- PA: PC/Tablet/Smartphone
- Learning goal: Draft your Europass CV
- SLA: Filling in personal details category (comprehension)
- LA: Follow a tutorial about how to complete the personal details category in your Europass CV
- LA: Take a test on completing the personal details category in your Europass CV
- LA: Complete the personal details category in your Europass CV

See Annex 3 – MaTHiSiS Learning Experience Examples, Learning goal: Draft your Europass CV

Learning Experience Flow

1. The counsellor sets up the system and assigns to John the learning goal “Draft your Europass CV”
2. The PA asks John “Do you know how to complete the personal details category?”
3. John answers “No” or “Not sure” or “I have some ideas but would like to be more sure”

4. The PA shows to John a video tutorial about how to complete the personal details category in the Europass CV
5. John watches the video or pauses the video half way through
6. PA asks John to complete a questionnaire to assess whether he is capable of completing the personal details category in the Europass CV
7. John starts the multiple-choice questionnaire and selects the correct answer from the list of possible answers
8. PA asks John to complete the personal details category in the Europass CV
9. John correctly creates required information.

Termination outcome: John is more confident about completing the personal details category the Europass CV

Alternative Flow 3A

3A1. John answers yes
3A2. Proceed with 6

Alternative Flow 7A

7A1. John does not select the correct answer or does not select any answer at all
7A2. John is transferred to another query containing only 2 possible answers, right and wrong
7A3. John selects the correct answer
7A4 Proceed with 8.
7A5 John does not select the correct answer
7A6. Counsellor calls John at a counselling interview to give him personal advice

Alternative Flow 9A

9A1 John does not create correct information for his personal details category in Europass CV
9A2. Counsellor calls John at a counselling interview to give him personal advice

5.5.4.4 Learning Experience: Learning goal – Present yourself well at an interview

As a common design approach has been used to define the details of SLAs and Learning Actions for all learning goals of this UC promoting active learning. The description of the learning experience flow for each of SLA of this learning goal will be very similar. In this particular case, next section presents two illustrative worked example of the learning experience flow for SLAs: one for passive learning as the SLA "Types of interviews (understanding)" and the other for an active learning like "Body language (awareness)" as included in the Table 8.

5.5.4.4.1 Example 1 Types of interviews (understanding)

- PA: PC/Tablet/Smartphone
- Learning goal: Present yourself well at an interview
- SLA: Types of interviews (understanding)
- LA: Follow a tutorial about the various types of interviews
- LA: Take a test on the various types of interviews

See Annex 3 – MaTHiSiS Learning Experience Examples, Learning goal: Present yourself well at an interview

Learning Experience Flow

1. The counsellor sets up the system and assigns to John the learning goal "Present yourself well at an interview"
2. The PA asks John "Do you know about the various types of interviews?"
3. John answers "No" or "Not sure" or "I have some ideas but would like to be more sure"
4. The PA shows to John a video tutorial about the various types of interviews
5. John watches the video or pauses the video half way through

6. PA asks John to complete a questionnaire to assess whether he knows about the various types of interviews
7. John starts the multiple-choice questionnaire and selects the correct answer from the list of possible answers

Termination outcome: John knows about the various types of interviews

Alternative Flow 3A

3A1. John answers yes
3A2. Proceed with 6

Alternative Flow 7A

7A1. John does not select the correct answer or does not select any answer at all
7A2. John is transferred to another query containing only 2 possible answers, right and wrong
7A3. John selects the correct answer
7A4 Termination outcome: John knows about the various types of interviews
7A5 John does not select the correct answer
7A6. Counsellor calls John at a counselling interview to give him personal advice.

5.5.4.4.2 Example 2 Body language (awareness)

- PA: PC/Tablet/Smartphone
- Learning goal: Present yourself right at an interview
- SLA: Body language (awareness)
- LA: Follow a tutorial about using the right body language
- LA: Take a test on right and wrong body language
- LA: Play a role-play simulation about using the right body language in an interview

Learning Experience Flow

1. The counsellor sets up the system and assigns to John the learning goal “Present yourself right at an interview”
2. The PA asks John “Are you aware about how to use the right body language?”
3. John answers “No” or “Not sure” or “I have some ideas but would like to be more sure”
4. The PA shows to John a video tutorial about using the right body language
5. John watches the video or Pauses the video in the half of its play time
6. PA asks from John to complete a questionnaire to assess whether learner knows how to use the right body language
7. John first starts the multiple-choice questionnaire and he selects the correct answer from the list of multiple answers
8. PA asks John to play a role-play simulation to practice the correct use of body language in an interview
9. John successfully passes all play challenges practicing his body language.

Termination outcome: John is more confident using the right body language

Alternative Flow 3A

3A1 John answers yes
3A2. Proceed with 6

Alternative Flow 7A

7A1. John does not select the correct answer or does not select any answer at all
7A2. John is transferred to another query containing only 2 possible answers, right and wrong
7A3. John selects the correct answer
7A4 Proceed with 8.
7A5 John does not select the correct answer

7A6. Counsellor calls John at a counselling interview to give him personal advice

Alternative Flow 9A

9A1. John does not use proper body language in the role-play simulation
9A2. Counsellor calls John at a counselling interview to give him personal advice

6. User Stories Generated from Requirements

The user requirements summarised from interviews in Annex 2 – User Requirements have been analysed to extract user stories, which will go forward to the testing and integration framework described in D7.1. These user stories are presented here.

6.1 Learning Content Editor

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
LCE16	As a teacher, I want to configure degrees of complexity in order to test different levels of cognitive ability.	M	Learning Content Editor	PMLD
LCE17	As a teacher, I want to be able to configure very small incremental learning steps in order to suit the individual learners learning abilities.	M	Learning Content Editor	PMLD
LCE18	As a teacher, I want to be able to provide an activity linked to the daily experience in order to understand the concepts being presented.	M	Learning Content Editor // Learning Experience Supervisor // Experiencing Service	PMLD
LCE19	As a teacher, I want to be able to customise the response time for vocal input in order to suit the individual learners vocal ability and limitations in communication through speech.	M	Learning Content Editor // Learning Experience Supervisor // Experiencing Service	PMLD
LCE20	As a teacher, I want to have a system that can present information to students with hearing limitations in order to not exclude those with limitation in hearing.	M	Learning Content Editor // PA // Experiencing Service	PMLD
LCE21	As a teacher, I want to have a system that vocalises instructions in order to not exclude those with limited vocabulary and reading ability.	M	Learning Content Editor // PA // Experiencing Service // Learner Profile Repository	PMLD
LCE22	As a teacher, I want to have a system that keeps the students motivated even if they go back a step in order to not exclude those where investment in time and repetition is needed i.e. memory difficulties.	S	Learning Content Editor // PA // Experiencing Service // Learner Profile Repository	PMLD
LCE23	As a teacher, I want to be able to have a system that incorporates multi-sensory engagement in order to facilitate those who have a tendency to repeat when stimulated.	C	Learning Content Editor // PA // Experiencing Service // Learner Profile Repository	PMLD
LCE24	As a teacher, I want to have a system that can be implemented alongside current teaching practice in order to facilitate a student using MaTHiSiS that may distract others or because of other lessons or content that may have to be run concurrently.	M	Learning Content Editor // PA // Experiencing Service	PMLD
LCE25	As a teacher, I want to be able to segment an activity into simple phases in order to suit the individual learners learning attention period(s).	M	Learning Content Editor // Learning Experience Supervisor // Learners Profile Repository	PMLD

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
LCE26	As a teacher, I want to have learning actions developed considering the class level in order to cater for the curriculum being different depending on the level of the students.	M	Learning Content Editor // Learning Graph Repository // Experience Engine	ME
LCE27	As a teacher, I want to have learning actions developed considering the content of the curriculum in order to cater for the curriculum being different depending on age of the students.	M	Learning Content Editor // Learning Graph Repository // Experience Engine	ME
LCE28	As a teacher, I want to have a system that accounts for regression in skills in order to facilitate learning for those where help of an assistant is needed.	S	Learning Content Editor	PMLD

Table 9: Learning content editor

6.2 Learning Experience Supervisor

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
LES19	As a teacher, I want to track user progress over long periods of time in order to have enough activity recorded to register progress.	S	Learning Experience Supervisor // Learning Analytics	PMLD
LES20	As a teacher, I want to be able to control the playback and progression of an activity in order to suit the individual learners learning abilities and physical capabilities.	M	Learning Experience Supervisor // Learners Profile Repository // Experiencing Service // Learning Materials Controller	PMLD
LES21	As a teacher, I want to be able to provide aid to a student during the activity in order to suit the individual learner's cognitive and physical abilities.	M	PA // Learning Experience Supervisor // Experiencing Service	PMLD
LES22	As a teacher, I want to be able to repeat an activity in order to suit the individual learner's memory capability.	M	Learning Experience Supervisor // Learners Profile Repository // Experiencing Service	PMLD
LES23	As a teacher, I want to be able to override the task completion status for an activity in order to suit the individual learner's physical and vocal ability where the system cannot detect input.	M	Learning Experience Supervisor // Learners Profile Repository	PMLD
LES24	As a teacher, I want to have a system that can replicate activities in different contexts or with different PAs in order to not generalise skills.	M	Learning Experience Supervisor	PMLD
LES25	As a teacher, I want to be able to have a system that provides the possibility of an external intervention during the use in order to facilitate learning for those where help of an assistant needed.	M	Learning Experience Supervisor // Learners Profile Repository	PMLD

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
LES26	As a teacher, I want to be able to have a system that allows more than one user per student with different levels of permissions in order to enable a learner's parents to collaborate but not modify the educational goals.	M	Learning Experience Supervisor // Learners Profile Repository	PMLD
LES27	As a teacher, I want to be able to monitor the sessions of use (when, where, progress) in order to allow me to conduct performance monitoring.	C	Learning Experiencing Supervisor // Learners Profile Repository // Experience Service // Learning Analytics	PMLD
LES28	As a teacher, I want to be able to monitor the sessions of use (when, where, progress) and the feedback of different students learning path in order to ensure that the system provides the support for teaching and learning.	M	Learning Experience Supervisor // Experiencing Service	ASD
LES29	As a teacher, I want to be able to work in a class setting with many students working on their own in order to enable the customisation of lessons respective of the learners needs.	S	Learning Experience Supervisor // DSS // Adaptation and Personalization	ASD
LES30	As a teacher, I want to use the PA to engage the students in order to encourage and motivate those who need it.	S	Learning Experience Supervisor // PA	ASD
LES31	As a teacher, I want to use the system in conjunction with a learner in order to enable assisted learning.	M	Learning Experience Supervisor // Experiencing Service	ME
LES32	As a teacher, I want to have a system where quick solutions can be implemented in order to ensure lesson flow is not interrupted by technical problems.	M	Learning Experience Supervisor // Experiencing Service	ME
LES33	As a teacher, I want to have easy system management in order to be able to understand and apply the system in an educational context.	M	Learning Experience Supervisor // Learning Content Editor	ME
LES34	As a teacher, I want to set up the lesson quick and easy in order to cater for the time restrictions teachers face between set lessons.	M	Learning Experience Supervisor	ME
LES35	As a teacher, I want to be able to collect user data such as client answers in career guidance exercises, questionnaires etc. in order to amplify evaluation information since sensory information alone cannot be the only source of evaluation.	M	Learning Experience Supervisor // Learners Profile Repository // User Repository	CG
LES36	As a teacher, I want to use my native language in order to comply with the teaching language.	M	Learning Experience Supervisor // Experiencing Service	ME
LES37	As a teacher, I want to be able to work in a class setting with different learning actions available for individual activities and the entire class in order to allow students to work cooperatively or one to one.	S	Learning Experience Supervisor // PA // Experiencing Service	ASD

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
LES38	As a teacher, I want to have a system that can cater for variance in class size in order to enable system use across different class compositions.	M	Experiencing Service	ME
LES39	As a learner, I want to use my native language in order to understand and interact with the materials.	M	Experiencing Service // Learning Materials Repository	ME
LES40	As an learner, I want to have an intuitive interface similar to existing IT solutions in order to avoid having to learn how to navigate the system in a new way.	M	Learning Materials Repository // PA // Experiencing Service	IT

Table 10: Learning Experience Supervisor

6.3 Learning Profile Repository

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
LPR14	As a teacher, I want to be able to have a system with an easy and quick procedure to create a learner profile in order to ensure no additional workload for teachers and educators.	M	User Manager // Learner Profile Repository	PMLD
LPR15	As a learner, I want to have a genderless design in the system in order to not feel exclusion due to my gender.	M	Learners Profile Repository	ASD
LPR16	As a teacher, I want to have a system with learning actions that considers different school curricula in order to facilitate use by student groups that vary in composition.	M	Learners Profile Repository // Learning Materials Repository // User Management	ME
LPR17	As a teacher, I want to cater for a wide educational background range in order to support university leavers through to long term unemployed.	S	Learners Profile Repository // User Management	CG
LPR18	As a teacher, I want to store and manage information about both the client and the environment (education, labour market, social environment etc.) in order to appropriately adjust the level of support.	S	Learners Profile Repository // User Repository // Learning Graph Repository	CG
LPR19	As a learner, I want to the system to avoid gender stereotypes in order not to feel exclusion due to my gender.	M	Learners Profile Repository	PMLD

Table 11: Learning Profile Repository

6.4 Platform Agent Layer

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
PA1	As a teacher, I want to use the system with more than one learner in order to enable collaboration between students.	S	PA // Experiencing Service	PMLD
PA2	As a teacher, I want to use the system in conjunction with a learner in order to enable assisted learning.	S	PA // Experiencing Service	PMLD

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
PA3	As a teacher, I want to use more than one PA for the same LA in order to allow students to use their preferred method of interaction.	S	PA // Experiencing Service	PMLD
PA4	As a teacher, I want to use more than one PA for the same LA at the same time in order to allow students to use their preferred method of interaction.		PA // Experiencing Service // DSS // Agent Collaboration	PMLD
PA5	As a learner, I want to easily access the platform from home in order to learn independently.	C	PA // Learning Experience Supervisor // Experiencing Service	PMLD
PA6	As a learner, I want to use my native language in order to understand and interact with the materials.	M	PA // Experiencing Service	PMLD
PA7	As a learner, I want to be able to use symbolic representations (AAC) in order to understand and interact with the materials.	M	PA // Experiencing Service // DSS // Adaptation and Personalization	PMLD
PA8	As a learner, I want to have the system recognise my vocal input in order not to feel exclusion due to my vocal capabilities such as pronunciation.	M	PA // Experiencing Service	PMLD
PA9	As a learner, I want to have the system recognise my voice in a noisy environment in order to learn in a classroom environment.	M	PA // Experiencing Service	PMLD
PA10	As a teacher, I want to have a system that is able to detect subtle vocal input from my students in order to not exclude those with limited speech abilities, unclear pronunciation, limited natural speech.	M	PA // Experiencing Service	PMLD
PA11	As a teacher, I want to have a system that is able to detect subtle visual input from my students in order to not exclude those who are not able to sustain gaze.	M	PA // Experiencing Service	PMLD
PA12	As a learner, I want to have the system recognise input from my limited range of eye movements in order to not feel exclusion due to my physical capabilities.	M	PA // Experiencing Service	PMLD
PA13	As a teacher, I want to be able to use PA's with hand/head/neck adaptors in order to not exclude those with limited movement, lack of coordination and specific medical problems.	M	PA // Learners Profile Repository	PMLD
PA14	As a teacher, I want to be able to use PA's via the individual learners Assistive Technology in order to suit the individual learner's access and communication capabilities.	M	PA // Learners Profile Repository	PMLD
PA15	As a teacher, I want to be able to use the system and PA's via alternative input methods such as assistive switches in order to suit the individual learner's access and communication capabilities.	M	PA // Learners Profile Repository	PMLD

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
PA16	As a teacher, I want to be able to manipulate the location of PA's in order to not exclude those who have mobility restrictions such as being bedridden and or aid frame dependant.	M	PA // Learners Profile Repository	PMLD
PA17	As a teacher, I want to have a system that allows the correct answer to be given with imprecise movements in order to enable those with limited movement, lack of coordination and specific medical problems to operate the system.	S	PA // Learners Profile Repository	PMLD
PA18	As a teacher, I want to have a system compatible with standard assistive technologies in order to enable interaction for a learner if the system will not cater for learners bespoke access and communication capabilities.	M	PA // Learners Profile Repository	PMLD
PA19	As a teacher, I want to be able to have a system that works across the home/school barrier in order to enable both solitary and guided learning and enhance the time of exercise.	C	PA // Experiencing Service	PMLD
PA20	As a teacher, I want to ensure that PA's and all hardware is robust in order to cater for possible unexpected movement and accidents.	S	PA	PMLD
PA21	As a teacher, I want to ensure that PA's and all hardware should be fitted with a protective case where applicable in order to cater for possible unexpected movement and accidents.	S	PA	PMLD
PA22	As a teacher, I want to ensure that any protective screen should be easy to interact with in order to ensure that the touch screens are able to be used and not impede interaction.	M	PA	PMLD
PA23	As a teacher, I want to have sensors of sufficient fidelity to be able to collect info from students who may not be able to hold the device themselves in order to not exclude those who have multiple disabilities.	M	PA	PMLD
PA24	As a learner, I want to have platform agents that can communicate with/receive input from assistive technologies in order to enable me to access the learning materials.	M	PA	PMLD
PA25	As a teacher, I want to be able to gather information from different users on the same device in order to ensure that the same device may be used by different students.	S	PA // Experiencing Service // Learning Material Controller	PMLD
PA26	As a teacher, I want to have feedback from the sensors during the activities in order to be able to recognise the efforts of the student.	C	PA // Experiencing Service // Learning Material Controller	PMLD

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
PA27	As a teacher, I want to have a system that allows visual displays to be positioned for pupil's field of vision in order to enable use by students on beds and within restrictive frames.	M	PA	PMLD
PA28	As a learner, I want to have a system that caters for my non-orthodox posture and position in order to prevent me from becoming frustrated and demotivated if the system cannot respond appropriately to me.	M	PA	PMLD
PA29	As a learner, I want to have a system at school that can collect sufficient sentiment/pose information from me to be responsive to my performance in order to prevent me from becoming frustrated and demotivated if the system cannot respond appropriately to me.	M	PA	PMLD
PA30	As a teacher, I want to be able to use the PAs with group of students in order to ensure that I am able to use the system with a limited number of devices available.	M	PA	PMLD
PA31	As a teacher, I want to be able to use the system in a cooperative way in order to ensure that students with ASD are included in the mainstream education classes and cater for the ASD cognitive difficulties.	S	PA // Experiencing Service // DSS // Agent Collaboration	ASD
PA32	As a teacher, I want to involve the entire class according to the needs of the learners in order to ensure that students with ASD are included in the mainstream education classes and cater for the ASD cognitive difficulties.	S	PA // Experiencing Service	ASD
PA33	As a teacher, I want to be able to use platform agents with different students at the same time in order to manage the organisation of the entire class of students.	M	PA // Experiencing Service	ASD
PA34	As a learner, I want to have a system where PA's are able to attract my attention in order to cater for my attention deficit, emotional dysregulation and because I will get frustrated and demotivated if the system cannot respond appropriately to me.	M	PA // Learning Experience Supervisor // Learning Material Controller // DSS // Adaptation and Personalization	ASD
PA35	As a learner, I want to have a system where PA's are able to gather my feedback even if I move continuously in order to cater for my attention deficit, emotional dysregulation and because I will get frustrated and demotivated if the system cannot respond appropriately to me.	M	PA // Learning Experience Supervisor // Learning Material Controller // DSS // Adaptation and Personalization	ASD
PA36	As a learner, I want to have a system where PA's are able to gather my feedback even if I am not able to communicate in order to cater for my attention deficit, emotional disregulation and because I will get frustrated and demotivated if the system cannot respond appropriately to me.	M	PA // Learning Experience Supervisor // Learning Material Controller // DSS // Adaptation and Personalization	ASD

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
PA37	As a learner, I want to have a system where PA's are able to gather my feedback even if I am not able to move properly in order to cater for my attention deficit, emotional disregulation and because I will get frustrated and demotivated if the system cannot respond appropriately to me.	M	PA // Learning Experience Supervisor // Learning Material Controller // DSS // Adaptation and Personalization	ASD
PA38	As a learner, I want to interact with a PA able to encourage my engagement in order to combat my self-esteem and socialisation difficulties as I could refuse to or not be able to communicate with PA.	M	PA // Experiencing Service	ASD
PA39	As a teacher, I want to have a system that is able to gather information from different users on the same device in order to ensure that teaching is effective in a cooperative environment and I have to manage the whole class of students.	M	PA // Experiencing Service	ASD
PA40	As a teacher, I want to have sensors of sufficient fidelity to be able to collect info from students who may not be able to maintain gaze in order to cater for students with these impairments and not exclude those who have multiple disabilities.	M	PA // Learning Material Repository	PMLD / ASD / ME
PA41	As a teacher, I want to have sensors of sufficient fidelity to be able to collect info from students who may not be able to gesture consistently in order to cater for students with these impairments and not exclude those who have multiple disabilities.	M	PA // DSS // Adaptation and Personalization	PMLD / ASD / ME
PA42	As a teacher, I want to have sensors of sufficient fidelity to be able to collect info from students who will be at a greater distance than usual from the mobile device in order to cater for students with these impairments and not exclude those who have multiple disabilities.	M	PA	PMLD / ASD / ME
PA43	As a teacher, I want to have a system that analyse data collected from users in many different, non-orthodox positions, constantly moving etc. in order to not exclude students on beds from being able to the system.	M	PA	ASD
PA44	As a learner, I want to have a system at school that can collect sufficient sentiment/pose information from me and is responsive to my performance in order to prevent me from becoming frustrated and demotivated if the system cannot respond appropriately to me.	M	PA	ASD
PA45	As a teacher, I want to be able to move PA's in a potentially cluttered classroom in order to ensure that I can engage students in the lesson.	M	PA	ASD / PMLD
PA46	As a teacher, I want to have an adequate number or typology of PAs in order to allow me to work with different students at the same time and manage a class of many students.	M	PA // DSS // Agent Collaboration	ASD

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
PA47	As a teacher, I want to work with different students at the same time in order to ensure that I can engage my students in an inclusive lesson.	M	PA	ASD
PA48	As a teacher, I want to have technical assistance available so that I can continue working if a problem with the system develops in order to enable me to continue working and so that the system does not cause disruption.	S	PA // Learning Material Repository	ASD
PA49	As a teacher, I want to have PA's that can be used collaboratively by more than one learner in order to enable collaborative exercises between students.	M	PA // Experiencing Service // User and Roles Manager // Security and User Management	ME
PA50	As a teacher, I want to have PA's that can be used individually by a learner in order to enable individual learning exercises.	M	PA // Experiencing Service	ME
PA51	As a teacher, I want to have PA's that can gather feedback from more than one learner at the same time in order to enable collaborative exercises between students.	M	PA // Experiencing Service // Learning Experience Supervisor	ME
PA52	As a teacher, I want to have PA's that can gather feedback from an individual learner in order to enable individual learning exercises.	M	Experiencing Service // PA // Learning Experience Supervisor	ME
PA53	As a teacher, I want to have a system that has adaptability of content in order to enable customisation of content to present materials appropriate to an individual or group of learners.	M	PA // Experiencing Service // DSS // Adaptation and Personalization	ME
PA54	As a teacher, I want to have a system that has adaptability of methods in order to enable customisation of content to present materials appropriate to an individual or group of learners.	M	PA // Experiencing Service // DSS // Adaptation and Personalization	ME
PA55	As a teacher, I want to have a system that has a genderless design in order to facilitate use by student groups or classes that contain both boys and girls.	M	Experiencing Service	ME
PA56	As a teacher, I want to have a system that is inclusive in order to not exclude PMLD and ASC students within mainstream classes.	M	Experiencing Service // Experience Engine // DSS // Adaptation and Personalization	ME
PA57	As a teacher, I want to have a system that can adapt to different activities in order to not exclude PMLD and ASC students within mainstream classes and to cater for variance in age range.	M	Experiencing Service // Experience Engine // DSS // Adaptation and Personalization	ME

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
PA58	As a teacher, I want to have a system that gives several levels of complexity for the same activity in order to not exclude PMLD and ASC students within mainstream classes and to cater for variance in age range.	M	Experiencing Service // Experience Engine // Learning Graph Repository // Learning Material Repository	ME
PA59	As a teacher, I want to have a system that will run on equipment available in the class in order to be usable on the older PCs we have available.	M	PA // Experiencing Service	ME
PA60	As a teacher, I want to have a system that will run on desktop PC's in order to cater for our lack of access to tablets or IWBs.	M	PA // Experiencing Service	ME
PA61	As a teacher, I want to have a system that is able to be used by many users at the same time in order to cater for devices being shared by students.	M	Learning Experience SuperVisor // Experiencing Service // Learning Materials Repository // Experiencing Engine // Security and User Managemet // User and Roles Manager	ME
PA62	As a teacher, I want to have a system that can be used by many users at the same time in order to enable the whole class to be involved.	M	Learning Experience SuperVisor // Experiencing Service // Learning Materials Repository // Experiencing Engine	ME
PA63	As a teacher, I want to have a system that can be used in a cooperative way in order to cater for devices being shared by students.	M	Experiencing Service // Security and User Management // User and Roles Manager // DSS // Agent Collaboration	ME
PA64	As a teacher, I want to have a system that can be used in a cooperative way in order to enable the whole class to be involved.	M	Experiencing Service // Security and User Management // User and Roles Manager // DSS // Agent Collaboration	ME
PA65	As a teacher, I want to ensure that pilot organisation should consider the presence of special needs students and the participation of all the students to the learning activity in order to Ensure that the lesson be inclusive.	S	Experiencing Service // Learners Profile Repository // DSS // Adaptation and Personalization	ME
PA66	As a teacher, I want to have a system that will run without an internet connection in order to enable my school to use the system without an internet connection.	M	PA // Experiencing service // Platform configurator	ME

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
PA67	As a teacher, I want to have a system that is able to gather information from a group of students working on the same device in order to allow multiple students to use the same device at the same time.	M	PA // Experiencing Service // Learning Experience Supervisor // Security and User Management	ME
PA68	As a teacher, I want to have sensors of sufficient fidelity to be able to collect info from students who may not be able to hold the device themselves in order to not exclude those who have multiple disabilities.	M	Experiencing Service // Learners Profile Repository	ME
PA69	As a teacher, I want to ensure all platform agents can communicate with/receive input from assistive technologies (e.g., switch) in order to not exclude those with cognitive and or physical disability.	M	Experiencing Service // Learners Profile Repository	ME
PA70	As a learner, I want to ensure all platform agents can communicate with/receive input from assistive technologies (e.g., switch) in order to interact with the system as I cannot do this without assistive technologies.	M	Experiencing Service // Learners Profile Repository	ME
PA71	As a teacher, I want pilot materials to be differentiated in order to cater for the variance in ability within a mainstream education class.	M	Experiencing Service // Learning Experience Supervisor // Learners Profile Repository // DSS // Adaptation and Personalization	ME
PA72	As a learner, I want pilot materials to be differentiated in order to enable inclusivity of those with PMLD or ASD who may find the material too complex.	M	Experiencing Service // Learning Experience Supervisor // Learners Profile Repository // DSS // Adaptation and Personalization	ME
PA73	As a teacher, I want to have Platform agents that can gather data from more than one student in order to ensure or record instances of cooperative learning.	M	Experiencing Service // PA	ME
PA74	As a teacher, I want to have system compatibility with the devices schools already have in order to cater for the hardware and resource limitations of a school.	M	PA	ME
PA75	As a teacher, I want the system to gather information from different users on the same device in order to enable the device to be used by different students.	M	Experiencing Service // Security and User Management	ME
PA76	As a teacher, I want to have a system with sensors of sufficient fidelity to be able to collect info from places with a lot of noise or which are crowded in order to prevent interference with other activity in order to make the system function.	M	Experiencing Service // PA // Learning Experience Supervisor	ME

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
PA77	As a teacher, I want to have a system that can work offline at certain times in order to account for breaks in internet connectivity that would otherwise interrupt the flow of the lesson.	M	Experiencing Service	ME
PA78	As a teacher, I want to Ensure that the system will run on older hardware/OS/software in order to be compatible with our existing technology.	M	Experiencing Service // PA // Learning Experience Supervisor // General	ME
PA79	As a learner, I want to be able to use the system in a noisy classroom environment in order to enable classes work in an inclusive and cooperative environment.	M	General // Experiencing Service	ME
PA80	As a teacher, I want to be able to use the system in a noisy classroom environment in order to allow for a lack of quiet areas being available during the school hours.	S	General // Experiencing Service	ME
PA81	As a teacher, I want to be able to use the system in a noisy classroom environment in order to ensure that all students that are part of the class work at the same time, including students with special needs.	M	General // Experiencing Service	ME
PA82	As a teacher, I want to have a system that can gather feedback from users not maintaining a proper posture and attention in order to ensure inclusivity for special needs students part of the mainstream class do not maintain an appropriate posture.	S	PA // Experiencing Service	ME
PA83	As a teacher, I want to have a system that can be set up and operated in a potentially cluttered classroom in order to cater for limitations in available classroom resource.	S	General // Experiencing Service	ME
PA84	As a teacher, I want to have a system that is amenable to shifts of siting and to restricted device mobility in order to cater for limitations in available classroom resource.	S	General // Experiencing Service	ME
PA85	As a teacher, I want to have a system that is amenable to restricted device mobility in order to cater for limitations in available classroom resource.	S	General // Experiencing Service	ME
PA86	As a teacher, I want to ensure that the pilot setting takes into account interactions between students in order to enable students to work collaboratively and inclusively with pupils working both individually and collaboratively in groups.	M	Experiencing Service // Learning Experience Supervisor	ME
PA87	As a teacher, I want to have learning goals that will require interaction between students in order to enable students to collaborate whilst sharing devices.	M	Experiencing Service // Learning Experience Supervisor // Learners Profile Repository // Learning Content Editor // Security and User Management // DSS // Agent Collaboration	ME

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
PA88	As a teacher, I want to have the system gather information from different learners working on the same learning goal at the same time on the same device in order to enable students to collaborate whilst sharing devices.	M	Experiencing Service // Learning Experience Supervisor // Learners Profile Repository // Learning Content Editor // Security and User Management	ME
PA89	As an learner, I want to be able to use the system in extreme industrial environments in order to enable use in workshop and industry environments.	S	PA // Experiencing Service	IT
PA90	As an teacher, I want to be able to use alternative PAs that employers already have in order to Benefit familiarity and save costs	M	Experiencing Service // PA	IT
PA91	As a learner, I want to have a system that is usable in a 'distance learning' mode (used at home/at work outside the training session by learners). in order to Allow me to learn in an at home context and thus fully exploit the potential of the solution for industrial trainings	S	PA // Experiencing Service	IT
PA92	As a learner, I want to use mainly tablets and PCs to provide training in order to be best adapted to the SME where the pilot will be organized.	M	PA // Experiencing Service	IT
PA93	As a learner, I want to be able to use my own personal devices in order to fully exploit the potential of the solution for industrial training via my own equipment.	S	PA // Experiencing Service	IT
PA94	As a trainer, I want to be able to register problems with the system in order to cater for when technical staff not available.	S	PA // Experiencing Service	IT
PA95	As a trainer, I want to be able to use the system in a remote learning context in order to allow for multisite and remote learning	S	PA // Learning Experience Supervisor	IT
PA96	As a learner, I want to be able to use the system in a remote learning context in order to allow for multisite and remote learning.	S	PA // Experiencing Service	IT
PA97	As a learner, I want to have a system that is to be useable on personal devices in order to allow me to use my own devices and fully exploit the potential of the solution for industrial training.	S	PA // Experiencing Service // Learning Experience Supervisor	IT
PA98	As a teacher, I want to have a system that is useable on tablets and PCs used during the training session in order to Provide PA's for training and fully exploit the potential of the solution for industrial training.	S	PA // Experiencing Service // Learning Experience Supervisor	IT
PA99	As a teacher, I want to select between Greek and English languages in order to support native as well as immigrant trainees.	M	Experiencing Service // Learning Experience Supervisor // Learning Material Repository	CG

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
PA100	As a teacher, I want to provide career guidance to people with soft cognitive impairments or learning difficulties (e.g. dyslexia) in order to enable those who are normally excluded to have an opportunity of some employment.	S	Experiencing Service // Learning Experience Supervisor // Learners Profile Repository // DSS // Adaptation and Personalization	CG
PA101	As a teacher, I want to have a system that supports face to face as well as PA interaction in order to Career guidance cannot be provided without human interaction.	M	PA	CG
PA102	As a learner, I want the system to be available anytime anywhere in order to I am not constrained to specific times and places.	C	Experiencing Service // PA // DSS // Agent Collaboration	CG
PA103	As a teacher, I want a system to evaluate the cognitive state of the client in order to provide an appropriate level of training for each stage.	S	Experiencing Service // Learners Profile Repository // DSS // Adaptation and Personalization	CG
PA104	As a teacher, I want to need a system that is compatible with all kinds of PCs and tablets (even older models) in order to enable users to access from own devices at home.	S	PA // Experiencing Service	CG

Table 12: Platform Agent Layer

6.5 Learning Material Repository

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
LMR01	As a learner, I want to have a system at school whose responsiveness to me does not rely only on assessing my ability to reply verbally in order to not be excluded due to not wanting or being able to express myself verbally.	M	PA // Learners Profile Repository // DSS // Adaptation and Personalization	ASD
LMR02	As a learner, I want to use iconic representations where applicable in order to understand and interact with the materials.	M	Experiencing Service // Learning Materials Repository	ASD
LMR03	As a teacher, I want to have any materials which are provided in English for teachers be both simple and concise in order to be able to understand, interact and apply the materials	M	Learning Materials Repository // Learners Profile Repository // User Management	ASD
LMR04	As a teacher, I want to use my native language in order to understand and interact with the materials.	M	Learning Experience Supervisor // Learning Materials Repository	ASD
LMR05	As a teacher, I want to have materials for teachers that are in English be both simple and concise in order to be able to understand, interact and apply the materials.	M	Learning Materials Repository	ASD

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
LMR06	As a teacher, I want to have the ability to present other languages in order to include students without the classes' native language as a first language.	M	Learning Materials Repository // Learning Experience Supervisor // Experiencing Service // Experience Engine // Learner Profile Repository	ASD
LMR07	As a teacher, I want to have the ability to present other languages in order to provide means for teaching language.	M	Learning Experience Supervisor // Learning Materials Repository	ME
LMR08	As a teacher, I want to cater of a wide range of user age range in order to provide training for all employees.	M	Learning Materials Repository // Learners Profile Repository // DSS // Adaptation and Personalization	ME
LMR09	As a teacher, I want to ensure there is no gender discrimination in order to ensure equal opportunity.	M	Learning Materials Repository // Learners Profile Repository // DSS // Adaptation and Personalization	ME
LMR10	As a teacher, I want to be able to tailor the system in order to enable users with different levels of educational background to use the system.	M	Learning Materials Repository // Learners Profile Repository // Experiencing Service // DSS // Adaptation and Personalization	ME
LMR11	As a teacher, I want to be able to cater for different styles and rates of learning in order to enable an inclusive approach to providing training.	M	Learning Materials Repository // Learners Profile Repository // Experiencing Service // DSS // Adaptation and Personalization	ME
LMR12	As a learner, I want to be able to use the system based on visual information only in order to overcome my hearing impairment.	M	Learning Materials Repository // Learners Profile Repository // Experiencing Service // DSS // Adaptation and Personalization	ME
LMR13	As a trainer, I want to be able to reuse material provide by other trainers in order to efficiently produce and configure learning materials.	M	Learning Materials Repository // Experiencing Service	ME
LMR14	As a learner, I want to be able to stop and resume as frequently as I need to from different places in order to optimise my chances of using the system to train.	M	Learning Materials Repository // Experiencing Service // PA // DSS // Agent Collaboration	ME

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
LMR15	As a learner, I want to have an easy to use system in order to avoid distraction and lose motivation due to difficulties.	M	Learning Materials Repository // Experiencing Service	ME
LMR16	As a learner, I want to be able to use the system anytime and anywhere in order to So that I can make the most of any opportunity I get to receive training.	M	Learning Materials Repository // Experiencing Service // PA	ME
LMR17	As a teacher, I want to easily move existing training materials into the system (.ppt, .odp or .pdf document, .mp4 or .swf, copy/paste feature) in order to save time and provide continuity for those who are already familiar with the training.	M	Security and User Management // User Repository	ME
LMR18	As a learner, I want to have audio and video of the system to be loud and clear in most environments in order to use the system in most reasonable places.	M	Learning Materials Repository	ME
LMR19	As a trainer, I want to use different modes of interaction with the system in order to my clients can choose the most appropriate combination for a given task.	S	Learning Materials Repository	IT
LMR20	As a teacher, I want to be able to use dispensative or compensative tools in order not to exclude those who would struggle with the base level.	M	Learning Content Editor // Learning Materials Repository // DSS // Adaptation and Personalization	IT
LMR21	As a teacher, I want to have a system that can adapt the tasks using purely audio alternatives in order to support and not exclude those with sensory disability.	M	Learning Content Editor // Learning Materials Repository // DSS // Adaptation and Personalization	IT
LMR22	As a teacher, I want to have a system that can adapt the tasks using purely visual alternatives for individual users in order to support and not exclude those with sensory disability.	M	Learning Content Editor // Learning Materials Repository // DSS // Adaptation and Personalization	IT
LMR23	As a learner, I want to have a system which is understandable for people with various levels of education in order to understand and interact with the materials.	M	Learning Content Editor // Learning Materials Repository // DSS // Adaptation and Personalization	IT
LMR24	As a teacher, I want to be able to present differentiated learning in order to not exclude those with some form of SEND.	M	Experiencing Service // DSS // Adaptation and Personalization // Learning Material Repository	IT

Table 13: Learning Material Repository

6.6 General

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
GEN01	As a teacher, I want to have a system with a simple user guide in order to enable use by teachers/students with different levels of competence in IT.	S	General // Frontend	PMLD
GEN02	As a teacher, I want to have a system with support systems in place in order to enable use by teachers/students with different levels of competence in IT.	S	General // Frontend	PMLD
GEN03	As a teacher, I want to have some kind of support/insurance for expensive PAs in order to cater for damage during use so that teaching can continue if the PAs break or are broken.	S	General	PMLD
GEN04	As a teacher, I want to have technical support during the pilot in order to enable use by teachers/students with different levels of competence in IT.	M	General // Assisted pilots	PMLD
GEN05	As a teacher, I want to be able to have a user guide to help operate the system in order to enable use by teachers/students with different levels of competence in IT.	M	General	PMLD
GEN06	As a teacher, I want to have a system that works smoothly in order to avoid frustration and demotivation of students who are expecting to use it.	M	General	PMLD
GEN07	As a teacher, I want to have a system that works without the need for setup in order to save me valuable teaching time.	S	General	PMLD
GEN08	As a teacher, I want to have a system in schools that do not depend on internet access in order to cater for instances where internet access is unavailable.	M	General	PMLD
GEN09	As a teacher, I want to have a system that runs on operating systems such as Android, iOS, Windows Phone and as a desktop application in order to allow me to use it in many more situations and within the constraints of my school's equipment.	C	General // Frontend	PMLD
GEN10	As a teacher, I want to ensure that I have adequate training on using the system in order to ensure that I am able to use the system and that teachers/students with different levels of competence in IT can also use the system.	M	General	PMLD
GEN11	As a teacher, I want to ensure that I have direct help by mail, FAQ, helpline or similar tools in order to ensure that I am able to use the system when technical assistance is not available.	M	General	PMLD
GEN12	As a teacher, I want to ensure that I have direct help by mail, FAQ, helpline or similar tools in order to ensure that I am able to use the system when technical assistance is not available.	M	General	PMLD

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
GEN13	As a teacher, I want to have a system that presents information in the language spoken in my school in order to not exclude those who cannot read the language and because some students do not want or are not able to express themselves verbally.	M	General	PMLD
GEN14	As a teacher, I want to be have a system that works smoothly in order to combat the frustration and demotivation of students who are expecting to use it.	M	General	PMLD
GEN15	As a teacher, I want to be ensure access to downloaded content is easy in schools (firewall security) in order to save me valuable teaching time.	M	General	PMLD
GEN16	As a teacher, I want to have been trained on how to set up the system in order to ensure that the system is a usable platform for me to support teaching and learning.	M	General // Training	PMLD
GEN17	As a teacher, I want to have been trained on how to use the system in order to ensure that the system is a usable platform for me to support teaching and learning.	M	General // Training	PMLD
GEN18	As a teacher, I want to have a system in school that does not depend on internet access in order to ensure that it can be used when internet access is unavailable.	M	General	ASD
GEN19	As a teacher, I want to have been equipped with the operating systems and equipment required for the system in order to ensure that the school is not excluded from MaTHiSiS as the school equipment might not be adequate.	M	General // Infrastructure	ASD
GEN20	As a teacher, I want to be able to use the software in a noisy environment (both for inputs and for outputs) in order to prevent me from having to disrupt the class in order to use the software.	M	General	ASD
GEN21	As a teacher, I want to have a system that records errors and issues with its performance in order to improve the usability of the system.	S	General	ASD
GEN22	As a teacher, I want to have a system that can simplify tasks for individual users in order to not exclude those who would struggle with the base level.	M	General	ASD
GEN23	As a teacher, I want to be provided with training for using robots in order to cater for teachers that have no experience with robots.	M	General	ASD
GEN24	As a learner, I want to be provided with training for using robots in order to cater for my lack of experience using robots.	M	General	ASD
GEN25	As a learner, I want to be provided with training for using the system in order to cater for my lack of experience using ICT.	M	General	ASD

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
GEN26	As a teacher, I want to be provided with training for using the system in order to cater for my lack of experience using ICT.	M	General	ASD
GEN27	As a learner, I want to be provided with training for using the PAs in order to cater for my lack of experience using PAs.	M	General	ASD
GEN28	As a teacher, I want to be provided with training for using the PAs in order to cater for my lack of experience using PAs.	M	General	ASD
GEN29	As a teacher, I want to have training on the technical use of the system in order to get up and running with the system quickly.	M	General	ASD
GEN30	As a teacher, I want to have training on the technical use of the system in order to able to use the system in the educational context.	M	General	ME
GEN31	As a teacher, I want to be provided with Instructions that are clear and concise in order to allow quick problem solving.	M	General	ME
GEN32	As a teacher, I want a system that is intuitive in order to get up and running with the system quickly.	M	General	ME
GEN33	As a teacher, I want to have a system that can maintain value across habitual or occasional paradigms of access and use in order to Because it could have a positive impact for teaching and learning.	M/S	General	ME
GEN34	As a teacher, I want to have a system that can maintain value across habitual or occasional paradigms of access and use in order to sustain pupils' engagement, leading to higher achievement and progression.	M/S	General	ME
GEN35	As a teacher, I want to be able to run the software without need for extra staff in order to facilitate a possible lack of additional staff resource.	M	General	ME
GEN36	As a teacher, I want to ensure that training and assistance be provided on the pedagogical use of the system in order to enable use by (most) teachers who do not have experience using ICT.	M	General	ME
GEN37	As a teacher, I want to have a system where support will be provided to ensure lesson flow is not interrupted by technical problems in order to ensure lesson flow is not interrupted by technical problems.	M	General	ME
GEN38	As a teacher, I want to have my schools internet connection checked to verify if it corresponds to the requirements of the system in order to verify that my school is able to use the system with our existing internet connection.	M	General	ME

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
GEN39	As a teacher, I want to have training provided in order to be equipped to solve issues themselves.	S	Social Networks Bindings	ME
GEN40	As a teacher, I want to have a helpline provided for the system in order to allow quick solution of problems that may prevent system use.	M	Social Networks Bindings	ME
GEN41	As a teacher, I want to be able to meet with other schools involved in the project in order to enable knowledge sharing.	M/S	Social Networks Bindings	ME
GEN42	As a teacher, I want to FAQ database should be set up in order to allow quick solution of problems that may prevent system use.	M	General	ME
GEN43	As a teacher, I want to have tests conducted by the system with a restricted profile in order to ensure that privacy is maintained.	M	General	ME
GEN44	As a teacher, I want to have training on the technical use of the system in order to be able to understand and use the system in an educational context.	M	General	ME
GEN45	As a teacher, I want to be provided with be clear and concise instructions for the use of the system in order to be able to understand and use the system in an educational context.	M	General	ME
GEN46	As a teacher, I want to have robust hardware in order to enable it to be handled by students with limited supervision.	M	General	ME
GEN47	As a teacher, I want to have PA's fitted with a protective case in order to enable it to be handled by students with limited supervision.	M	General	ME
GEN48	As a teacher, I want to ensure that any protective screen for PA's should be easy to interact with in order to counteract frustration that can be caused by screen covers if they impede interaction.	M	General	ME
GEN49	As a teacher, I want to have a system that has centralised device management in order to combat a lack of time or technical support resources to manage devices individually.	M	General	ME
GEN50	As a teacher, I want to have a system that does not rely on video feedback in order to cater for hardware at the school not being able to support this.	M	General	ME
GEN51	As a teacher, I want to have a system that is compatible with Promethean Active Inspire for IWB in order to be compatible with our existing technology.	M	General	ME
GEN52	As a learner, I want to have a system that supports a range of devices ideally some at low spec in order to be able to use my own devices that would increase use of system in school and out.	S	General	ME

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
GEN53	As a teacher, I want to have technical assistance provided if needed in order to allow quick solution of problems that may prevent system use.	M	General	ME
GEN54	As a teacher, I want to have an automated means for recording problems with the system in order to allow quick solution of problems that may prevent system use.	M	General	ME
GEN55	As a teacher, I want adequate teacher training in order to equip teachers as technical experts in the system.	M	General	ME
GEN56	As a teacher, I want to have direct access to help with the system if needed in order to enable teachers to troubleshoot issues quickly.	M	General	ME
GEN57	As a teacher, I want to page dedicated to technical assistance on the web site in order to enable teachers to troubleshoot issues quickly.	S	General	ME
GEN58	As a teacher, I want to have help available by email if needed. in order to give quick access to support from MaTHiSiS team.	S	General	ME
GEN59	As a teacher, I want to have a list of FAQ available for troubleshooting in order to enable teachers to solve their own problems.	S	General	ME
GEN60	As a teacher, I want to use the system in French as well as other languages in order to enable local French users benefit from the system.	M	Experiencing Service // Platform Configurator	ME
GEN61	As a teacher, I want to be able to join a user community in order to communicate with other users in order to answer the main technical problems encountered with the solutions they found?	S	Social Networks Bindings	ME
GEN62	As a teacher, I want to be able to seek advice on technical issues with the system in order to allow quick solution of problems that may prevent system use.	S	Social Networks Bindings	ME
GEN63	As a teacher, I want to have training on the system in order to enable trainers to troubleshoot issues quickly.	S	General	ME
GEN64	As a teacher, I want to be able to seek assistance online in order to allow quick solution of problems that may prevent system use.	S	General	ME
GEN65	As a teacher, I want to cater for an age range between 18 to 65 in order to provide guidance services to university leavers upwards.	S	General // Learners Profile Repository	ME
GEN66	As a teacher, I want to ensure that trainees are not discriminated according to their gender in order to comply with EU law.	S	General	ME

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
GEN67	As a teacher, I want to use a system that does not require special skills or experience in order to avoid having to learn additional skills to operate the system.	S	Experiencing Service // Learning Experience Supervisor // Learning Material Repository	ME
GEN68	As a learner, I want to use a system that is easy and engaging to use in order to avoid being put off due to technical difficulties or boredom.	M	General	ME
GEN69	As a teacher, I want to receive appropriate training before I support my clients in order to make sure best use of the opportunity to engage the client.	M	General	IT
GEN70	As a learner, I want to receive appropriate training before I use the system in order to make sure that I am not disadvantaged if I am not familiar with technology.	M	General	IT
GEN71	As a learner, I want the system to provide specific and measurable support for all aspects such as action plan, e-portfolio, psychometric testing etc. in order to see clear steps in improvement.	S	General	IT
GEN72	As a learner, I want all of my personal data as well as all interaction with counsellors are handed with discretion in order to ensure that I have confidence in using the system.	M	Security and User Management // User and Roles Manager	IT
GEN73	As a learner, I want to be reminded at appropriate intervals and stages of my rights and systems limitations in order to ensure that I have realistic expectations of the level of support the system provides.	M	Experience Engine // Learning Graph Engine // Learners Profile Repository // Learning Graph Repository	IT
GEN74	As a learner, I need a helpline in order to avoid getting stuck due to lack of knowledge or technical issues.	S	General	CG
GEN75	As a trainer, I want to get assistance in operating the MaTHiSiS platform via regular face to face support in order to be fully familiar with its characteristics and abilities and to be able to explore its full potential.	M	General	CG
GEN76	As a teacher, I want to get assistance in operating the MaTHiSiS platform via a helpline in order to be fully familiar with its characteristics and abilities and to be able to explore its full potential.	M	General // Social Networks Bindings	
GEN77	As a teacher, I want to get assistance in operating the MaTHiSiS platform via a list of frequently asked questions in order to be fully familiar with its characteristics and abilities and to be able to explore its full potential.	M	General // Social Networks Bindings	
GEN78	As a learner, I want to have a system that is understandable for people with a non-technical background in order to understand and interact with the materials.	M	Learning Experience Supervisor // Learning Materials Repository	

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
GEN79	As a teacher, I want to have a system that is understandable for people with a non-technical background in order to not exclude those without digital experience.	M	Learning Materials Repository // Experiencing Service // Learning Experience Supervisor // Learning Content Editor	

Table 14: General

6.7 Platform Configurator

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
PC11	As a teacher, I want to have a system that is easy to set up in order to enable use by teachers with low technical experiences.	S	Platform Configurator / Learning Experience Supervisor	PC11
PC12	As a teacher, I want to have a system that can be calibrated and personalised for individual learners in order to enable bespoke settings that facilitate the requirements of those with special needs i.e. physical and or cognitive.	M	Platform Configurator / Learning Experience Supervisor	PC12
PC13	As an administrator, I want to ensure access to downloaded content is easy in schools (firewall security) in order to ensure that institution restrictions do not impede the performance of the system.	M	Platform Configurator	PC13
PC14	As an administrator, I want to ensure that the system works with a restricted profile in order to ensure that institution restrictions do not impede the performance of the system.	M	User Account Manager	PC14
PC15	As an administrator, I want to ensure that parents, teachers, students should have different access rights and that individual students data needs to be stored securely in order to ensure compliance with ethics and personal privacy.	M	User Access Management // Cloud security	PC15
PC16	As a teacher, I want to be able to have easy access to the platform in order to manage the organisation of the entire class of students.	M	Platform Configurator	PC16
PC17	As a teacher, I want to have a platform that is useable by different users on the same device, and their data separated in order to cater for multiple classes using the same devices.	M	Security and User Management // User and Roles Manager	PC17
PC18	As a teacher, I want to have a platform that is useable by different users on the same device, and their data separated in order to cater for devices being shared amongst students.	M	Security and User Management // User and Roles Manager	PC18

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
PC19	As a teacher, I want to ensure access to downloaded content is easy in schools (firewall security) in order to cater for the security constraints of some schools that have firewalls, careful checking using a pupil log in will be needed.	M	Open API // PA // Security and User Management	PC19
PC20	As a teacher, I want to ensure access to downloaded content is easy in schools in order to combat the limitations often found within schools such as: firewall security, school connectivity and bandwidth.	M	Open API // PA // Security and User Management	PC20
PC21	As an learner, I want to be able to rely on the system security in order to feel confident that my personal data is secure wherever it is saved.	M	Security and User Management // User Repository // User and Roles Manager	PC21
PC22	As a teacher, I want to ensure employer data is safeguarded in order to protect company intellectual property.	M	Security And User Management // User and Roles Manager	PC22
PC23	As a teacher, I want to be able to use the system in a classroom environment in order to enable use within the standard educational context.	M	Experiencing Service // Platform Configurator	PC23
PC24	As a teacher, I want to have a help mechanism built-in to the system that aids with setup and configuration in order to enable teachers without the assistance of technical staff to configure or reconfigure it.	M	Platform Configurator	PC24

Table 15: Platform Configurator

6.8 Decision Support System

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
DSS01	As a teacher, I want to have a system that can cater for the variance in class ability in order to enable system use across different abilities.	M	Learners Profile Repository // Experiencing Service // Learning Material Repository // DSS Adaptation and Personalization	ME
DSS02	As a teacher, I want to have a system that can cater for the variance in class age in order to present materials appropriate age of individual or a group of learners.	M	Learners Profile Repository // Learning Materials Repository // DSS // Adaptation and Personalization	ME
DSS03	As a teacher, I want to have a system with adaptability across a range of idiosyncrasies and levels of functioning in order to enable inclusive learning across a large heterogeneous group.	M	DSS // Adaptation and Personalization	ME

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
DSS04	As a teacher, I want to be able to adapt the size of presented text in order to not exclude those with limitation in vision or visual impairments.	S	Learning Material // PA // Learners Profile Repository // DSS // Adaptation and Personalization	PMLD
DSS05	As a teacher, I want to be able to adapt the font type of presented text in order to not exclude those with limitation in vision or visual impairments.	S	Learning Material // PA // Learners Profile Repository // DSS // Adaptation and Personalization	PMLD
DSS06	As a teacher, I want to have the system present graphics that are clear in order to not exclude those with limitation in vision or visual impairments.	S	Learning Material // PA // Learners Profile Repository // DSS // Adaptation and Personalization	PMLD
DSS07	As a teacher, I want to have the system present images with sharp outlines in order to not exclude those with limitation in vision or visual impairments.	S	Learning Material // PA // Learners Profile Repository // DSS // Adaptation and Personalization	PMLD
DSS08	As a learner, I want to be able to use text or images to access content in order to understand and interact with the materials.	M	Learning Material // PA // Learners Profile Repository // DSS //Adaptation and Personalization	PMLD
DSS09	As a teacher, I want to have the possibility to give appropriate content and methods for each age in order to present materials appropriate to a range of physical and mental ages.	M	Learning Material // PA // Learners Profile Repository // DSS // Adaptation and Personalization	ASD
DSS10	As a teacher, I want to have a system that supports non-verbal communication (symbols) in order to not exclude those who cannot read the language and because some students do not want or are not able to express themselves verbally.	M	PA // Learners Profile Repository // DSS // Adaptation and Personalization	ASD
DSS11	As a teacher, I want to have a system that that presents information using both the auditory and visual channel in order to not exclude those who have either a visual or an auditory or motor or verbal impairment or a combination of.	M	PA // Learners Profile Repository // DSS // Adaptation and Personalization	ASD
DSS12	As a learner, I want to have a system at school whose responsiveness to me does not rely only on assessing my direct eye gaze in order to not be excluded due to my peripheral vision, and ensure that I will not get frustrated and demotivated if the system cannot respond appropriately to me.	M	PA // Learners Profile Repository // DSS // Adaptation and Personalization	ASD

ID	User Story	MoSCoW	MaTHiSiS Component (FrontEnd//BackEnd)	UC
DSS13	As a learner, I want to have a system at school whose responsiveness to me does not rely only on assessing my ability to move an object in order to not be excluded due to my peripheral vision, and ensure that I will not get frustrated and demotivated if the system cannot respond appropriately to me.	M	PA // Learners Profile Repository // DSS // Adaptation and Personalization	ASD

Table 16: Decision Support System

7. Accessibility

It is integral to the MaTHiSiS system that it must support users that have physical, cognitive or sensory impairments. The guidelines published by Becta [22] call upon ISO, IBM and VPAT (Voluntary Product Accessibility Template - best practices for electronic & information technology vendors) guidelines to provide a comprehensive and robust set of principles that should ensure that the MaTHiSiS platform is accessible to all potential users. These guidelines are listed in Annex 1 – Accessibility Guidelines. Guidelines from the ACE Centre [23] and IBM [24] offer respectively, further discussion on assisting people with PMLD, and a summary of the current (January 2016) context.

Becta disability categories:

- Hearing
- Motor
- Visual
- Visual perceptual
- Dyslexia
- Visual perceptual and Motor
- MLD/SLD/PMLD (Moderate Learning Difficulties / Severe Learning Difficulties / Profound & Multiple Learning Difficulties)
- ADHD

The information included in the Annex 1 – Accessibility Guidelines , as well as the data presented in the next sections, will serve as requirement reference for all components involved in the MaTHiSiS adaptation and personalization process.

7.1 Alternative and Augmentative Communication (AAC)

AAC describes communication tools and strategies that should be considered for PMLD and ASD students.

> ***"AAC is a set of tools and strategies that an individual uses to solve everyday communicative challenges. Communication can take many forms such as: speech, a shared glance, text, gestures, facial expressions, touch, sign language, symbols, pictures, speech-generating devices, etc. Everyone uses multiple forms of communication, based upon the context and our communication partner. Effective communication occurs when the intent and meaning of one individual is understood by another person. The form is less important than the successful understanding of the message."***
>
> *Linda J. Burkhart, Technology Integration Specialist* [25]

Symbols used in AAC include line drawings, pictures, photographs, gestures, hand signals, words and letters. The choice of symbol system will depend on the AAC user's abilities, and the system used may be different at different times. Several symbol sets exist [26], including Blissymbols [27], which have linguistic features such as grammatical indicators, and other approaches such as the iconic Picture Communication Symbols (PCS) [28]. The choice of symbol system is highly dependent on the user's capability and their support team, so there can be no categorical set that will suit all users; the capacity to use local materials must be present.

7.2 Mobile Accessibility

The W3C/WAI has published a working draft discussing how the Web Content Accessibility Guidelines (WCAG) apply to mobile [29]. This draft references many of the resources and guidelines that others have also collated [30, 31]. Mobile accessibility has largely been concerned at supporting users with physical and sensorial disability, and for these use cases, there are a number of developer resources available, e.g. from the BBC [32], Mozilla [33], Funka Nu [34] and device OS manufacturers Google [35], Blackberry [36], iOS [37] and Windows [38].

Cognitive impairment and learning difficulty are less well covered, but could generally make use of the principals expounded for AAC. A particularly useful resource is the Concept Coding Framework (CCF) [39] that manages and maintains lexical & ontological resources, which link graphical symbolic libraries to mainstream lexical and other Language Technology resources.

8. Outline Planning for the Pilots

A number of issues have been identified that need to be articulated, considered and addressed in the detailed pilot design in order to plan for the 3 phases of piloting. These are addressed in outline below, and the following table has been drawn up to be completed for each Use Case. This Pilot Design and Requirements table should be carried forward to be used in the Evaluation Plan (D2.5), Integration Strategy (D7.1) and detailed pilot design.

8.1 Requirements Impact upon Testing & Evaluation

MATHISIS is evaluated in three phases. Two initial Pilot phases followed by a Real-Life phase. The pilot phases consider evaluation from a formative perspective aiming to capture relevant information that can be used to enhance the operation and performance of the system. The third phase focuses on developing a summative evaluation that reflects on how the project objectives have been met.

In all these phases the Quality of Experience (QoE) is closely linked to the Quality of Service (QoS). Naturally, technical faults or low system performance affect user experience. Close monitoring of QoS measurement will provide very useful insights into interpreting the QoE feedback. A set of specific metrics has been defined to enable measurement of QoS (WP7).

Deliverable D2.5, the Evaluation Strategy, maps out the details of the key evaluation criteria and how they are to be measured for the three different Phases of the project. Specifically, Use Case Leaders are guided to define what and how the effectiveness of the system is to be evaluated for each phase of the evaluation and link the measures to the KPIs that are used to determine the QoS.

8.2 Pilot design and Requirements

These questions must be considered for each set of pilots. As they are applied to different phases of piloting, the weights and context of them is likely to change. Therefore, this list is to be used as to direct inquiry and specification, rather than to be taken as a categorical definition of the issues to be considered. WP8 & WP9 should use Table 17: Template for capture of piloting requirements for each Use Case and pilot site as a basis for elaborating piloting requirements and issues. The table considers the following:

8.2.1 Site

- Identify the Driver pilot site per use case
- Need to cover all UCs (what selection criteria are relevant to choosing locations for driver pilot site?)

8.2.2 Dates

- What dates and restrictions are there?
  - The timeframe for driver pilots is M13-M16 (Jan –Apr 2017); M14 as a start date is preferred.
- Dates and duration
  - Especially for Mainstream, exact dates and duration of pilot sessions are required – curriculum delivery is fixed to particular dates and times, teachers need to achieve successful delivery of their teaching materials in the time assigned for piloting sessions.
  - What is the anticipated length of sessions – needed by MaTHiSiS pilots, and that teachers/trainers can expect to be involved for.

8.2.3 No. of participants

- How many participants (learners) will participate?
- How many are needed for this stage of the MaTHiSiS evaluation activities
- How many does the pilot site have potentially
- How many must or should be part of any session

8.2.4 Ethics application

- Ethical consent must be obtained in accordance with the local requirements of the partner country, and the MaTHiSiS policy as described in D2.6 – Framework for impact assessment of MaTHiSiS against LEPOSA requirements

8.2.5 Permissions

- Participants will be asked to complete consent forms. These documents must be manged appropriately, and cover the activities that each stage of the learners' involvement with the MaTHiSiS project
- Data and privacy protection processes and policy must be in place and clear to all partners before they proceed.

8.2.6 SLAs/Learning graph/weighting

- Learning materials to be used must be clearly identified (considering temporal and durational constraints).
- SLAs and Learning graphs must be created for specific pilot scenarios; the lesson plans and learning materials defining them must be identified and made available. The process of transforming materials to SLAs must involve teachers/trainers in order to ensure appropriate and meaningful learning activities are delivered during the pilot sessions.
- Weighting must be well defined and clearly expressed, to allow teachers/trainers to apply meaningful values.
- SLA formulation / design (responsibilities, activity style - collaborative or individual) must be defined

8.2.7 Technical requirements and support

- Technical requirements: equipment (required by the platform)
- Technical assistance needed / technical support provided

8.2.8 Training of trainers

- Teachers involved with the pilots need an introduction to and training on the platform, and the pilot process – we need to book this into teacher timetables, especially for mainstream teachers.
- Delivery of training must be planned.

8.2.9 Coordination with trainers schedule

- Organization (one student or in class/collaborative context)
- process for annotation
- Time spent on the platform per participant
- Institution effort required

8.2.10 Information to be provided by technical partners

- What do the Use Case partners undertaking the pilots in each country need to be aware of?
- What are they responsible for when running the pilots?
- What else do the technical partners need to ask?
- What else do the technical partners need to explain?

8.2.11 Information provided by pedagogical partners

- What do the technical partners developing the platform need to be aware of?
- What else do the pedagogical partners need to ask?
- What else do the pedagogical partners need to explain?

8.2.12 PA availability

- What PAs will be available, and/or what can be provide or lent by the pilot partner

8.2.13 Methodological approach

- Methodological approach – three approaches proposed:
    a. Single subject design using pre-test and post-test data
    b. ABAB design - the group serves as its own control
    c. Between groups design

8.2.14 Special features to be described in metadata

- Specifically for ASDC & PMLDC – observations that may be pertinent to understanding affect state of learners that could be captured by the PA/system.

Table 17: Template for capture of piloting requirements for each Use Case and pilot site

Pilot design and Requirements (for each Use Case and pilot site)	
Site	
Dates	
No. of participants	
Ethics application	
Permissions	
SLAs/Learning graph/weighting	
Technical requirements and support	
Training of trainers	
Coordination with trainers schedule	
Information to be provided by technical partners	

Information provided by pedagogical partners	
PA availability	
Methodological approach	
Special features to be described in meta data	

9. Conclusion

This document describes the user requirements (user characteristics, technical environment, physical environment and social & organisational environment) that have been elicited from semi-structured interviews with domain experts (teachers, trainers & pedagogists) for each of the Use Cases set out in the DoW. These requirements have been transformed into formally stated User Stories, categorised by their involvement with the system, as described in D2.3 – Full system Architecture. They describe a broad range of functional and Use Case specific requirements that the MaTHiSiS platform will be challenged to fulfil. Learning activities used by the trainers and teachers in their regular practice were recorded and analysed and were composed into exemplar Learning Experiences, SLA, LAs and moments of interaction. These results from the requirements elicitation process will inform the development activities in WP3 to WP7, and will be used to ensure that WP8 and WP9 can produce a valuable and meaningful assessment of the MaTHiSiS platform.

Key accessibility and usability resources have been identified that should further feed in to the development if the MATHISIS platform, and additionally, the process of engaging with domain experts has produced a number of matters around the practical matter of implementing a series of pilots have been raised and are being fed into the piloting activities of WP8 and WP9.

The results of this deliverable apply across whole the scope of MaTHiSiS activities, and must be used as an input into the following deliverables:

D2.5 - Evaluation Strategy

D3.1 & D3.2 - The MaTHiSiS Smart Learning Atoms

D3.3 & D3.4 - The MaTHiSiS Learning Graphs

D3.5 & D3.6 - Experience Engine

D3.7 & D3.8 - Learners' Profile Repository

D3.9 & D3.10 - MaTHiSiS Frontend

D4.1 & D4.2 - MaTHiSiS sensorial component

D4.3 & D4.4 - Affect Understanding in MaTHiSiS

D4.5 & D4.6 - Multimodal learning analytics

D5.1, D5.2 & D5.3 - Description of the robotic layer

D5.4, D5.5 & D5.6 - Description of the mobile layer

D5.7, D5.8 & D5.9 - Description of the interactive white board layer

D6.1 - Adaptation and Personalization principles based on MaTHiSiS findings

D6.2 & D6.3 - The MaTHiSiS Learning Graph Engine

D6.4 & D6.5 - Synchronous and Asynchronous collaboration among platform agents

D7.1 - Integration Strategy and planning

D8.1, D8.2 & D8.3 - Report on Autism Spectrum Case pilots

D8.4, D8.5 & D8.6 - Report on Profound and Multiple Learning Disabilities Case pilots

D8.7, D8.8 & D8.9 - Report on Mainstream Education Case pilots

D8.10 - Report on transferable lessons from Educational Pilots

D9.1, D9.2 & D9.3 - Report on Industrial Training pilots

D9.4, D9.5 & D9.6 - Report on Career Guidance Distance Learning pilots

D9.7 - Report on transferable lessons from industrial and Career Guidance pilots

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11. Annex 1 – Accessibility Guidelines

Source: BECTA: Standards and guidelines for making accessible software [22]

Abbreviations

AT – assistive technology
MLD – moderate learning difficulties
PMLD – profound and multiple learning difficulties
SLD – severe learning difficulties

Becta Guideline A short description of the guideline	Essential functionality What necessary performance should the application or resource provide?	Extra functionality What additional features would be helpful in adapting the software?	Additional needs Which areas of difficulty will be assisted by software that follows this guideline?
Access to interface names and labels **Assistive technology should be able to access interface controls and labels and make them available to users**	Provide understandable and meaningful names for every interface control and label and make these names available to assistive technology. These names should be short, to facilitate ease of use with AT such as screen readers.		**Motor** **Visual**
Choosing alternative inputs and outputs **Users should be able to switch between alternative inputs and output devices**	System accessibility utilities and alternative software driven mouse-pointing systems should be enabled.	Users should be able to choose alternative input and output devices and switch between these alternatives without having to re-start the system or program.	**Hearing** **Motor** **Visual** **Visual perceptual** **MLD / SLD / PMLD**

Becta Guideline	Essential functionality	Extra functionality	Additional needs
Keyboard Control **Menus and controls should be accessible from the keyboard without the need for mouse emulation**	Menus and common controls should be accessible via keyboard shortcuts.	All menus, dialogues, buttons and other controls should have keyboard equivalents. Re-definition of keyboard shortcuts used in the program to avoid clashes with AT use would be useful.	**Motor** **Visual** **Visual perceptual** **MLD/ SLD / PMLD**
User Preferences **Users should be able to save preferences**	It should be possible to save any user preferences to file.	Software should be able to inherit all relevant settings from the users' system preferences.	**All**
AT Compatibility **Software should be compatible with, and enable, common assistive technology**	All software should work with common assistive technology devices and software.	Compatibility with screen readers would be useful to many users with visual problems.	**Motor** **Visual** **Visual perceptual and Motor** **MLD / SLD / PMLD**
Text manipulation **Text should be copiable to a clipboard or other applications**	Users should be able to copy text so it can be read by other utilities such as text-to-speech readers. Where text is input, it should be possible to paste it from other applications such as predictors, communication symbol translators and other word processors.	Compatibility with interactive spell checkers for learners with dyslexia would be useful.	**Visual** **Visual perceptual** **Dyslexia**
Text Presentation **Enable customisation of text presentation**	Customisation of typeface, size and colour of all text should be available to the user. Choice of background colour should enable high contrast.	Where users require very large fonts, text copying and pasting to and from the application should be possible.	**Visual** **Visual perceptual** **Dyslexia** **Visual perceptual and Motor** **MLD / SLD / PMLD**

Becta Guideline	Essential functionality	Extra functionality	Additional needs
Multimedia **Supplementary materials for multimedia content should be provided**	Essential information conveyed visually or by sound should be available in alternative forms such as easy-to-read text.	Sub-titles and closed captioning of video sequences and audio description should be available on all multimedia.	**Hearing** **Visual** **Visual perceptual** **ADHD** **Visual perceptual and Motor** **MLD / SLD / PMLD**
Accessibility options **Enable users to employ accessibility options including keyboard and mouse features**	System accessibility utilities should be implemented, including keyboard and mouse features.		**Hearing** **Motor** **Visual**
Diagrams **Ensure that diagrams are clear, with good visibility**	All diagrams should be large and clear. Alt text should be available, and longer text (if necessary)	Diagrams available in vector graphic format that can be enlarged or copied to other viewers would assist users.	**Visual**
Interface Labels **Captions and labels should follow system settings, or enable application-wide user preferences**	Typeface and icon size and colour contrast should inherit the user's settings or offer these options in user preferences.	All interface settings should be inherited from the user's system display settings.	**Visual** **Visual perceptual** **Dyslexia** **Motor** **MLD / SLD / PMLD**
Screen Flicker **Avoid all flickering screens or components**	No part of the screen should flash at rates between 2 Hz and 60 Hz.		**All**
Documentation **Documentation should be provided and available in accessible electronic forms**	Documentation should be provided that is easily understood and available in accessible electronic forms.	Support and clear documentation of the accessibility features should be available.	**All**

Becta Guideline	Essential functionality	Extra functionality	Additional needs
Alternative Pointer Systems **Provision should be made for enabling alternative mouse pointing devices such as head- and eye operated systems**	Hardware mouse emulating head pointing systems should be enabled.	All head- and eye pointing systems that use a combination of hardware such as webcams and software drivers should be enabled.	**Motor**
Texts **Provide easy-to-read alternative texts**	Simplified or shorter language (simple English) alternatives of texts should be provided for those with reading difficulties or for quick scanning by screen readers.	Provide editable alternative texts.	**Visual** **Visual perceptual** **Dyslexia** **Visual perceptual and Motor** **MLD / SLD / PMLD**
Application windows **Application windows should be easily identifiable and simply manipulated**	Window titles and other interface labels should be clearly, appropriately and fully labelled.	All user interface information should be made transparent to accessibility systems such as MSAA (Active accessibility) and UI Automation (Windows Vista).	**Motor** **Visual**
Pointer visibility **Large mouse pointers and large targets or hotspots should be available**	The user should be able to change the size, shape and colour of pointer cursors in all states. The user interface should always contrast with the mouse cursor and be easily locatable.	The system's cursors should be inherited or mimicked so they make the visibility as good.	**Motor** **Visual** **Visual perceptual and Motor** **MLD / SLD / PMLD**
Time dependence **Enable flexibility in timed responses**	Users should be able to control the time available for responses.	Control of all time dependent responses with user-specific settings.	**All**

Table 18: Becta Accessibility Guidelines

12. Annex 2 – User Requirements

12.1 ASD

The following tables summarise the requirements of the teachers within the ASD category.

12.1.1 User Group Characteristics

User Group Characteristics User Group: Autistic Spectrum Disorder			
Characteristics	**User Requirements**	**Purpose/Reason**	**MOSCOW**
Size of user group: **Students with ASD**	As a teacher, I should be able to use the system in a cooperative way involving the entire class according to the needs of the learners	Students with ASD are included in the mainstream education classes Because of ASD cognitive difficulties	S S
	As a teacher, I should be able to have access easily the platform and to use platform agent with different students at the same time	Manage the organisation of the entire class of students	S
Age Range: **8 to 18 year old students**	As a teacher, I must have the possibility to give appropriate content and methods for each age	Range of chronological and mental ages	M
Gender: **Generally balanced**	The system must have a genderless design		M
Language and Culture: **All the students understand the national language, some cannot read and rely on symbols and icons, some do not want or are not able to express themselves verbally.**	As a teacher, I must have a system that presents information in the language spoken in my school, as well as supported by non-verbal communication (symbols)	Because the system must be used by students who cannot read the language and because some students do some do not want or are not able to express themselves verbally.	M
Sensory and physical impairments: **Many people will have additional sensory or physical disabilities (gross and fine motor impairments) or**	As a teacher, I must have a system that presents information using both the auditory channel but also the visual channel.	Because the system must be used by students who have either a visual or an auditory or motor or verbal impairment or a combination of them.	M

cognitive difficulties or disruptive behaviour (attention deficit, emotional dysregulation, anxiety, moving continuously) or communication difficulties	As a learner with peripheral vision, I must have a system at school whose responsiveness to me does not rely only on assessing my direct eye gaze, ability to move an object or reply verbally.	Because I will get frustrated and demotivated if the system cannot respond appropriately to me.	M
	As a student with attention deficit, emotional dysregulation I must interact with platform agents able to attract my attention and able to gather my feedback even if I move continuously or I am not to communicate or move properly	Because I will get frustrated and demotivated if the system cannot respond appropriately to me.	M
Lack of self-esteem socialisation difficulties	As a student with lack of self-esteem socialisation difficulties I might interact with a PA able to encourage my engagement	Because could refuse or not be able to communicate with PA	S

Table 19: User Requirements (ASD) User Group Characteristics

12.1.2 Technical Environment

Technical Environment **User Group: Autistic Spectrum Disorder**			
Characteristics	**User Requirements**	**Purpose/Reason**	**MOSCOW**
The MaTHiSiS system usability.	As a teacher, I must have a system that works smoothly.	Because it is frustrating and demotivating for students when they are expecting to use it.	M
	Ensure access to downloaded content is easy in schools (firewall security).	Because it will save me valuable teaching time.	M
	As a teacher, I must have been trained on how to setup and use the system.	Because the system must be a support for teaching and learning to be used	M
	As a teacher, I must have a system in school that does not depend on internet access.	Because there might not be internet access or proper internet access in the classroom it will be used.	M
	The system should be able to gather information from different users on the same device.	Because the teaching is effective in a cooperative environment and I have to manage the whole class of students.	M

	As a teacher, I need to monitor the sessions of use (when, where, which progresses,…) and the feedback of different students learning path.	Because the system must be a support for teaching and learning to be used.	M
	As a teacher, I must have a technical support during the pilot or a user guides should be provided.	Because the system must be a support for teaching and learning to be used.	M
	As a teacher, I must have sensors of sufficient fidelity to be able to collect info from students who may not be able to maintain gaze, or gesture consistently, hold the device themselves, be at a greater distance than usual from the mobile device.	Because of students impairments.	M
The class is equipped based on the pilot requirements and the number of students involved.	As a teacher, I must have been equipped with the operating systems and equipment required for the system.	Because the school equipment might not be adequate.	M

Table 20: User Requirements (ASD) Technical Environment

12.1.3 Physical Environment

Physical Environment **User Group: Autistic Spectrum Disorder**			
Characteristics	**User Requirements**	**Purpose/Reason**	**MOSCOW**
Auditory Environment	As a teacher, I must be able to use the software in a noisy environment.	So that I don't have to disrupt the class to use the software.	M
User posture **Most of ASD students manifest hyperactivity and lack of motor coordination, some of them move continuously, some of them also have physical disabilities that affect gross and fine motor skills**	As a teacher, I must have a system that analyse data collected from users in many different, non-orthodox positions, constantly moving etc.	So that students on beds can use the system.	M
	As a learner with a non-orthodox posture and position I must have a system at school that can collect sufficient sentiment/pose information from me to be responsive to my performance.	Because I will get frustrated and demotivated if the system cannot respond appropriately to me.	M

Organisation of the class	The moveable PAs should be able to move in a potentially cluttered classroom.	Because I have to engage students in the lesson	M
	The PA should be in and adequate number or typology to allow me to work with different students at the same time.	Because I have to manage a class of many students engaging them in an inclusive lesson.	M

Table 21: User Requirements (ASD) Physical Environment

12.1.4 Social & Organisational Environment

Social & Organisational Environment **User Group: Autistic Spectrum Disorder**			
Characteristics	**User Requirements**	**Purpose/Reason**	**MOSCOW**
Assistance Available	As a teacher, I might need technical assistance to continue working, a recording problems should be developed.	Record the system problems and improve the usability.	S
Learning setting **In the case of external experts working outside the school hours, the tutor work one to one or with small groups.**	As a teacher, I might need to work in a class pilot setting with many students working cooperatively or one to and I need the system to take in account that different learning actions can be proposed.	Because the learning actions might be different if conducted one to one or within the entire class.	S
Students behaviour **Most of ASD students manifest hyperactivity, communication difficulties, tend to isolate in the social context.**	As a teacher, I need to work with PA able to engage the students.	Because students could feel demotivated and have to be encouraged.	S

Table 22: User Requirements (ASD) Social & Organisational Environment

12.2 PMLD

The following tables summarise the requirements of the teachers within the PMLD category.

12.2.1 User Group Characteristics

User Group Characteristics Use Case: PMLD			
Characteristics	**User Requirements**	**Purpose/Reason**	**MOSCOW**
Size of user group: Students with Profound and Multiple Learning Disabilities	As a teacher, I should be able to decide if use the system in a cooperative way according to the needs of the learners	Students are included in the mainstream education classes	S
	As a teacher, I should be able to have access to use more than one platform agent at the same time with different students	The lessons can involve different PA	S
	As an independent student the access to the platform could be easy	Cognitive difficulties	C
Age Range: 3 to 21 year old students	As a teacher, I must have the possibility to give appropriate content and methods for each age	Range of chronological and mental ages	M
Gender: Generally balanced	The system must have a genderless design		M
Language and Culture: Countries involved: UK, Italy, Spain All students understand their mother tongue	As a teacher, I must have a system that presents information in the language spoken in my school (i.e. English, Italian, Spanish)	Not all the Italian and Spanish students are able to understand English	M
	As a teacher, I must have a system that presents information in the symbolic representation system we use (for Spain: SPC - Pictographic communication System; Bliss - semantic graphical language; TBD for the other countries)	Some students cannot read and rely on symbols and icons	M
Educational level: individually established by the educational professionals and special needs teachers: from profound and complex learning disabilities to mainstream level	As a teacher, I must be able to choose among activities at different levels of complexity	Students with different cognitive skills	M
	As a teacher, I must be able to offer very small incremental steps to learning	Student works on individual task	M
	As a teacher, I should track individual students' progress over a longer period of time	Long time and repetitions needed	S

Cognitive impairments: These children have profound and multiple learning disabilities and have more than one disability, the most significant of which is a profound learning disability	As a teacher, I must have the possibility to stop and restart the activities when needed	Short attention span or require medical assistance	M
	As a teacher, I must provide activities segmented in various simple phases	Short attention span	M
	As a teacher, I must a have a system that allows me to help the student during the exercise	No adequate cognitive strategies or physical abilities	M
	As a teacher, I must provide repetitive activities	Memory difficulties	M
	As a teacher, I must provide the activities linked to the daily experience	Students cannot understand abstract concepts	M
	As a teacher, I must have a system with a longer speed of response	Limitations in communication through speech	M
Sensory and physical impairments: The students have additional sensory or physical disabilities, complex health needs or mental health difficulties	As a teacher, I must have a system with sensitive sensors	Limited speech abilities, unclear pronunciation, limited natural speech, not be able to sustain gaze	M
	As a teacher, I must have a system that allows me to reward the right answer even if not detected by the system itself	Limited speech abilities, unclear pronunciation, limited natural speech, limited motor skills	M
	As a teacher, I must have a system that produce written messages or alternatively images to guide the exercises	Limitation in hearing	M
	As a teacher, I must have a system that produce voice instruction for the activities	Limitation in hearing or hearing impairments	M
	As a teacher, I should be able to adapt the size of the font	Limitation in vision or visual impairments	S
	As a teacher, I should have a system that produce clear cut and images with sharp outlines	Limitation in vision or visual impairments	S
	As a teacher, I should have a platform that can be used with hand/head/neck adaptors	Limited movement, lack of coordination and specific medical problems	S
	As a teacher, I must have a system with option for being controlled by other devices such as voice control, switches	Limited movement, lack of coordination and specific medical problems	M

	As a teacher, I must have visual displays able to be positioned for pupil's field of vision	Some students are on beds and some use mobility aids, frames, etc.	M
	As a teacher, I should have a system that allows to consider correct the answer given with imprecise movements, limited movement, lack of coordination and specific medical problems	Limited movement, lack of coordination and specific medical problems	S
	As a teacher, I must have a system compatible with standard assistive technologies.	Additional communication, sensory needs, physical needs or specific medical needs	M
Special Skills:			
Experience with Similar Systems: Some students/teachers have experience in using IWBs, mobile devices - iPads and switch accessible toys but no robots. The robot aspect of the project is appealing to the school and the teacher as it is believed that humanoid robots could prove to be very useful in assisting students in learning, capturing their progress and achieving goals.	As a teacher, I need a system that must be easy to set up and be used in a classroom environment	Teachers with low technical experiences	M
IT Experience: Some students/teachers have experience in using IWBs, mobile devices - iPads and switch accessible toys but mainly no robots.	As a teacher, I should have a system that accommodate trial and error and calibration to be truly personalised and responsive for various needs	Teachers/students with different levels of competence in IT	S
Knowledge of Task: The PMLD students may not have a good understanding of the task until well modelled and repeated a number of times over a period.	As a teacher, I must have a system that can replicate the activities in different contexts or with different PAs	No generalisation skills	M

Previous Training: None. A training is needed for the use of NAO robots	As a teacher, I should have a system with a simple user guide and support systems in place	Teachers/students with different levels of competence in IT	S
Frequency of Use: Highly dependent on individuals, schools, and families. Could vary from daily to once a week.	As a teacher, I should have a system that account for regress in skills – and keep the students motivated even if they go back a step	Long time and repetitions needed	S
Motivation to Use: The students are motivated by interactive technologies, use of the robots, their favourite sounds/ music/videos, films/tactile experiences/movements	As a teacher, I could have system that incorporate multi-sensory engagement	Tendency to repeat when stimulated	C
Discretion to Use:	As a teacher, I must have a system that provide the possibility of an external intervention during the use	Help of the assistant needed	M
	As a teacher, I could have a system that works across the home/school barrier	Enhance the time of exercise	C
	As a teacher, I must have a system that allow more than one user per student with different levels of permissions	Parents can collaborate but cannot modify the educational goals	M
Likely Concerns:	As a teacher, I must have a system with an easy and quick procedure to create a learner profile	No additional workload for teachers	M
	As a teacher, I must have a technical support during the pilot or a user guides should be provided	Teachers/students with different levels of competence in IT	M
	Some kind of support/insurance should be necessary for the NAO robot	Students don't necessarily treat things with care	S
	As a teacher, I must have a system that work within current teaching content	A student using MaTHiSiS may distract others in their class	M

Table 23: User Requirements (PMLD) User Group Characteristics

12.2.2 Technical Environment

Technical Environment **Use Case: PMLD**			
Characteristics	**User Requirements**	**Purpose/Reason**	**MOSCOW**

Platform agents	Hardware should be robust Hardware should be fitted with a protective case	Possible unexpected movement	S
	Any protective screen should be easy to interact with	Necessity to use the touch screen	S
Network	Ensure access to downloaded content is easy in schools (firewall security)	Different school devices	M
Security	The system must works with a restricted profile	Different school devices	M
Instrumentation	As a teacher, I must have sensors of sufficient fidelity to be able to collect info from students who may not be able to maintain gaze, or gesture consistently, hold the device themselves, be at a greater distance than usual from the mobile device	Multiple disabilities	M
	As a student, I must have platform agents that can communicate with/receive input from assistive technologies	Limited motor skills, hearing or visual impairment	M
	The system should be able to gather information from different users on the same device	The same device may be use by different students	S
Support	As a teacher, I must have a technical support during the pilot or a user guides should be provided	Teachers/students with different levels of competence in IT	M
	Some kind of support/ insurance should be necessary for the NAO robot	Students don't necessarily treat things with care	S
The MaTHiSiS app will be available to all students	As a teacher, I must have a system that works smoothly	because it is frustrating and demotivating for students when they are expecting to use it	M
	As a teacher, I should have a system that works without the need to setup	because it will save me valuable teaching time	S

	As a teacher, I must have a system in school that does not depend on internet access	because there won't be internet access in the classroom it will be used	M
	As a teacher, I could have a system that runs on operating systems such as Android, iOS, Windows Phone and as a desktop application	as this will allow me to use it in many more situations	C
	As a teacher, I need to monitor the sessions of use (when, where, which progresses,…)	Performance monitoring	C
	As a teacher, I need to have feedback from the sensory during the activities	To recognise the efforts of the student	C

Table 24: User Requirements (PMLD) Technical Environment

12.2.3 Physical Environment

Physical Environment **Use Case: PMLD**			
Characteristics	**User Requirements**	**Purpose/Reason**	**MOSCOW**
Auditory Environment	As a teacher, I must be able to use the software in a noisy environment (both for inputs and for outputs)	so that I don't have to disrupt the class to use the software	M
User posture Many users with PMLD will use walking aids, wheelchairs, etc…	As a teacher, I must have a system that allows visual displays to be positioned for pupil's field of vision	so that students on beds can use the system	M
	As a learner with a non-orthodox posture and position I must have a system at school that can collect sufficient sentiment/pose information from me to be responsive to my performance	Because I will get frustrated and demotivated if the system cannot respond appropriately to me	M

Space and furniture Common classroom	The moveable PAs should be able to move in a potentially cluttered classroom	Because they will be used in mainstream classroom	S

Table 25: User Requirements (PMLD) Physical Environment

12.2.4 Social & Organisational Environment

Social and organisational environment **Use Case: PMLD**			
Characteristics	**User Requirements**	**Purpose/Reason**	**MOSCOW**
Assistance Availability	As a teacher, I need an adequate training	Teachers/students with different levels of competence in IT	M
	As a teacher, I need a direct help by mail, FAQ, helpline or similar tools	When technical assistance is not available	M
School devices	As a teacher, I must be able to use the PAs with group of students	Limited number of devices available	M
Data protection	Parents, teachers, students should have different access rights. Individual students data needs to be stored securely	Privacy	M

Table 26: User Requirements (PMLD) Social & Organisational Environment

12.3 Mainstream Education

The following tables summarise the requirements of the teachers within the ME category.

12.3.1 User Group Characteristics

User Group Characteristics Use Case: Mainstream Education			
Characteristics	**User Requirements**	**Purpose/Reason**	**MOSCOW**
Italy: 2,583,514 pupils at primary school, 1,649,408 at the first grade secondary school and 2,628,648 at the second grade secondary school.[7] **Spain: 2,918,630 pupils at primary school; 1,864,712 pupils at compulsory secondary school**[8] **In Castilla y León Region: 182,793 pupils at primary school, 84,694 pupils at compulsory secondary school.**[9] **UK: There are around 8.5 million children in schools.** **Lithuania: There are 335,202 children in schools (2015/2016 statistics)**	Platform agents should be able to gather feedback from different students working collaboratively and individually.	Because students with special needs have to be included in the mainstream class; students will work in groups and individually.	M
	Adaptability across a range of idiosyncrasies and levels of functioning	Because student groups in mainstream education will vary in composition by: • size of class • ability of class • age of class • class members with SEND • class members with different languages	M

[7]Source: Italian Ministry of Education, University and Research: http://hubmiur.pubblica.istruzione.it/web/ministero/cs130915

[8]Source: Spanish Ministry of Education, Culture and Sport- statistics data: http://www.mecd.gob.es/servicios-al-ciudadano-mecd/dms/mecd/servicios-al-ciudadano-mecd/estadisticas/educacion/indicadores-publicaciones-sintesis/datos-cifras/Datosycifras1516.pdf

[9] Source: Regional statistics data course 2015/16

Age Range: 8 to 22	Learning actions should take into consideration the different school curricula Adaptability of content and methods across a range of chronological ages and different levels of complexity	Because student groups in mainstream education will vary in composition by: • size of class • ability of class • age of class	M
Gender: **Generally balanced**	Genderless design	Because classes contain both boys and girls	M
Language and Culture: **IT: Italian, presence of immigrants in different proportions**	IT: Italian (or iconic) should be the working language Materials in English for the teachers should be simple and concise	Because the teachers and students can speak some English, but Italian is the first language. Some students with foreign languages or SEN could benefit from symbol use	M
Language and Culture: **ES: Spanish, presence of immigrants/migrants**	ES: System will have to be proposed in Spanish	Because this is the teaching language	M
Language and Culture: **UK: English**	UK System should be presented in English. Ability to translate could be beneficial in some instances.	As English is the main spoken language, but there may be some students without English as a first language	S
Language and Culture: **LT: Lithuanian** **No presence of immigrants/migrants**	LT: All the system should be in Lithuanian language. Instructions for the teachers could be provided in English language Ability to choose language (Lithuanian, EN, FR, ES) – could be added value teaching some curriculum subjects	Lithuanian language is the state language and teaching language in Lithuanian mainstream schools Lithuanian language is the first language	M

Educational Level: **IT: 3rd , 4th of primary school** **3rd of secondary school second grade (high school)** **ES: Infant school up to 6th grade primary school (possibility of secondary school level if needed) (up to 11 years old or over if needed)** **UK: ages 11-18** **LT : age 11 -16 – secondary school**	Inclusive learning must be considered The system must adapt to different activities or give several levels of complexity for the same activity System understandable for people with various levels of education and non-technical background	Because the age ranges are wide and because classes may include PMLD and ASC students	M
Cognitive impairments: **ES: Presence of students with ASD, Cerebral Palsy, intellectual disability, pupils with sensorial impairment, dysphasia, aphasia or other very significant communication and language disorders. Pupils with specific learning difficulties (dyslexia, dyscalculia, etc.). Pupils non-native speakers** **UK: Presence of students with SEND.**	The system must be able to present differentiated learning	Because there will likely be students with some form of SEND within the cohort	M
Cognitive impairments: **IT: Presence of students with specific learning difficulties (dyslexia, dyscalculia, etc.) or non-native speaker and presence of ASC and PMLD students**	The system must include the possibility to: - Simplify tasks for individual users - Use dispensative or compensative tools	Because some students would struggle with the base level	M

LT: Cognitive impairments are related to learning disabilities, concentration difficulties, decreased mental intelligence. **Pupils with specific learning difficulties such as reading disorder (dyslexia), writing disorder (dysgraphia), calculation disorder (dyscalculia), speech disorder (dyslalia). Also, some students might have attention deficit hyperactivity disorder.** **UK: Presence of students with a range of SEND.**	Ability to individualize learning tasks for each student according specific his/her learning needs		
Sensory and physical impairments: **ES: Deaf children and also children with severe visual impairment may be in the classroom** **Lithuania: there might be few students with the visual impairment in the classroom** **IT: there might be children with severe visual, verbal and motor impairments in the classroom**	The system must include the possibility to adapt the tasks using purely audio or purely visual alternatives for individual users.	Because we need to support sensory disability	M
Experience with Similar Systems: **They do not have experience of robot, they have experience using PC and IWB, some of them using tablets** **Some students/teachers have experience with different devices. Some none.**	Training for using robots will be needed The system should adapt to different activities or give several levels of complexity for the same functions	As many teachers have no experience with robots. As some students have more experience than others. As the system will be used in classes of different ages	M

IT Experience **The students have experience of using PC and IWB, some of the teachers have experience using IWB and mobile devices. Schools are not currently equipped with technology but they will be through the project based on technical partners' advice.** **In some classes teachers work with coding programs** **UK: Most teachers will use PC, some will have access to tablets and IWBs. Occasional use by computing teachers of using Lego robots.** **LT: Using as well tablets. Some of them are familiar with Lego robots.**	Training on the technical use of the system should be provided Instructions should be clear and concise Intuitive system required	To get up and running with the system quickly To allow quick problem solving	M

Previous Training **IT: The student did not receive any training. Some of the teachers completed training on the use of mobile technologies (tablets) and IWB for teaching** **UK: Pupils have experience of PCs, some will have experience of tablets and other mobile devices.** **ES: Pupils are familiar with IWB, notebooks (those on 5th and 6th primary school level) and most of them use tablets or other mobile devices at home.** **LT: Lithuania: students use PCs, laptops, IWBs, tablets and mobile devices. Some of them are familiar with Lego robots.**	Training on the technical use of the system should be provided Instructions should be clear and concise Training required for robot use	To be able to use the system in the educational context Because some teachers and students do not have experience using ICT To get up and running with the system quickly To allow quick problem solving As not familiar with the technology	M
Frequency of Use **UK: In general, IWBs used frequently, tablets used less frequently.** **PCs and tablets (where schools have these) need to be pre- booked for a session.** **Robots unavailable unless provided by the project.** **LT: Mobile devices need to be booked for a session.**	The system should run on equipment available in the class. System must maintain value across habitual or occasional paradigms of access and use.	Because some schools may have older PCs and no access to tablets or IWBs.	M

Motivation to Use **IT: The school and the teacher are willing to develop the use of technologies for mainstream education and special needs in order to develop a more inclusive learning environment.** **UK: The teachers want to know what engages pupils to move to higher levels and what helps pupils to become more persistent in learning leading to higher achievement and progression.** **ES: For teachers, make sure that the system has an initial approach to what is expected: emotional and cognitive recognition, interactivity, reusability of materials, "friendly use"…** **LT: Administration believes that MaTHiSiS platform would help easier to communicate new learning materials. It is expected that students will be engaged and will increase his/her learning motivation.** **System / Technology must help / facilitate the learning process.** **The platform would allow more intense learning pace, i.e. students who are engaged can continue progressing in new topics at home and outside the school.** **Everything depends on the quality and attractiveness of learning material - if it will be interesting, students will be eager to get access to platform inside and outside the school.**		Because it could have a positive impact for teaching and learning Because pupils' engagement could be sustained leading to higher achievement and progression.	S

Discretion to Use **Depending on the school curriculum** **Different users on the same device** **Numerous users**	The learning actions should be developed considering the class level and curriculum content The platform should be useable by different users on the same device, and their data should be separated. The system should be able to be used by many users at the same time or in a cooperative way	Because the curriculum is different depending on age of the students Because multiple classes use the same devices and devices are not available one per student Because devises are not available one per student and the whole class has to be involved	M
Likely Concerns **Technical support during the pilot not to waste time of the lesson.** **Possible isolation of the special need student in the context of the class due to the use of system not involving the whole class or at least a group of students.** **Lack of support staff.**	The pilot organisation should consider the presence of special needs students and the participation of all the students to the learning activity I need to be able to run the software without need for extra staff	Because the lesson has to be inclusive Because Teaching Assistants may only be present when students with severe SEND students present and technical staff is not available	S M
Other Relevant Characteristics **The teacher would like to receive training on the technical use, and support to develop pedagogical application in class and with special needs students in an inclusive environment.**	Training and assistance should be provided on the technical and pedagogical use of the system Support will be needed which can provide quick solutions to ensure lesson flow is not interrupted by technical problems.	Because most of the teachers do not have experience using ICT Teachers are not technical so a technical support will be essential.	M

Table 27: User Requirements (ME) User Group Characteristics

12.3.2 Technical Environment

Technical Environment Use Case: Mainstream Education			
Characteristics	**User Requirements**	**Purpose/Reason**	**MOSCOW**
Internet access	Internet connection must be checked to verify if it corresponds to the requirements: Speed Not blocked sites Number of users Ensure access to downloaded content is easy in schools (firewall security)	Because some schools do not dispose of proper internet connection Some schools have firewalls, careful checking using a pupil log in will be needed.	M
Multiple students per device	The system must be able to gather information from a group of students working on the same device	As devices are not available one per student, more students use the same device at the same time	M
Training and support	The system management should be easy (training should be provided). Helpline should be provided FAQ database should be set up Meeting with other schools involved in the project would be useful	Because teachers need to be equipped to solve issues themselves Because if issues cannot be solved this will disrupt lessons. Because this would enable knowledge sharing.	M
Restricted profile	Test system must be conducted with a restricted profile.	Because of privacy	M

Sensor appropriateness	Sensors must be of sufficient fidelity to be able to collect info from students who may not be able to maintain gaze, or gesture consistently, hold the device themselves, be at a greater distance than usual from the mobile device…	To take into account students with special needs included in the mainstream class	M
Assistive technology interface	Ensure all platform agents can communicate with/receive input from assistive technologies (e.g., switch)	Because some students cannot interact with the system without assistive technologies.	M
Differentiation	Pilot materials must be differentiated	Because learning actions that can be performed by some ASC and PMLD students in the class might not be complex enough for the other students in the class	M
Training	Training on the technical use of the system must be provided, instructions should be clear and concise	Because training will be required in order to use the system.	M
Multiple students	Platform agents must gather data from more than one student	To ensure or record instances during cooperative learning	M
All types of users will have the MaTHiSiS app/software downloaded and installed on their PC, laptop or mobile device.	Compatibility with devices schools already have. Pilots technical requirements should adapt to the school's devices. Ensure access to downloaded content is easy in schools (firewall security, and sometimes school connectivity is shared between many classrooms at the same time).	Because the schools do not have budget to support the project?? Because it will not be possible to increase speed of data for the project?	M

20-25 children per classroom	The system should be able to gather information from different users on the same device. Sensors should be of sufficient fidelity to be able to collect info from places with a lot of noise or which are crowded Consider the possibility to work offline at certain times.	Because the same device may be used by different students so So as not to interfere with other activity to make the system function. Because school broadband can go down and the lesson needs to flow.	M
Crowded class	Hardware should be robust Hardware should be fitted with a protective case Any protective screen should be easy to interact with	Because it will be handled by students with limited supervision. Because screen covers can cause frustration if they impede interaction	M
All types of users will have the MATHISIS app downloaded and installed on their mobile device.	Device management is important (centralised device management).	As there is not time or technical support resources to manage devices individually	M
Old PCS	The system should run on older hardware/OS/software	Because school budgets do not enable the most up to date hardware/OS/software systems	M
Desktop PCs may lack webcams and speakers	Systems should not rely on video feedback.	Because the school hardware may not support this	M
IWBs use promethean Active inspire software.	System should be compatible with promethean Active Inspire for IWB	Because this is the present technology.	M

Own devices	The system should support a range of devices ideally some at low spec.	Because students have their own devices which would increase use of system in school and out	S

Table 28: User Requirements (ME) Technical Environment

12.3.3 Physical Environment

Physical Environment **Use Case: Mainstream Education**			
Characteristics	**User Requirements**	**Purpose/Reason**	**MOSCOW**
Auditory Environment	System should be usable in a noisy classroom environment, and consideration should be given to this in terms of both output (e.g., sufficient volume control on mobile devices) or input (e.g., for audio sentiment analysis)	Classes work in an inclusive and cooperative environment: all students are part of the class work at the same time including students with special needs Because it might not be possible to separate groups of students during the school hours to enable quiet areas	M S
User posture	The system should be able to gather feedback from users not maintaining a proper posture and attention	Because special needs students part of the mainstream class do not maintain an appropriate posture	S
Space and furniture **Individual desk and chairs that can be organized in different ways**	The system must be able to be set up and operated in a potentially cluttered classroom and amenable to shifts of siting and to restricted device mobility	Because classroom space is limited and some mainstream classes have limited space.	S

Table 29: User Requirements (ME) Physical Environment

12.3.4 Social & Organisational Environment

Social & Organisational Environment **Use Case: Mainstream Education**			
Characteristics	**User Requirements**	**Purpose/Reason**	**MOSCOW**
Assistance Available **The teacher might need technical support: no technical staff available at**	Technical assistance should be provided, if needed, or a system recording problems should be developed	To allow quick solution of problems that may prevent system use	M

schools	Adequate teacher training should be provided Direct help available if needed	To equip teachers as technical experts in the system	M
	Page dedicated to technical assistance on the web site	To give quick access to support from MaTHiSiS team	M
	Help by email may be needed. List of FAQ also useful	To enable teachers to troubleshoot issues quickly	S
	Ideally the system should offer built-in help in setup and configuration so that teachers without the assistance of technical staff can configure or reconfigure it.	To enable teachers to solve their own problems	S
Classroom population **IT: The classrooms are composed of approximately 20 students.** **UK: Classes generally have 30 pupils per group.** **ES: Classrooms with maximum of 25 pupils in primary school levels and 30 pupils in secondary school levels** **LT: Classrooms with up to 25 students in secondary level**	The pilot setting should take into account interactions between students. Some learning goals will require interaction between students. It would be useful if the system can gather information from different learners working at the same learning goal at the same time on the same device	Because the class works collaboratively and inclusively with pupils working both individually and collaboratively in groups. Because students collaborate together whilst sharing devices	M
Setup time	The lessons must be quick and easy to set up	Because teachers get no turnaround time between set lessons	M

Table 30: User Requirements (ME) Social & Organisational Environment

12.4 Industrial Training

The following tables summarise the requirements of the teachers within the industrial training category.

12.4.1 User Group Characteristics

User Group Characteristics Use Case: Industrial Training			
Characteristics	**User Requirements**	**Purpose/Reason**	**MOSCOW**
Size of user group: **Active population in Europe** **(242 million in 2014)**	Potential for massive use and thus solicitation of the system, to be considered at a later stage of development.	N/A	N/A
Age Range: **18 to 65 years old (depending on EU member-states)**	Extremely variable characteristic, most users will nonetheless be comprised in the 25-45 age range. Younger profiles will have more exposure to IT technologies while older profiles will remain less computer-literate, **but both profiles will nonetheless require a user-friendly interface.**	Can be all employees of the European workforce	M
Gender: **Roughly balanced but overall deficit of women in some field of industries**	Reflect gender split seen in the real world in pilots	Provide the pilot experience the closest possible to reality	M
Language and Culture: **Mostly French-speaking employees, with various (although mainly technical) background/education levels**	System will have to be proposed in French A first pilot in English can be acceptable, due to the level of training of the employees involved in the pilots but if the system is to be deployed more globally French will have to be proposed.	To be useable by everyone regardless of their educational background	S
Educational Level: ***Min.* completed secondary education** ***Max*. Engineers and/or university graduates**	Make sure that the system can be understandable and tailored for people with various levels of education and with a mostly technical background	To be useable by everyone regardless of their educational background	M

Cognitive impairments: **None beyond specific learning schemes and cognitive patterns (not impairment but rather individual specificities)**	The algorithm should be able to take these specificities into account.	To be useable by everyone regardless of their impairment or absence thereof	M
Sensory and physical impairments: **No major impairment to be expected but some extreme learning conditions could be expected**	Ensure that the system can collect user data in extreme environments such as factory lines, workshops, etc. (noise, dust, limited luminosity, etc.) **The first pilots can however be held in more 'learning friendly' environments to mitigate that risk.**	Have the solution ready for industrial use cases	S
Learners with hearing impairments could be targeted at a later stage	Ensure that the system can work for hearing-impaired people (visual learning, no sound).	To be useable by everyone regardless of their impairment or absence thereof	W
Experience with Similar Systems: **None.**	Ensure that the system is easily understandable and that the interaction with the platform is as intuitive as possible.	To be useable by everyone regardless of their educational background	M
IT Experience **High, used to deal with IT systems for professional purposes mainly.**	Ensure that the system provides a user experience at least similar to classical professional IT tools (cf. MS Office and other professional suites, possibly user-friendlier)	To be easy to use with a basic IT-knowledge	M
Knowledge of Task **Variable. Cannot be detailed.**			
Previous Training **Classical training methods (presentations, lectures, etc.)** **Possibly no training.**	The system must be capable of reusing contents provided by the trainers to minimize the effort to be foreseen	To be easy and effortless to use for trainers.	M

Frequency of Use **Could vary depending on the training session considered/multisite live training could be envisioned.**	Make sure that the system can be used remotely, with a trainer being in one physical place and learners being in a different place. This can be envisioned at a later stage of development, first pilots will be held 'in situ'	To fully exploit the potential of the solution for industrial trainings	S
Motivation to Use **Improve the efficiency of training sessions/modernize the professional training methods used by the company**	Make sure that the system provides what is expected from it: interactivity, personalized training and efficiency in the learning process	To be sure that the platform is actually used in the long run and not a simple 'gadget'	M
Add a 'distance learning' component to existing in-class or on-site training	Make sure that the MATHISIS platform can be used at home/on personal devices by the learners, in order for them to complement the teaching received in class/on site individually. Here again, could be envisioned for a later stage of the development.	To fully exploit the potential of the solution for industrial trainings	S
Discretion to Use **Pedagogical contents will be confidential**	Ensure that the system has enough security to deal with confidential materials/at least at the stage of the pilot, only adapting to the platform training materials that are not too sensitive.	To make sure industrial players are not reluctant to use the platform.	M
Likely Concerns **TBD.**			
Other Relevant Characteristics **TBD.**			

Table 31: User Requirements (IT) User Group Characteristics

12.4.2 Technical Environment

Technical Environment **Use Case: Industrial Training**			
Characteristics	**User Requirements**	**Purpose/Reason**	**MOSCOW**
Companies already have some digitalized training	Existing content should be easily adaptable (automatic	To be easy and effortless to use for	M

content and will show interest in being able to reuse them	extraction from .ppt, .odp or .pdf document, .mp4 or .swf, copy/paste feature, intuitive interface for the integration of content)	trainers.	
Companies already use a certain type of IWB, tablets, PCs, etc. **IDGEO does not use IWB but it could be a plus to be adaptable to IWB for future developments of the platform**	Compatibility with the material used by the company (different IWB brands, tablets (Android, Apple), OS (Windows, Mac OS), possibility to use MATHISIS on a simple PC, etc.)	To fully exploit the potential of the solution for industrial training	W
Companies want to keep their data confidential, including some of their training materials	Sufficient security of data in the cloud/possibility to work offline/**on a local server**	To make sure industrial players are not reluctant to use the platform.	M/**S**

Table 32: User Requirements (IT) Technical Environment

12.4.3 Physical Environment

Physical Environment **Use Case: Industrial Training**			
Characteristics	**User Requirements**	**Purpose/Reason**	**MOSCOW**
Auditory Environment	System should be usable both in collective 'in-class' and 'remote' training modes, as well as in a 'distance learning' mode (used at home/at work outside the training session by learners).	To fully exploit the potential of the solution for industrial trainings	S
User posture	Expectations for the pilots are to use mainly tablets and PCs to provide training.	For simplicity purposes (also best adapted to the SME where the pilot will be organized	M
	Personal devices of the learners could also be used if the 'distance learning' mode is tested during the pilots	To fully exploit the potential of the solution for industrial trainings	S

Space and furniture	Expectations for the pilots are to use mainly tablets and PCs to provide training. Personal devices of the learners could also be used if the 'distance learning' mode is tested during the pilots	For simplicity purposes (also best adapted to the SME where the pilot will be organized)	S

Table 33: User Requirements (IT) Physical Environment

12.4.4 Social & Organisational Environment

Social and organisational environment **Use Case: Industrial Training**			
Characteristics	**User Requirements**	**Purpose/Reason**	**MOSCOW**
Assistance Available **Possibly available from technical staff if trainers feel out of their depth?**	Technical staff not always available and so trainers need either some way of registering problems or receive adequate training (at least a way of registering problems and seek assistance online – a MATHISIS community could answer the main technical problems encountered with the solutions they found?)	To make sure the way to use the solution is understood and that trainers are not left alone in their handling of the platform, which could later cause disinterest if they face some issues	S
Remote sessions **Trainers would potentially organize training sessions remotely**	The system will have to be useable remotely, with the trainer being present in one physical space and the learners being in another physical space/possibly several physical spaces, if a multisite training session is organized	To fully exploit the potential of the solution for industrial training	S
	The system will have to be useable on personal devices in addition to tablets and PCs used during the training session	To fully exploit the potential of the solution for industrial training	S

Table 34: User Requirements (IT) Social and organisational environment

12.5 CGDL

The following tables summarise the requirements of the teachers within the CGDL category.

12.5.1 User Group Characteristics

User Group Characteristics Use Case: Career Guidance			
Characteristics	**User Requirements**	**Purpose/Reason**	**MOSCOW**
Size of user group:	Number of students of primary-secondary-tertiary education: approx 2.150.000 (2008) Unemployed people: approx 950000 (registered unemployed)		
Age Range:	As a career guidance counsellor I need a system that is suitable for the age group 18 to 65 years old (university students to retirement years)	Because this age group includes university students, employed and unemployed people who are the clients of career guidance services	S
Gender:	As a career guidance counsellor I need a system that does not discriminate based on gender	As this is a principle of career guidance provision	S
Language and Culture:	As a career guidance counsellor I must have a system that presents information in Greek and English	due to an increasing number of immigrants and refugees in Greece	M
Educational Level:	As a career guidance counsellor I must have a system that can support the career needs of all different education groups	Because e.g. the needs of a university graduate who seek their self-awareness is different than those of unemployed professionals who lost their jobs due to the financial crisis. The later need to take employment decisions and to find new career opportunities.	S

Cognitive impairments:	As a career guidance counsellor I may need to provide career guidance to people with soft cognitive impairments or learning difficulties (e.g. dyslexia)	Because these people are able to integrate into and offer to the labour market doing simple jobs (e.g. gardening) or more complicated ones and because they are sometimes neglected by career guidance structures and strategies.	S
Sensory and physical impairments:	As a career guidance counsellor I must have a system that can collect user data by analysing client answers in career guidance exercises, questionnaires etc.	Because career guidance skills and state of learners cannot be evaluated only by facial and skeleton motion analysis	M
Special Skills:	As a career guidance client I want a system that does not need special skills	Because I may not have such skills	S
Experience with Similar Systems:	As a career guidance client I would like a system for which previous experience with similar systems is not necessary	Because I may not have such an experience	S
IT Experience	As a career guidance client I need a system that: • is as simple as possible • works in an automated way • is very friendly • uses games • has colourful interface and graphics etc.	Because otherwise I could face technical difficulties or get easily bored with the system	M
Knowledge of Task	As a career guidance counsellor I must receive appropriate training (this is also the case for clients) before I support my clients or ask them to fill the tasks in the platform. I must have a system that is as friendly and pleasant to use as possible	Because although most students have good IT skills (they own a smartphone and are familiarized with a tablet) some older unemployed people, refugees etc. may lack IT skills due to the fact that they don't have a PC or smartphone, or they lack modern obligatory education and may not easily understand their tasks	M

Previous Training	The system should take into consideration regular face to face contacts between counsellor and clients	as career guidance cannot be provided without human contact – human assessment.	M
Frequency of Use	As a career guidance client, I want a system that is available at times and in places that suit my needs (ideally at a 24hour base)	Because I may need to use the system according with my availability	C
Motivation to Use	As a career guidance client, I would like a system that offers real career gains e.g. • helps me with my action plan • gives me psychometric tests results • provides me with a portfolio app • helps me to build my career network • informs me about career opportunities	otherwise I would not have strong motives to participate at the pilots and because building a system that does not connect my needs with the needs of the environment (education system, labour market) is of minor use.	S
Discretion to Use	As a career guidance client, I would prefer that all of my personal data as well as all interaction with counsellors are handled with discretion. As a career guidance counsellor I would want a system that respects the principle of confidentiality	Otherwise I would not feel comfortable to work with the system and the counsellor	M
Likely Concerns	As a career guidance counsellor I want the interaction of my clients with the system to be combined with constant face to face counselling sections (and the system to constantly take into consideration such input)	Because the counselling relation between the client and the counsellor is very important for the success of the career intervention.	S
Other Relevant Characteristics	As a career guidance client I would like to: • Know my rights and obligations when using the system (principle of transparency) • Get informed about the aims, advantages and limitations of the system during the whole period I interact with it.	Because that way I will not have unrealistic hopes when using the system nor I will set wrong targets through it	S

	As a career guidance counsellor I need a system that • evaluates the cognitive state of my client in a clever way • stores and manages information about both the client and the environment (education, labour market, social environment etc.) • gives regular feedback to the clients about their state • encourages the clients to act • investigates the needs of the clients • investigates the satisfaction of the clients • respects the principles of career guidance provision[10]	As these may influence the effectiveness of the system and the project for the career guidance clients	S

Table 35: User Requirements (CGDL) User Group Characteristics

12.5.2 Technical Environment

Technical Environment Use Case: Career Guidance			
Characteristics	**User Requirements**	**Purpose/Reason**	**MOSCOW**
	As a career guidance client, I need a system that is compatible with all kinds of PCs and tablets (even older models). Although we plan to hold most career guidance sessions at the PC labs of the stakeholders, which are equipped with modern technology, As a career guidance client I need a system that is: • Supported by a helpline	It could be possible that some clients may want to log in from their houses, where their PCs are not equipped with a modern OS. (e.g. they have a windows 98 OS)	S

[10] European Lifelong Guidance Policy Network (ELGPN). (2012) *Life guidance policy development: A European Resource kit*. University of Jyvaskyla, Finland and Finnish Institute for Educational Research (FIER), Saarijarvi, Finland, page 14-15, available at http://www.elgpn.eu/publications/browse-by-language/english/ELGPN_resource_kit_2011-12_web.pdf

Table 36: User Requirements (CGDL) Technical Environment

12.5.3 Physical Environment

Physical Environment Use Case: Career Guidance			
Characteristics	**User Requirements**	**Purpose/Reason**	**MOSCOW**
e.g., Auditory Environment	As a career guidance client, I would like the audio and video of the system to be loud and clear.	Because auditory may not be only a classroom, but also home and road.	M
e.g. user posture – many users	As a career guidance counsellor I would prefer that the system gives me the ability to choose if the answer could be given by the client through: • Posture • Audio • Video • free text • multiple questions • exercises incorporating graphics e.g. a ladder in which the client must write the steps he has to follow in order to accomplish his goal etc.	Because the career guidance evaluation cannot be made only by one channel but by a multichannel approach (narration, fill in exercises etc.)	S
e.g. Space and furniture	As a career guidance client I would like comfortable space and furniture at the premises where the pilots will take place	In order to make the pilots as pleasant as possible	S

Table 37: User Requirements (CGDL) Physical Environment

12.5.4 Social & Organisational Environment

Social and organisational environment Use Case: Career Guidance			
Characteristics	**User Requirements**	**Purpose/Reason**	**MOSCOW**
e.g., Assistance Available	As a career guidance counsellor / client I would like to get assistance in operating the MaTHiSiS platform, through • regular face to face support • helpline • list of frequently asked questions	In order to be fully familiar with its characteristics and abilities and to be able to explore its full potential	M

Table 38: User Requirements (CGDL) Social and organisational environment

13. Annex 3 – MaTHiSiS Learning Experience Examples

13.1 ASD Learning Experience examples

13.1.1 Learning goal: Motor Skills

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Motor sequencing	Repeat/imitate a sequence	Tablet PC IWB Robot (Turtlebot & NAO)	Present a sequence of gestures and ask the student to repeat them. Give feedback and prompting.	Teacher initialises the system and begins the student's interaction	Start of learning, initial setup	None
				The PA displays (or performs) a sequence of gestures and then asks the student to repeat them.	Observe, learn and interpret sequence of gestures	None
				Physical demonstration of the observed sequence.	Develop motor sequencing and spatial coordination	None
				The system responds with confirmation, correction or prompting	Feedback on success, failure or inactivity	None
				Repeat for the predetermined number of times	Completion => LA achieved	None

Table 39: Learning experience example (ASD) – Learning goal: Motor skills (from the Learning Experience outlined in Section 5.1.3)

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Conversation	Engage in dialogue	Tablet PC IWB Robot (Turtlebot & NAO)	Begin a conversation with introductions and continue to ask the student questions. Use a predetermined action to regain student concentration when attention wanes.	Teacher initialises the system and begins the student's interaction	Start of learning, initial setup	None
				The PA poses questions to the student.	Listening and turn taking.	None
				Appropriate verbal response given.	Demonstrate comprehension and develop conversational skills.	None
				The system responds with confirmation, correction or prompting	Feedback on success, failure or inactivity	None
				Repeat for the predetermined number of times	Completion => LA achieved	None

Table 40: Learning experience example (ASD) – Learning goal: Communication/Socialisation Skills (from the Learning Experience outlined in Section 5.1.3)

13.1.2 Learning goal: Language spontaneity (improvement)

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Imitation	Imitate gestures in a song / story.	IWB Tablet PC Robot (Turtlebot & NAO)	The PA will tell a story/or sing (play) a song. The story/song will have a different gesture with the body. The child will imitate them.	1. PA shows a different gesture while it tells a story. 2. The pupil listens to them. 3. The pupil has to imitate the gestures.	1. Initial setup. 2. Pay attention. 3. 50% SLA achieved.	None
	Imitate onomatopoeia in a song / story.	IWB Tablet PC Robot (Turtlebot & NAO)	The PA will tell a story/or sing (play) a song that will include different onomatopoeias. Pupil will have to imitate them.	1. PA expresses different onomatopoeias while it tells a story. 2. The pupil listens to them. 3. The pupil has to imitate the onomatopoeias.	1. Initial setup. 2. Pay attention. 3. SLA achieved.	None
Spontaneity in asking questions	Guess where an object / person is.	IWB Tablet PC Robot (Turtlebot & NAO)	Hide an object in a virtual (IWB, Tablet, PC) or physical (Robot) space and the pupil will ask to clues to guess what it is.	1. PA shows different objects. 2. One of them is hidden. 3. Pupil has to guess it. He/she can ask clues to guess what it is. 4. PA says different clues. 5. The pupil guesses the object.	1. Initial setup. 2. Attention to the item. 3. Feedback 4. Feedback 5. 50% SLA achieved.	1 minute / 5 seconds Time decreases in response to progress

	Game "Veo-veo". / "I Spy" NOTE: the detailed rules of the game are culturally specific	IWB Tablet PC	Display a number of pictures or a photo of a room. Describe one of the visible objects, by initial letter, learner must guess what the object is.	**I spy version** 1. PA says "I spy with my little eye, something beginning with…" 2. The pupil begins to guess 3. PA responds with "yes that's it" or "Try again" 4. If pupil struggles, PA can give further clues (see Veo veo version below) 5. The pupil guesses correctly.	1. Initial setup. 2. Start of the action. 3. Feedback 4. Feedback 5. SLA achieved.	None
		Robot (Turtlebot & NAO)	Describe an object in the room, by colour or initial letter, learner must guess what the object is.	**Veo veo version** 1. PA says to the pupil: "I see, I see…!" / 2. The pupil has to start guessing, so asks: "What do you see?" 3. PA says: "I see a thing". 4. The pupil answers: "That thing is?" 5. PA gives clues about the object (e.g. it 6. starts with the letter…; it's big, it`s red colour, goes close to the examined object etc.) 7. The pupil begins to guess 8. If pupil struggles, PA can give further clues (see Veo veo version below) 9. The pupil guesses correctly.	1. Initial setup. 2. Start of the action. 3. Feedback 4. Engagement 5. Feedback 6. Engagement 7. Feedback 8. SLA achieved.	None
Describe	Guess what object is it.	IWB Tablet PC	Display an object obscured / in outline, the image is gradually revealed as the student tries to identify it	1. PA introduces the obscured object 2. PA asks: "What is it?" 3. Pupil has to guess what the object is 4. PA says if the answer is correct/wrong 5. If wrong, the PA reveals part of the object and asks him/her: "Do you know what it is yet" 6. Pupil says the name of the object. 7. PA says if the answer is correct/wrong	1. Initial setup. 2. Starting the action 3. Pupil interaction 4. Communication 5. Feedback 6. 50% SLA achieved. 7. Feedback	1 minute / 5 seconds Time decreases in response to progress

		Robot (Turtlebot & NAO)	Robot introduces the pupil to an object inside a bag. The pupil feels the object and tries to guess what it is.	1. Robot introduces one object inside a bag. 2. Robot asks: "What is it?" 3. Pupil has to guess what it is. To do this he/she touches the bag without watching. 4. Pupil describes features of the object. 5. Robot asks him/her: "Have you got the solution?" 6. Pupil says the name of the object. 7. The pupil then will take out the object and place it in front of the robot. The robot will recognise the object and say if the answer is correct/wrong.	8. Initial setup. 9. Starting the action 10. Pupil interaction 11. Communication 12. Feedback 13. 50% SLA achieved. 14. Feedback	1 minute / 5 seconds Time decreases in response to progress
	Describe a picture.	IWB Tablet PC Robot	The screen displays an image/picture or the robot points to a physical object. The PA says the beginning of the sentence: for example, "the ball is…" and pupil has to complete the sentence "…red!".	1. Screen will show an image / a picture or robot will point to a physical object. 2. The PA asks: "What are you seeing?" 3. Pupil answers everything he/she sees. 4. Robot introduces a sentence. 5. Pupil completes the sentence. 6. Robot will say if the answer is correct/wrong.	1. Initial setup. 2. Starting the action. 3. Pupil interaction 4. Feedback 5. Pupil interaction 6. SLA achieved.	None

Table 41: Learning experience example (ASD) – Learning goal: language spontaneity (improvement) (from the Learning Experience outlined in Section 5.1.3)

13.1.3 Learning goal: Emotional identification and expression (emotional traits)

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Visual attention	Visually track pictures (focusing)	IWB Tablet PC	The PA will present different pictures about one topic (emotional traits). They move in the screen.	1. Show several pictures in the screen (about one emotional trait). 2. Provide instructions about one emotional trait. 3. The pupil has to select the picture according this emotional trait.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved.	5 seconds / 1 minute Time increases in response to progress
		Robot (Turtlebot & NAO)	The PA will present different (physical) pictures about one topic (functional vocabulary). It will have it in its hands and move it around.	1. Teacher places a picture in the hand of the robot. 2. The robot provides instructions about one emotional trait. 3. Pupil selects this object/picture according to this emotional trait.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved.	5 seconds / 1 minute Time increases in response to progress
	Look at pictures for a time.	IWB Tablet PC	The PA will present different pictures about one topic (emotional traits). They will be static in the screen.	1. Show several pictures in the screen (about one emotional trait). 2. Provide instructions about one emotional trait. 3. The pupil has to describe features about it to the teacher/partner.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved.	5 seconds / 1 minute Time increases in response to progress
		Robot (Turtlebot & NAO)	The PA will present different (physical) pictures about one topic (emotional traits). They will be static in front of it.	1. Teacher arranges a set of physical pictures in front of the PA. 2. System provides instructions about one emotional trait. 3. Pupil observes at the picture for a while.	1. Initial setup. 2. Understanding and following instructions. 3. SLA achieved.	5 seconds / 1 minute Time increases in response to progress

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Hearing attention	Focus on a sound.	IWB Tablet PC Robot (Turtlebot & NAO)	The PA will present different sounds about one topic: emotional traits • Crying. • Laughs. • Snarls.	1. Appear different sounds about one topic connected with emotional trait (crying, laughs, snarls). 2. The pupil has to recognize which emotion it is. 3. The robot says if the pupil´s answer is correct/wrong.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved.	5 seconds / 1 minute Time increases in response to progress
	Hearing a sound for a time.	IWB Tablet PC Robot (Turtlebot & NAO)	The PA will present different sounds about emotional traits during a time.	1. Appear different sounds about one topic connected with emotional trait (crying, laughs, snarls). 2. The pupil has to recognize which emotion it is. 3. The robot says if the pupil´s answer is correct/wrong. 4. The pupil has to imitate it with his/her voice and express with body and facial gestures.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved. 4. SLA achieved.	5 seconds / 1 minute Time increases in response to progress
Visual discrimination	Find differences between two facial expressions.	IWB Tablet PC	The PA shows different facial expression from (digital) pictures of children (photograph, picture, image, icon, symbol). Differences increase.	1. System shows different pictures about facial expression connected with emotional traits. 2. The pupil has to recognize which emotion it is. 3. The PA says if the pupil´s answer is correct/wrong. 4. The pupil has to imitate it with his/her voice and express with body and facial gestures.	1. Initial setup. 2. Understanding the instructions. 3. Feedback. 4. SLA achieved.	None

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
		Robot	The PA shows different facial expression from (physical) pictures of children (photograph). Differences increase.	1. Robot points out at different pictures about facial expression connected with emotional traits. 2. The pupil has to recognize which emotion it is. 3. The PA says if the pupil´s answer is correct/wrong. 4. The pupil has to imitate it with his/her voice and express with body and facial gestures.	1. Initial setup. 2. Understanding the instructions. 3. Feedback. 4. SLA achieved.	None
	Match two identical pictures.	IWB Tablet PC	The PA shows several facial expressions from pictures of children (photograph, picture, image, icon, symbol). The pupil should match the identical pictures.	1. Show different pictures about facial expression connected with emotional traits. Two of the set of pictures are referred about the same emotional trait. 2. The pupil has to recognize which emotion it is. 3. The PA says if the pupil´s answer is correct/wrong. 4. The pupil has to match the pictures referred to the same emotional trait.	1. Initial setup. 2. Understanding the instructions. 3. Feedback. 4. SLA achieved.	1 minute / 5 seconds Time decreases in response to progress

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
		Robot	The PA has several physical pictures of facial expressions of children (photograph) laid out if front of it and a stack of the pictures on the side. The pupil should match the identical pictures.	1. Teacher lays out different pictures about facial expression connected with emotional traits in front of the robot and a set of pictures in a stack on the side. Two of the set of pictures are referred about the same emotional trait. 2. The pupil has to recognize which emotion it is. 3. The PA says if the pupil´s answer is correct/wrong. 4. The pupil has to match the pictures referred to the same emotional trait by placing one picture next to the other.	1. Initial setup. 2. Understanding the instructions. 3. Feedback. 4. SLA achieved.	1 minute / 5 seconds Time decreases in response to progress
Hearing discrimination (prosodic elements)	Find differences between two sounds of emotional trait (crying, laughing…).	IWB Tablet PC Robot	The PA expresses different emotional sounds.	1. The PA expresses two different sounds about two different emotional traits. 2. The pupil has to recognize which emotions they are. 3. The PA says or shows on screen if the pupil´s answer is correct/wrong.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved.	None

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Match two identical emotional sounds.	IWB Tablet PC Robot	The PA expresses different emotional sounds. Several of them are identical. The pupil says which are identical.	1. The PA expresses different sounds about different emotional traits. Some of them are referred to the identical emotion. 2. The pupil has to recognize which emotions are similar. 3. The PA says if the pupil´s answer is correct/wrong. 4. The pupil has to imitate them.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved. 4. Feedback. 5. SLA achieved.	None
Eye contact	Make eye contact with an animated target.	IWB Tablet PC	Make eye contact with an avatar on the screen. While the PA narrates a story through an animated avatar, pupil makes eye contact with the avatar.	1. The PA will tell a little story through an animated avatar. 2. The pupil has to make a visual contact with the avatar´s eyes (region). 3. The avatar will smile when the pupil has a good level of visual contact. 4. The pupil has to tell the same story (which the PA told previously), and always the two of them (pupil and avatar) have to keep their eyes themselves.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved /Feedback. 4. SLA achieved / Feedback.	5 seconds / 1 minute Time increases in response to progress

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
		Robot	Make eye contact with the robot. While the PA talks, pupil makes eye contact with it.	1. The robot will tell a little story with a little head´s movements. 2. The pupil has to make a visual contact with the robot´s eyes. 3. The Robot will show its eyes with the green colour when the pupil has a good level of visual contact. 4. The pupil has to tell the same story (which the robot told previously), and always the two of them (pupil and robot) have to keep their eyes themselves.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved /Feedback. 4. SLA achieved / Feedback.	5 seconds / 1 minute Time increases in response to progress
	Make eye contact with different facial expression.	IWB Tablet PC	A simulator of facial expression makes different emotional traits while pupil makes eye-contact.	1. The PA will show different pictures about facial expression about one emotional trait. They will appear one by one. 2. The pupil has to recognize it (each picture will belong to one emotional trait). 3. The PA will say if it is correct/ wrong. 4. The PA will show a dynamic line according to an emotional trait morphology (mouth, eyes…). 5. The pupil has to brush up the lines with his/her finger.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved /Feedback. 4. SLA achieved.	5 seconds / 1 minute Time increases in response to progress

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
		Robot	While the PA expresses emotions through a song, the pupil expresses the emotions through facial expressions, while making eye contact.	1. The robot plays a song about emotions that points out to facial expressions (e.g. when you are happy, smile). 2. The pupil has to act out the expression in the song, and always the two of them (pupil and robot) have to keep their eyes themselves. 3. The PA will say if it is correct/ wrong.	1. Initial setup. 2. SLA achieved 3. Feedback.	5 seconds / 1 minute Time increases in response to progress
Imitation	Imitate facial expressions.	IWB Tablet PC	A simulator of facial expression makes different emotional traits while pupil imitates them.	1. The PA will show different expression about one emotional trait. 2. The pupil has to recognize it (each expression will belong to one emotional trait). 3. The PA will say if it is correct/wrong. 4. The pupil has to imitate it.	1. Initial setup. 2. Understanding the instructions. 3. Feedback. 4. SLA achieved.	5 seconds / 1 minute Time increases in response to progress
		Robot	The robot has pictures of facial expressions of different emotional traits laid out in front of it. The robot picks out one expression at a time and asks the pupil to imitate them.	1. The PA will point to different pictures of expressions about one emotional trait. 2. The pupil has to recognize it (each expression will belong to one emotional trait). 3. The PA will say if it is correct/wrong. 4. The pupil has to imitate it.	1. Initial setup. 2. Understanding the instructions. 3. Feedback. 4. SLA achieved.	5 seconds / 1 minute Time increases in response to progress

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Imitate body gestures.	IWB Tablet PC	PA shows a video of a person/cartoon making different body gestures and pupil imitates them.	1. The PA will show a video of a person or cartoon making different body gestures about one emotional trait. 2. The pupil has to recognize it (each body gesture will belong to one emotional trait). 3. The PA will say if it is correct/wrong. 4. The pupil has to imitate it.	1. Initial setup. 2. Understanding the instructions. 3. Feedback. 4. SLA achieved.	5 seconds / 1 minute Time increases in response to progress
		Robot	Robot makes different body gestures and pupil imitates them.	1. The robot will make different body gestures about one emotional trait. 2. The pupil has to recognize it (each body gesture will belong to one emotional trait). 3. The robot will say if it is correct/wrong. 4. The pupil has to imitate it.	1. Initial setup. 2. Understanding the instructions. 3. Feedback. 4. SLA achieved.	5 seconds / 1 minute Time increases in response to progress
Parts of the face (cognition)	Match part of the face (eyes, noses, cheek...)	IWB Tablet PC	Pupil plays a lotus game where s/he matches pictures with the same part of the face, between several cards that shows parts of the face. The cards are face down.	1. The PA will show flash cards with parts of the face. Several of them are identical. The cards are face down. 2. The pupil has to lift two cards (two of the rest of the set). 3. The pupil has to match the cards referred to the same part of the face.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved.	None

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
		Robot	The robot touches part of its face with its finger and asks pupil to touch the same part and say which part of the face that is.	1. The PA will touch parts of its face. 2. The pupil has to touch the same part of his/her own face that the robot touches. 3. The pupil has to call out the part of the face.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved.	None
	Make puzzles with faces forms.	IWB Tablet PC	Pupil completes a puzzle with the different parts of the face. The number of puzzle pieces will increase according to pupil's progress.	1. The PA will show pieces of a puzzle about the face. 2. The pupil has to complete the puzzle. 3. The PA will say if it is correct/wrong.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved / Feedback.	None
		Robot	Pupil completes a physical puzzle game with the different parts of the face.	1. The robot will go next to a physical puzzle game in the classroom and prompt the pupil to play it. 2. The pupil has to complete the puzzle. 3. The PA will say if it is correct/wrong.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved / Feedback.	None

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Parts of the body (cognition)	Match part of the body (leg, arms...)	IWB Tablet PC	Pupil matches pictures with the same part of the body (between several cards which one shows parts of the body?) Cards should be face down.	1. The PA will show flash cards with parts of the body. Several of them are identical. The cards are face down. 2. The pupil has to lift two cards (two of the rest of the set). 3. The pupil has to match the cards referred to the same part of the body.	1. Initial setup. 2. Understanding of the instructions. 3. SLA achieved.	None
		Robot	The robot touches part of its body with its finger and asks pupil to touch the same part and say which part of the face that is.	1. The PA will touch parts of its body with parts of its body. 2. The pupil has to touch the same part of his/her own body that the robot touches. 3. The pupil has to call out the part of the body.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved.	None
Basic emotions recognition	Say emotions.	IWB Tablet PC	The PA shows different digital pictures (photograph, image, icon, symbol) and pupil says what emotion they express.	1. The PA will show different pictures about basic emotions (one by one). 2. The pupil has to recognise them. 3. The pupils will express which emotion it is. 4. The PA will say if it correct/wrong. 5. The pupil has to express the emotion with his/her voice/face/body.	1. Initial setup. 2. Understanding the instructions. 3. SLA 50%. 4. Feedback. 5. SLA achieved.	None

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
		Robot	The PA points to different physical pictures laid out in front of it and pupil says what emotion they express.	1. The PA will show different pictures about basic emotions (one by one). 2. The pupil has to recognise them. 3. The pupils will express which emotion it is. 4. The PA will say if it correct/wrong. 5. The pupil has to express the emotion with his/her voice/face/body.	1. Initial setup. 2. Understanding the instructions. SLA 50%. 3. Feedback. 4. SLA achieved.	None
	Classify emotions.	IWB Tablet PC	The PA shows different digital pictures (photograph, image, icon, symbol) at the same time and the pupil says what emotion they express.	1. The PA will show different pictures about basic emotions (a set of pictures at the same time). 2. The pupil has to recognise them. 3. The pupils will express which emotion it is. 4. The PA will say if it correct/wrong. 5. The pupil has to express the favourite emotion with his/her voice/face/body.	1. Initial setup. 2. Understanding the instructions. 3. SLA 50%. 4. Feedback. 5. SLA achieved.	None
		Robot	The PA points to different physical pictures laid out in front of it and pupil says what emotion they express.	1. The PA will show different pictures about basic emotions (a set of pictures at the same time). 2. The pupil has to recognise them. 3. The pupils will express which emotion it is. 4. The PA will say if it correct/wrong. 5. The pupil has to express the favourite emotion with his/her voice/face/body.	1. Initial setup. 2. Understanding the instructions. 3. SLA 50%. 4. Feedback. 5. SLA achieved.	None

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Basic emotions (cognition)	Deduce basic emotions from different body gestures.	IWB Tablet PC	The PA shows a video of different body gestures and pupil says what emotion it expresses.	1. The PA will show a video of a person or cartoon doing different body gestures (referred to one emotional trait). 2. The pupil has to recognize which emotion is. 3. The system will say if it correct/wrong. 4. The pupil imitates the same body gesture path.	1. Initial setup. 2. Understanding the instructions. 3. Feedback. 4. SLA achieved.	None
		Robot	The PA shows different body gestures and pupil says what emotion it expresses.	1. The Robot will make different body gestures (referred to one emotional trait). 2. The pupil has to recognize which emotion is. 3. The robot will say if it correct/wrong. 4. The pupil imitates the same body gesture path.	1. Initial setup. 2. Understanding the instructions. 3. Feedback. 4. SLA achieved.	None
	Deduce basic emotions from different social situations.	IWB Tablet PC	The PA shows different stories about different social situations (sequences) and pupil says what emotion they express.	1. The PA will show a graphical sequence about a story referred a one social situation (connected with an emotional trait). 2. The pupil has to recognize which emotion is. 3. The PA will say if it correct/wrong.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved / Feedback.	None

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
		Robot	The PA tells different stories about different social situations (sequences) and pupil says what emotion they express.	1. The PA will tell a little story referred a one social situation (connected with an emotional trait). 2. The pupil has to recognize which emotion is. 3. The PA will say if it correct/wrong.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved / Feedback.	None
Basic emotions expression	Virtual role playing (children without movement possibilities)	IWB Tablet PC Robot	The PA shows a virtual role-play and pupil will express an emotional trait.	1. The PA will show a virtual role playing about one emotional trait. 2. The pupil has to recognize which emotion is. 3. The PA will say if it correct/wrong. 4. The pupil has to reproduce it with dynamic body movement.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved / Feedback. 4. SLA achieved.	None
	Play "Emociómetro" activity	IWB Tablet PC Robot	The PA asks to pupil – How are you? How do you feel today? The pupil has to respond.	1. The PA will show different graphical measurement about different emotional trait. 2. The pupil has to decide how he/she is feeling at this moment. 3. The PA will give him/her one visual acknowledgment.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved / Feedback.	None

Table 42: Learning goal (PMLD) – Learning goal: Emotional identification and expression (emotional traits) (from the Learning Experience outlined in Section 5.1.3)

13.2 PMLD Learning Experience examples

13.2.1 Learning goal: Vocabulary (improvement)

See 5.2.4.2.1 Example 1: Object recognition

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Object recognition	Show and name (object)	Tablet PC IWB Robot	Display a series of single object images on a theme. Give visual feedback and prompting (if no response, prompt twice, then change object)	Teacher initialises the system and begins the student's interaction	Start of learning, initial setup	None
				An object appears on screen, the system asks, "What is this object?"	Challenge to comprehension	None
				Verbal identification of the object	Broadens and cements vocabulary	10 seconds / 1 second Time decreases in response to progress
				The system responds with confirmation, correction or prompting	Feedback on success, failure or inactivity	None
				Repeat for the predetermined number of times	Completion => SLA achieved	None
		Robot (Turtle bot & NAO)	Indicate (point, call out, stand next to) a series of single physical object on a theme. Give audio feedback and prompting (if no response, prompt	Teacher initialises the system and begins the student's interaction	Start of learning, initial setup	None
				The robot points to a physical object and asks, "What is this object?"	Challenge to comprehension	None
				Verbal identification of the object	Broadens and cements vocabulary	10 seconds / 1 second Time decreases in response to progress

			twice, then change object)	The robot responds with confirmation, correction or prompting	Feedback on success, failure or inactivity	None
				Repeat for the predetermined number of times	Completion => SLA achieved	None

Table 43: Learning experience example (PMLD) – Learning goal: Vocabulary (improvement) (from the Learning Experience outlined in Section 5.2.35.1.3)

13.2.2 Learning goal: Maths (improvement)

See 5.2.4.2.2 Example 2: Quantity correspondence

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Number-quantity correspondence	Associate a number with a quantity	Tablet PC IWB	Display a number of dots. Give feedback and prompting (if no response, ask, "Are there [random number]?", if no response twice, change number, if response is hesitant, offer 3 alternatives)	Teacher initialises the system and begins the student's interaction	Start of learning, initial setup	None
				A random number of dots appear on screen, the system asks, "How many dots are there?"	Challenge to enumeration	None
				Verbal response with the correct number of dots	Develops and exercises counting	30 seconds / 1 second Time decreases in response to progress
				Verbal response with the wrong number of dots, the system states the correct number.	Develops and exercises counting	30 seconds / 1 second Time decreases in response to progress
				The system responds with confirmation, correction or prompting	Feedback on success, failure or inactivity	None
				Repeat for the predetermined number of times	Completion => SLA achieved	None
		Robot (Turtlebot & NAO)	Raise a number of fingers (NAO) or do a number of turns while travelling in a room (Turtlebot). Give feedback and prompting (if	Teacher initialises the system and begins the student's interaction	Start of learning, initial setup	None
				The robot holds up a random number of fingers or switches a number of directions while travelling in a room (give verbal indicator that a turn occurred), and then asks, "How many fingers are there?"/"How many time did I turn?"	Challenge to enumeration	None

			no response, ask, “Are there [random number]?”, if no response twice, change number, if response is hesitant, offer 3 alternatives)	Verbal response with the correct number of fingers	Develops and exercises counting	30 seconds / 1 second Time decreases in response to progress
				Verbal response with the wrong number of fingers, the robot states the correct number.	Develops and exercises counting	30 seconds / 1 second Time decreases in response to progress
				The robot responds with confirmation, correction or prompting	Feedback on success, failure or inactivity	None
				Repeat for the predetermined number of times	Completion => LA achieved	None

Table 44: Learning experience example (PMLD) – Learning goal: Maths (improvement) (from the Learning Experience outlined in Section 5.2.35.1.3)

13.2.3 Learning goal: Attention span (increase)

See 5.2.4.2.3 Example 3: Sequence reproduction

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Sequence reproduction	Reproduce a sequence of pictures / sounds	Tablet PC IWB	Display a number of images on screen. Highlight two in sequence. Increase number of items highlighted by one each repetition. Give feedback and prompting (repeat if response is wrong, or no response. Reduce number in sequence if no response twice)	Teacher initialises the system and begins the student's interaction	Start of learning, initial setup	None
				The system says, “Pay attention to the sequence and then repeat it.” Two or more images are highlighted in sequence.	Challenge to sequential recall	3 seconds / 0.1 second Time decreases with increasing capability (OR vary period to determine optimum for the learner)
				Verbal response with the correct sequence	Develops and exercises sequential recall	None
				The system responds with confirmation, correction or prompting	Feedback on success, failure or inactivity	None
				Repeat for the predetermined number of times	Completion => SLA achieved	None
		Robot (Turtlebot	Start with a pool of physical objects in front of the robot (NAO) or scattered around the	Teacher initialises the system and begins the student's interaction	Start of learning, initial setup	None

		& NAO)	room (Turtlebot). Robot points at (NAO) or goes next to (Turtlebot) two in sequence. Increase number of items pointed at/approached by one each repetition. Give feedback and prompting (repeat if response is wrong, or no response. Reduce number in sequence if no response twice)	The robot says, "Pay attention to the sequence and then repeat it." The robot points at two or more images in sequence.	Challenge to sequential recall	3 seconds / 0.1 second Time decreases with increasing capability (OR vary period to determine optimum for the learner)
				Verbal response with the correct sequence	Develops and exercises sequential recall	None
				The system responds with confirmation, correction or prompting	Feedback on success, failure or inactivity	None
				Repeat for the predetermined number of times	Completion => SLA achieved	None

Table 45: Learning experience example (PMLD) – Learning goal: Attention span (increase) (from the Learning Experience outlined in Section 5.2.35.1.3)

13.2.4 Learning goal: Telling time on analogue clock

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Clock numbers cognition	Identify numbers 1 to 12	Mobile PC IWB Robot (Turtlebot & NAO)	The PA shows a number (on screen or with fingers) and the learner says the name of the number. For nonverbal learners, roles then reversed: the PA says number and learner has to select correct card (physical or digital on-screen). For verbal learners, the PA shows number and gives feedback to learner's response.	Learner selecting correct number in response to PA and learner (if verbal) giving correct name of number displayed	Responses at key moments: SLA reached by 60% All correct responses: SLA achieved).	Time after PA action before learner makes a response. Varies between learners but as they may be searching for the correct card could give them about 40 to 50 seconds. If they take gaze from display/teaching materials this might be time to prompt.
	Correctly identify numbers by matching them to numbers of objects	Robot (NAO)	Shown groups of e.g. toy animals (start with very low numbers), Learner has to point to card showing correct number out of choice of two (later three or more). Robot gives feedback or even asks question "how many are there?"	Learner selecting correct card		When number of choices low, will need prompting sooner after being shown selection or asked question by robot (e.g. 20 seconds). Needs to be longer the more options are shown.
		Mobile PC IWB Robot (Turtlebot)	The PA presents three pictures and three numbers and learner has to drag them around to match them.	Some correct matching		Think 20 seconds since last touch of screen would need a prompt.

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Arrange numbers in ascending order	Robot (Turtlebot & NAO)	The PA tells learner to arrange cards depicting digits into the right order and gives feedback. Start with small number of cards, then increase number.	Fifty percent of cards in right order		None.
		Mobile PC IWB	Present series (starting with two, then increasing) of cards depicting different size groups, then cards displaying the digits. For each set of cards, pupil has to drag them into place with smaller followed by larger	Fifty percent of cards in right order		None.
Clock face numbers identification	Find position of 4 clock face numbers	Robot (NAO)	Robot verbally prompts with number and learner has to correctly place card with number on the correct place on the clock face	Two numbers in correct place.	Responses at key moments: SLA reached by 60% All correct responses: SLA achieved).	None.
		Robot (Turtlebot)	Robot travels on a (drawn/marked on the ground) clock face and learner has to correctly identify the number of that place in the clock face	Two numbers in correct place.	Responses at key moments: SLA reached by 60% All correct responses: SLA achieved).	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
		Mobile PC IWB	Same as before with a drag and drop game	Two numbers in correct place.	Responses at key moments: SLA reached by 60% All correct responses: SLA achieved).	None.
	Find position of all 12 clock face numbers	Robot (NAO)	As before but with all 12 numbers	Seven numbers in correct place.	Responses at key moments: SLA reached by 60% All correct responses: SLA achieved).	None.
		Robot (Turtlebot)	As before but with all 12 numbers	Seven numbers in correct place.	Responses at key moments: SLA reached by 60% All correct responses: SLA achieved).	None.
		Mobile PC IWB	As above but with all 12 numbers	Seven numbers in correct place.	Responses at key moments: SLA reached by 60% All correct responses: SLA achieved).	None.

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Hour hand recognition	Identify at what time activities take place e.g. start and finish school	Robot (Turtlebot & NAO)	Robot asks e.g. "When does school start?" "When is dinnertime?" Learner has to select correct version of clock face from choice of two or three. Robot gives feedback.	Selecting correct clock face	Done correctly once : SLA reached by 50% Done 12/12 times: SLA achieved).	None.
		Mobile PC IWB	PA prompts e.g. "When does school start?" "When is dinnertime?" Learner drags correct clock face on a digital clock displayed.	Selecting correct clock face	Done correctly once : SLA reached by 50% Done 12/12 times: SLA achieved).	None.
	Place hour hand in correct place in response to verbal prompts e.g. "one o'clock"	Robot (Turtlebot & NAO)	Robot prompts with e.g. "twelve o'clock" etc. and learner has to place hour hand in right place. Feedback from robot.	Correct placement of hour hand.	Done correctly once : SLA reached by 50% Done 12/12 times: SLA achieved).	None.
		Mobile PC IWB	Learner drags hour hand round to position on a digital clock given in text/spoken instruction.	Correct placement of hour hand.	Done correctly once : SLA reached by 50% Done 12/12 times: SLA achieved).	None.

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Minute hands recognition	Imitate positions of hour and minute hand for half past	Robot (NAO)	Robot says a time (e.g. half past four) and learner has to move robot's hands to this position.	Correct answer.	Done correctly once : SLA reached by 50% Done 12/12 times: SLA achieved).	None.
		Robot (Turtlebot)	Robot says a time (e.g. half past four) and learner has to move the robot to this position, on a marked-on-the-ground clock face. Robot first prompts "move me to the hour hand position" and then "move me to the minute hand position".	Correct answer.	Done correctly once : SLA reached by 50% Done 12/12 times: SLA achieved).	None.
		Mobile PC IWB	System calls out a time (e.g. half past four). Then learner has to move hands on a digital clock or select correct clock face depending on what time they are told.	correct position of hands or selection of clock face	Done correctly once : SLA reached by 50% Done 12/12 times: SLA achieved).	None.
	Imitate positions of hour and minute hand for quarter past	Robot (NAO)	Same activities as before but for quarter past (e.g. quarter past four)	Correct answer by learner.	Done correctly once : SLA reached by 50% Done 12/12 times: SLA achieved).	None.

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
		Robot (Turtlebot)	Same activities as before but for quarter past (e.g. quarter past four)	Correct answer by learner.	Done correctly once : SLA reached by 50% Done 12/12 times: SLA achieved).	None.
		Mobile PC IWB	Same activities as before but for quarter past (e.g. quarter past four)	Correct position of hands or selection of clock face	Done correctly once : SLA reached by 50% Done 12/12 times: SLA achieved).	None.
	Imitate positions of hour and minute hand for 5-minute intervals	Robot (NAO)	Same activities as above but examples will involve moving the minute hand round to one of the twelve numbers	Correct.	Done correctly once : SLA reached by 50% Done 12/12 times: SLA achieved).	None.
		Robot (Turtlebot)	Same activities as above but examples will involve moving the minute hand round to one of the twelve numbers	Correct.	Done correctly once : SLA reached by 50% Done 12/12 times: SLA achieved).	None.

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
		Mobile PC IWB	Same activities as above but examples will involve moving the minute hand round to one of the twelve numbers	Correct position of hands or selection of clock face	Done correctly once : SLA reached by 50% Done 12/12 times: SLA achieved).	None.

Table 46: Learning goal (PMLD) – Telling time on analogue clock (from the Learning Experience outlined in Section 5.2.35.1.3)

13.2.5 Learning goal: Navigation

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Left and right identification	Identify left and right (own/object)	Robot (NAO)	Robot stands in front of the learner with its back turned on him and raises/moves its left hand, left leg etc. Then it asks the learner to raise the same hand/leg. The robot then asks "which leg/hand was this?" and the learner has to answer if it's the left or right one. Robot gives feedback on learner's response.	Identifying correct item on correct side	Once: SLA reached by 60%. Whole process performed correctly 5 times: SLA achieved.	None.
		Robot (Turtlebot)	Robot moves from one side of the learner to the other and asks the learner "am I on your left or on your right?" and the learner has to answer. Robot gives feedback on learner's response.	Identifying correct side	Once: SLA reached by 60%. Whole process performed correctly 5 times: SLA achieved.	None.
		Mobile PC IWB	This would be left and right from learner's point of view. Shown series of two identical objects side by side and asked to touch the one on the right or the one on the left.	Identifying correct object on correct side	Once: SLA reached by 60%. Whole process performed correctly 5 times: SLA achieved.	None.
	Recognise left and right direction	Robot (NAO)	Robot points to a direction and learner has to say the correct word ("left", "right"). Robot gives feedback.	Identifying correct direction	Once: SLA reached by 60%. Whole process performed correctly 5 times: SLA achieved.	None.
		Robot (Turtlebot)	Robot moves to a direction (starting in front of the learner) and learner has to say the correct word ("left", "right"). Robot gives feedback.	Identifying correct direction	Once: SLA reached by 60%. Whole process performed correctly 5 times: SLA achieved.	None.
		Mobile PC IWB	Arrow shown on screen. Learner has to respond as above in the robot scenario and also to a mannequin shown on screen/IWB	Identifying correct direction	Once: SLA reached by 60%. Whole process performed correctly 5 times: SLA achieved.	None.

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Turn left and right	Robot (Turtlebot & NAO)	Send robot round simple maze with verbal commands. Maze can become more complex	One or more junctions correct.	One junction: SLA reached by 10%. All junctions: SLA reached by 60%. Whole process performed correctly 2 times: SLA achieved.	None.
		Mobile PC IWB	Move character round 2D maze with simple commands or tapping arrow on screen. Maze can become more complex	One or more junctions correct.	One junction: SLA reached by 10%. All junctions: SLA reached by 60%. Whole process performed correctly 2 times: SLA achieved.	None.
Area recognition	Match name or symbol to different rooms	Robot (Turtlebot & NAO)	Robot shows learner a symbol depicting e.g. the dining room. Learner has to name the correct room (if verbal) or match the symbol with the photo/picture of the room. This can be assisted by markers.	One or more symbols correctly identified.	Once: SLA reached by 70%. Correctly over 3 tries: SLA achieved.	None.
		Mobile PC IWB	Matching game either shown symbol and has to select correct picture from those below or shown all symbols and has to pair each one with correct location picture	One or more correct pairs made	Once: SLA reached by 70%. Correctly over 3 tries: SLA achieved.	None.
	Identify location of different places on map/model	Robot (Turtlebot & NAO)	Robot prompts learner to pick up a symbols or picture of a place, and he has to place them on correct part of 2D representation (floor plan) of school. Robot gives feedback. This can be assisted by markers.	One or more symbols/pictures correctly placed.	Once: SLA reached by 70%. Correctly over 3 tries: SLA achieved.	None.

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
		Mobile PC IWB	Learner has to drag pictures/symbols onto correct location of 2D representation of school.	One or more symbols/pictures correctly placed.	Once: SLA reached by 70%. Correctly over 3 tries: SLA achieved.	None.
Targeted location navigation	Walk/navigate to find location	Robot (Turtlebot & NAO)	Robot chooses location and asks the learner to and take it to that location. Learner has to take robot there. For those with limited mobility, human assistance is needed. This can be assisted by markers.	One or more locations correctly reached.	SLA achieved.	None.
		Mobile PC IWB	Desired location shown on screen. Learner then has to move character to desired location from their current location.	One or more locations correctly reached.	SLA achieved.	None.

Table 47: Learning goal (PMLD) – Learning goal: Navigation (from the Learning Experience outlined in Section 5.2.35.1.3)

13.2.6 Additional options – Learning goal: Vocabulary (improvement)

Additional options for some SLAs on the learning goal Vocabulary (improvement) than the ones in Table 43 or alternative LAs or Materialisations for common SLAs.

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Object recognition	(Correctly) point to picture of object named by tutor, being given an increasing number of objects to choose	Robot	Robot says word and learner points to or picks up card showing correct symbol of word. Robot gives feedback.	Correct selection of card.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
		Mobile PC IWB	Word said by device and learner selects named object from display on screen	Correct selection of card.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
	Match written name to picture being given an increasing number of objects to choose from	Robot	Robot says word and learner has to select matching picture from selection and repeat word (if verbal).	Correct selection of picture and correct utterance.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
		Mobile PC IWB	Matching game, either shown word and has to select correct picture from those below or shown all words and has to pair each one with correct picture. If verbal, has to say each word as it is matched.	Correct matching of at least one word.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
	Play Fish or pairs game	Robot	Learner has to select the two cards showing the same picture from a display of 10 or more. To make it more challenging cards shown face down and have to be turned over. Alternatively, must pair word with picture. Robot gives feedback.	Correct matching of at least one pair.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
		Mobile PC IWB	Learner has to select the two cards showing the same picture from a display of 10 or more. To make it more challenging cards shown face down and have to be turned over. Alternatively, match word cards with pictures.	Correct matching of at least one pair.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
Action words recognition	(Correctly) point to picture of action named by tutor, being given an increasing number of actions to choose	Robot	Robot says word and learner must perform action and select correct word card.	Selecting correct card.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
		Mobile PC IWB	Matching game either shown written word (or spoken word) and has to select correct picture from those below or shown all words and has to pair each one with correct location picture.	Selecting correct picture or matching correctly.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
	Play Fish or pairs game	Robot	Learner has to select the two cards showing the same action picture from a display of 10 or more. To make it more challenging cards shown face down and have to be turned over. Alternatively, must pair word with picture. Robot gives feedback.	Correct matching of at least one pair.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
		Mobile PC IWB	Learner has to select the two cards showing the same action picture from a display of 10 or more. To make it more challenging cards shown face down and have to be turned over. Alternatively match word cards with pictures.	Correct matching of at least one pair.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
Descriptor words recognition	(Correctly) point to picture of descriptor (e.g. big, yellow,	Robot	Robot says word and learner must select correct word card.	Selecting correct card.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	hairy) named by tutor, being given an increasing number of descriptors to choose	Mobile PC IWB	Matching game either shown written word (or spoken word) and has to select correct picture from those below or shown all words and has to pair each one with correct picture	Selecting correct picture or matching correctly	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
	Play Fish or pairs game	Robot	Learner has to select the two cards showing the same descriptor picture from a display of 10 or more. To make it more challenging cards shown face down and have to be turned over. Alternatively, must pair word with picture. Robot gives feedback.	Correct matching of at least one pair.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
		Mobile PC IWB	Learner has to select the two cards showing the same descriptor picture from a display of 10 or more. To make it more challenging cards shown face down and have to be turned over. Alternatively match word cards with pictures. .	Correct matching of at least one pair.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
Pronunciation (improvement)	Repeat name of object/action/colour spoken by tutor	Robot	Robot says word and rewards increasing approximations from learner	Increasingly improved pronunciation	Once: SLA reached by 50%. Correctly over 10 tries: SLA achieved.	None.
	(Correctly) respond with name of object/action/colour when shown it.	Robot	Robot shows picture of object/action/colour and rewards increasing approximations from learner	Increasingly improved pronunciation	Once: SLA reached by 50%. Correctly over 10 tries: SLA achieved.	None.
		Mobile PC IWB	Picture shown on screen and learner has to respond with correct pronunciation then gets score as reward.	Increasingly improved pronunciation	Once: SLA reached by 50%. Correctly over 10 tries: SLA achieved.	None.

Table 48: Learning goal (PMLD) – Learning Vocabulary (improvement) (additional options to the ones depicted in 5.2.3)

13.2.7 Additional options – Learning goal: Vocabulary (improvement)

Additional options for SLAs on the learning goal Vocabulary (improvement) than the ones in Table 43.

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Visual attention	Visually track pictures (focusing)	IWB Tablet PC	The PA will present different pictures about one topic (functional vocabulary). They move in the screen.	1. Show pictures in the screen. 2. Provide instructions about one topic (functional vocabulary). 3. Pupil selects this object/picture. 4. Pupil follows the picture in the screen according to the instructions.	1. Initial setup. 2. Understanding the instructions. 3. Starting of the visual contact. 4. 50 % SLA achieved.	5 seconds / 1 minute Time increases in response to progress
		Robot (Turtlebot & NAO)	The PA will present different (physical) pictures/objects about one topic (functional vocabulary). It will have it in its hands and move it around.	1. Teacher places a picture/object in the hand/in front of the robot. 2. The robot provides instructions about one topic (functional vocabulary). 3. Pupil selects this object/picture. 4. Pupil follows the picture as the robot moves it along according to the instructions.	1. Initial setup. 2. Understanding the instructions. 3. Starting of the visual contact. 4. 50 % SLA achieved.	5 seconds / 1 minute Time increases in response to progress
	Look at pictures for a time.	IWB Tablet PC	The PA will present different pictures about one topic (functional vocabulary). They will be static in the screen.	1. Show pictures in the screen. 2. System provides instructions about one topic (functional vocabulary). 3. Pupil observes at the picture for a while.	1. Initial setup. 2. Understanding and following instructions. 3. SLA achieved.	5 seconds / 1 minute Time increases in response to progress

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
		Robot	The PA will present different (physical) pictures about one topic (functional vocabulary). They will be static in front of it.	1. Teacher arranges a set of physical pictures in front of the PA. 2. System provides instructions about one topic (functional vocabulary). 3. Pupil observes at the picture for a while.	1. Initial setup. 2. Understanding and following instructions. 3. SLA achieved.	5 seconds / 1 minute Time increases in response to progress
Hearing attention	Focus on a sound or words.	IWB Tablet PC Robot (Turtlebot & NAO)	The PA will present different sounds of words: • Pupil´s interests, toys. • Foods. • Animals. • Clothing. • Body parts.	1. A sound is presented. 2. Pupil hears it and recognises it. 3. Pupil relates it with a topic.	1. Initial setup. 2. Hearing. 3. 50% SLA achieved.	5 seconds / 1 minute Time increases in response to progress
	Hear and recognize a sound of different words for a time.	IWB Tablet PC Robot (Turtlebot & NAO)	The PA will present different sounds of different words: • Pupil´s interests, toys. • Foods. • Animals. • Clothing. • Body parts.	1. A sound is presented. 2. Pupils hears a sound for a while. 3. Pupil has to recognize it and relates it with an object.	1. Initial setup. 2. SLA achieved. 3. SLA achieved.	5 seconds / 1 minute Time increases in response to progress
Visual discrimination	Find differences between two words.	IWB Tablet PC	The PA shows different words from different vocabulary. They can be support with photographs, pictures, images, icons, symbols.	1. Show two different words in the screen about one topic. 2. Say to the pupil: “Look for differences”. 3. The pupil has to select the differences (touch the lettering in the screen).	1. Initial setup. 2. Understanding the instructions. 3. 50% SLA achieved.	None

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
		Robot (Turtlebot & NAO)	The PA shows different words from different vocabulary on a set of word cards. The cards may be supported by coloured background or dedicated markers. The robot can support it with sounds, music, spatial navigation, gestures, other robot behaviours (e.g. changing eye led colours).	1. Show two different words on the cards about one topic. 2. Say to the pupil: "Look for differences". 3. The pupil has to select the differences (speak out the different lettering for the robot to recognize).	1. Initial setup. 2. Understanding the instructions. 3. 50% SLA achieved.	None
	Match two identical words between a set of them.	IWB Tablet PC	The PA shows several words from one set about one topic. It could be support with photographs, pictures, images, icons, symbols. The pupil should match the identical words.	1. Show several words. Two of them are identical. 2. Say to the pupil: "Match the identical words!" 3. The pupil has to select the identical word.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved.	1 minute / 5 seconds Time decreases in response to progress

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
		Robot (Turtlebot & NAO)	The PA has a set of several words about one topic placed in specific positions in front of it in cards and a stack of cards with the same set of words on the side. The cards may be supported by coloured background or dedicated markers. The pupil should match the identical words.	1. Show several words. Two of them are identical. 2. Say to the pupil: "Find the identical word from the stack and match it with the one in front of me!" 3. The pupil has to select the word from the stake and place it over its corresponding identical in front of the robot.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved.	1 minute / 5 seconds Time decreases in response to progress
Hearing discrimination	Find differences between the sounds of different words about a functional vocabulary.	IWB Tablet PC Robot (Turtlebot & NAO)	The PA expresses different words.	1. The PA expresses different words (very similar between them). 2. Say to the pupil: "Look for differences". 3. The pupil has to recognize them and to say which sounds are different.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved.	None

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Match two identical words in a set of words about one topic (connected with a functional vocabulary).	IWB Tablet PC Robot (Turtlebot & NAO)	The PA expresses different words. Most of them are identical. Pupil says which are identical. All of them are referred to a functional vocabulary.	1. The PA says several words about different topics. 2. The PA says how many topics are in the set of words. 3. The pupil says the number of topics. 4. The PA asks: "The words of each topic". 5. The pupil says one by one the words of each topic.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved. 4. Understanding the instructions. 5. SLA achieved.	None
Synonyms / antonyms	Find synonyms	IWB Tablet PC Robot (Turtlebot & NAO)	First, the PA says a word about one topic of functional vocabulary. Second, the PA says a set of words similar to the first word. Finally, pupil has to find the synonymous word. At that moment, pupil touches Robot´s head with his/her hands.	1. The PA says one word about a functional vocabulary topic. 2. The PA says three words, only one of them is similar to the first word. 3. The pupil has to discover the similar word to the first one. 4. The PA will say to him/her if it is correct/wrong.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved. 4. Feedback.	None

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Find antonyms	IWB Tablet PC Robot (Turtlebot & NAO)	First, the PA says a word about one topic of functional vocabulary. Second, the PA says a set of words similar to the first word. Finally, pupil has to find the antonymous words. At that moment, pupil touches the Robot´s head with his/her hands.	1. The PA says one word about a functional vocabulary topic. 2. The PA says three words, only one of them is opposite to the first word. 3. The pupil has to discover the opposite word to the first one. 4. The PA will say to him/her if it is correct/wrong.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved. 4. Feedback.	None
Semantic fields establishment (conceptual networks)	Connect words about one semantic field.	IWB Tablet PC	Create screens with different topics (home, school, park, swimming pool, hospital). Then the pupil has to add elements (things, people, decoration…).	1. In the screen will appear one topic. 2. The pupil has to recognize the topic. 3. The pupil has to say words connected with the topic. 4. The PA will say to him/her if it is correct/wrong.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved. 4. Feedback.	None

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
		Robot (Turtlebot & NAO)	The PA will call out different topics (home, school, park, swimming pool, hospital). It can be assisted by physical pictures of the topic placed on the floor that the PA moves near to. Then the pupil has to refer to different relevant elements (things, people, decoration…).	1. The robot will call out the topic. 2. The pupil has to recognize the topic. 3. The pupil has to say words connected with the topic. 4. The PA will say to him/her if it is correct/wrong.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved. 4. Feedback.	None
	Go through a cooking recipe.	IWB Tablet PC	The PA shows how to prepare a cooking recipe with simple instructions (+ pictures). Then the pupil has to choose what ingredients are necessary.	1. The PA shows to pupil one cooking recipe. 2. The PA will ask to the pupil: “What ingredients are necessary?” 3. The pupil has to choose on the screen what ingredients are necessary for doing it. 4. The system will say to him/her if it is correct/wrong.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved. 4. Feedback.	None
		Robot (Turtlebot & NAO)	The PA says how to prepare a cooking recipe with simple instructions. Then the pupil has to express what ingredients are necessary. It can be supported by spatial navigation near or pointing to physical objects (e.g. toy tomato etc.)	1. The robot says to pupil one cooking recipe. 2. The robot says to the pupil: “What ingredients are necessary?” 3. The pupil has to say what ingredients are necessary for doing it. 4. The robot will say to him/her if it is correct/wrong.	1. Initial setup. 2. Understanding the instructions. 3. SLA achieved. 4. Feedback.	None

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Derived words form usage	Connect derived words about one topic.	IWB Tablet PC	On the screen there is one word about a topic (e.g. bread). Then in the screen appear a set of words, only one of them will be linked with the first word. Pupil has to match the word that has the same lexical family (e.g. bread-baker-bakery). All words can be supported by images or pictures. Difficulty on the task can be increased with more words.	1. The screen will show one word about a topic. This word will be the word matrix. 2. In the screen will appear a set of words. 3. The pupil has to recognize the word that is connected with the matrix word. 4. The pupil will say the lexical words.	1. Initial setup. 2. Understanding the instructions 3. SLA 50% 4. SLA achieved.	1 minute / 5 seconds Time decreases in response to progress
		Robot (Turtlebot & NAO)	The PA speaks out a word about a topic (e.g. bread). Then it recites a set of words, only one of them will be linked with the first word. Pupil has to match (verbally) the word that has the same lexical family (e.g. bread-baker-bakery). Difficulty on the task can be increased with more words.	1. The PA will speak out a word about a topic. This word will be the word matrix. It will say “This is the topic”. 2. Then it will recite a set of other words. It will say “tell me which one matches the topic”. 3. The pupil has to recognize the word that is connected with the matrix word. 4. The pupil will say the lexical words.	1. Initial setup. 2. Understanding the instructions 3. SLA 50% 4. SLA achieved.	1 minute / 5 seconds Time decreases in response to progress

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Identify derived words form.	IWB Tablet PC	The PA shows one model word (e.g. bread). Then it shows other words, only one of them is connected with the lexical family of the model word. When the word connected with the model word is shown, the pupil will select it (click/tap on it).	1. The PA will show to the pupil one word about a topic. This word will be the word matrix. 2. The PA will show another set of words. Only one of them is connected lexically with the matrix word. 3. The pupil will click/tap on the word that he/she thinks is connected to the matrix word. 4. The PA will tell pupil if it is correct/wrong.	1. Initial setup. 2. Understanding the instructions 3. SLA achieved. 4. Feedback.	None
		Robot (Turtlebot & NAO)	Robot says one model word (e.g. bread). Then, the robot says other words, only one of them is connected with the lexical family of the model word. When the Robot says one word connected with the model word, the pupil will touch the Robot´s head with a hand.	1. The robot will say to the pupil one word about a topic. This word will be the word matrix. 2. The robot will say another set of words. Only one of them is connected lexically with the matrix word. 3. The pupil will say to Robot which word is connected with the matrix word. For that, when the robot says that word the pupil will touch the robot´s head with the hands. 4. The robot will say to pupil if it is correct/wrong.	1. Initial setup. 2. Understanding the instructions 3. SLA achieved. 4. Feedback.	None

Table 49: Learning goal (PMLD) – Vocabulary (improvement)

13.2.8 Additional – Learning goal: Sequencing

Additional learning goal and subsequent components of the Learning Experience for the PMLD Learning Graph(s).

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Sorting	Sort objects into right order	Robot	Robot prompts learner to take an object and learner has to place it in one of two/three piles according to e.g. colour or shape.	Correct placing of at least one object.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
		Mobile PC IWB	One object appears on top of screen and learner must drag it into one of two or three baskets shown at bottom of screen according to colour or shape.	Correct placing of at least one object.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
	Sort ascending / descending on one dimension e.g. height, number in group	Robot	Learner tells robot where to put cards or robot gives cards to learner to put in order of increasing size. Increase number of cards from two.	Correct placing of at least one object.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
		Mobile PC IWB	One object appears on top of screen and learner must drag it into correct position at bottom of screen depending on whether it is bigger or smaller than its neighbour. Could also be number of dots. Increase number of cards/objects as learner gets better at task.	Correct placing of at least one object.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
	Sort ascending / descending on two dimensions e.g. size and	Robot	Learner tells robot where to put cards on a 3x3 matrix according to their size and shape or robot gives cards to learner to put on matrix	Correct placing of at least one card.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	shape	Mobile PC IWB	One object appears on top of screen and learner must drag it into correct position on matrix.	Correct placing of at least one object.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
Order of events or actions recognition	Sort pictures into logical order e.g. child waking up, dressing, eating breakfast, leaving house. Identify incorrect sequences	Robot	Learner places group of pictures into correct order	Correct placing of at least one pair of pictures. Correct identification of sequence.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
		Mobile PC IWB	Learner drags pictures from top of screen into correct order at bottom	Correct placing of at least one pair of pictures. Correct identification of sequence.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
	Tell story or recount an event/outing in right order supplemented with their own pictures	Robot (NAO)	Robot gives verbal encouragement and sequence, asks "what next?", “what about that event?”	Correct sequence of at least two events.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
		Mobile PC IWB Robot (Turtlebot)	Learner reads story and selects pictures from those shown on device	Correct sequence of at least two events and description of events.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
	Sort words in sentence into logical order. Identify incorrect order.	Robot	Learner sorts words into correct order. Task can be made harder by increasing number of words.	Correct placing of at least one pair of words.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
		Mobile PC IWB	Learner drags pictures from top of screen into correct order at bottom	Correct placing of at least one pair of words.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Sort places on route into logical order (use their own pics taken on outing). Identify incorrect order.	Robot	Learner sorts words into correct order. Task can be made harder by increasing number of words.	Correct placing of at least one pair of words.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
		Mobile PC IWB	Learner drags pictures from top of screen into correct order at bottom	Correct placing of at least one pair of words.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.

Table 50: Learning goal (PMLD) – Learning goal: Sequencing (additional to the ones depicted in 5.2.3)

13.2.9 Additional – Learning goal: Building sentences – additional

Additional learning goal and subsequent components of the Learning Experience for the PMLD Learning Graph(s).

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Words' classes identification	Sort selection of pictures into groups	Robot	Shown 15 or more pictures and sorting into object doing or descriptor (need the word teachers actually use for these) words. Robot gives feedback.	At least one picture correct in each of three categories	Once: SLA reached by 50%. Correctly over 10 tries: SLA achieved.	None.
		Mobile PC IWB	Sorting pictures from top of screen into three baskets below.	At least one picture correct in each of three categories	Once: SLA reached by 50%. Correctly over 10 tries: SLA achieved.	None.
	(Correctly) identify class of picture by putting into correct pile	Robot	One picture at a time presented by robot and learner has to place them in correct pile.	At least one picture correct in each of three categories	Once: SLA reached by 50%. Correctly over 10 tries: SLA achieved.	None.
		Mobile PC IWB	One picture at a time appears at top of screen and learner has to drag them in correct basket at bottom.	At least one picture correct in each of three categories	Once: SLA reached by 50%. Correctly over 10 tries: SLA achieved.	None.
Object and descriptor words association	Sorting objects into groups, then into groups according to colour or size	Robot	Learner tells robot where to put cards on a 3x3 matrix according to their colour and size or robot gives cards to learner to put on matrix.	Correct placing of at least one card.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
		Mobile PC IWB	One object appears on top of screen and learner must drag it into correct position on matrix.	Correct placing of at least one object.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Identify objects on two dimensions.	Robot	Learner given a selection of toys. Robot asks e.g. "Place the black cow on the mark in front of me" Robot gives feedback.	Identifying correctly both type of animal (or shape) and colour.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
		Mobile PC IWB	Several pictures from 2D sorting tasks above shown on screen. Tutor asks e.g. "Show me the black cow" and learner has to touch correct picture.	Identifying correctly both type of animal (or shape) and colour.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
	(Correctly) describe presented object and its descriptor (for verbal learners).	Robot	Robot presents object, learner describes it (e.g. green brick, red ball, black cow) and gives feedback to learner's description.	Correctly saying both object and descriptor.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
		Mobile PC IWB	As above but pictures of object shown on screen and learner has to give correct description.	Correctly saying both object and descriptor.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
	Pair object with appropriate descriptor words (Pairs /Fish game)	Robot	Robot presents object (e.g. green brick) and learner has to select the cards showing the words "green" and "brick" from a display of 10 or more. To make it more challenging cards shown face down and have to be turned over. Robot gives feedback.	Correctly identifying at least one pair.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
		Mobile PC IWB	Object presented at top of screen. Learner has to select the two words that accurately describe it from a selection of 10 or more below. To make it more challenging, words only revealed when "cards" clicked.	Correctly identifying at least one pair.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Object and action words association	Sort objects into groups, then into groups according to action (e.g. "running rabbit")	Robot	Either robot presents cards one at a time or all cards are spread out in front of learner. First sorted into two "baskets", then each basket further sorted into two other baskets	Placing at least one card correctly in each basket.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
		Mobile PC IWB	Either pictures presented one at a time at top of screen and learner has to drag them to correct basket or all pictures shown at top at same time before first sorting. Then second sorting is into correct action "basket".	Placing at least one card correctly in each basket.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
	Play game of "Show me the children who are playing"	Robot	Robot asks question and learner has to select correct card from at least 10 showing e.g. children either sitting, playing, running, standing or cows jumping, running, lying down etc.	Correctly identifying at least one picture.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
		Mobile PC IWB	Tutor asks question and learner has to select correct card from at least 10 on screen showing e.g. children either sitting, playing, running, standing or cows jumping, running, lying down etc.	Correctly identifying at least one picture.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
	(Correctly) describe presented object and its action	Robot	Robot presents object or shows picture (e.g. running horse) and gives feedback to learner's description.	Correctly saying both object and action.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
		Mobile PC IWB	As above but pictures of object shown on screen and learner has to give correct description.	Correctly saying both object and action.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Pair object with actions it could make Pairs /Fish game	Robot	Robot presents object or picture (e.g. boy runs) and learner has to select the cards showing the words "boy" and "runs" from a display of 10 or more. To make it more challenging cards shown face down and have to be turned over. Robot gives feedback.	Correctly identifying at least one pair.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
		Mobile PC IWB	Pictures presented at top of screen. Learner has to select the two words that accurately describe it from a selection of 10 or more below. To make it more challenging, words only revealed when "cards" clicked.	Correctly identifying at least one pair.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
Object-action-object association	(Correctly) describe picture "What does Sara hit?" "What is the boy doing to the trolley?" or identify correct symbol	Robot	Robot shows card and asks question. Gives feedback on answer.	Correctly answering at least one question.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
		Mobile PC IWB	Picture shown on screen and tutor asks question.	Correctly replying to question.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
	Use three picture cards to create meaningful object action object sentences	Robot	Robot says e.g. "the girl eats the banana" and learner has to select three cards with the correct pictures and put them in the right order.	Identifying correct cards and getting at least two in right order.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
		Mobile PC IWB	Tutor says e.g. "the dog chases the cat" and learner has to select three pictures from several shown at top of screen and drag them below in the right order.	Identifying correct cards and getting at least two in right order.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Use three word cards to create meaningful object-action-object sentences	Robot	Robot says e.g. "the girl eats the banana" and learner has to select three cards with the correct words and put them in the right order.	Identifying correct words and getting at least two in right order.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
		Mobile PC IWB	Tutor says e.g. "the dog chases the cat" and learner has to select three words from several shown at top of screen and drag them below in the right order.	Identifying correct words and getting at least two in right order.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
	(Correctly) verbalise object-action-object picture	Robot	Robot shows picture e.g. a girl eating a banana" and learner has to say the three words in the right order. Alternatively could read out words shown in previous exercise.	Saying at least two words correctly in right order.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.
		Mobile PC IWB	Picture shown at top of screen learner has to say the three words in the right order. Alternatively could read out words shown in previous exercise.	Saying at least two words correctly in right order.	Once: SLA reached by 70%. Correctly over 5 tries: SLA achieved.	None.

Table 51: Learning goal (PMLD) – Learning goal: Building sentences (additional to the ones depicted in 5.2.3)

13.2.10 Additional – Learning goal: Emotional identification and expression (emotional traits)

Same as Table 42.

13.3 Mainstream Learning Experience examples

13.3.1 Learning goal: Programming skills (improvement)

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Sequencing	Sort cards into logical order.	IWB Tablet PC	Put cards into correct sequence for zebra crossing.	Student begins the interaction	Start of learning, initial setup	None
				Cards appear on screen in randomised order. Student is instructed to put cards in correct sequence.	Understand the task	None
				Student drags cards into correct sequence, indicates when finished	Show correct sequencing of events	None
				The system responds with congratulation or correction.	Feedback on success, failure or inactivity	None
				Repeat for the predetermined number of times	Completion => LA achieved	None
		Robot (Turtlebot & NAO)	Put robot control instructions in order Student has a set of commands on cards, that must be uttered in the correct order	Student begins the interaction	Start of learning, initial setup	None
				Student receives command cards (e.g. 4 cards describing a rectangle – move forward X & turn 90°, where X = 1, 1, 2 or 2) Student is instructed to put cards in correct sequence.	Understand the task	None
				Student is instructed say the commands in correct sequence.	Understand the task	None

				Student say the commands in the correct sequence,	Show correct sequencing of events	None
				The PA follows the commands, and responds with congratulation or correction.	Feedback on success, failure or inactivity	None

Table 52: Learning experience example (ME) – Learning goal: Programming skills (improvement) (from the Learning Experience outlined in Section 5.3.3)

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Simple flow control	Develop a simple flowchart	IWB Tablet PC	System plays a video of a zebra crossing. Student puts cards into correct sequence for zebra crossing. System plays a tutorial (video) of adding a start symbol, linking it to an output symbol with an arrow to turn lights on and off. Student creates flow chart.	Student begins the interaction	Start of learning, initial setup	None
				Video of Zebra crossing is displayed	Understand the sequence of activities	None
				Cards appear on screen in randomised order. Student is instructed to put cards in correct sequence.	Understand the task	None
				Student drags cards into correct sequence, indicates when finished	Show correct sequencing of events	None
				Video of start and output symbols displayed	Understand the use of specific flow chart symbols	None
				Student drags symbols into correct sequence, indicates when finished	Show correct sequencing of events	None
				The system displays the flowchart sequence in action	Feedback on success, failure or inactivity	None
				Functional flow chart produced	Completion => LA achieved	None
		Robot (Turtlebot & NAO)	Robot re-enacts/mimics (can be supported by narration) the steps for a zebra crossing along with visual instructions on an embedded laptop or a	Same as before (instead of appearing on a screen, physical cards are indicated by the robot in a random order), with added re-enactment of the target process by the robot.	Same as before.	None

			supplementary pc/laptop (as before). Robot indicates physical cards to the learner and asks to put it in the correct order. Student creates flow chart on the laptop/pc.			

Table 53: Learning experience example (ME) – Learning goal: Programming skills (improvement) (from the Learning Experience outlined in Section 5.4.3)

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Flow control	Develop a mimic flowchart	IWB Tablet PC	System describes flow chart symbols. System plays a Zebra crossing video. Student creates a flow chart to mimic the Zebra crossing.	Student begins the interaction	Start of learning, initial setup	None
				Description of flow chart symbols displayed	Understand the use of flow chart symbols	None
				Video of Zebra crossing is displayed	Understand the sequence of activities	None
				Student drags symbols into correct sequence, indicates when finished	Show correct sequencing of events	None
				The system displays the flowchart sequence in action	Feedback on success, failure or inactivity	None
				Functional flow chart produced	Completion => LA achieved	None
		Robot (Turtlebot & NAO)	Robot re-enacts/mimics (can be supported by narration) the steps for a zebra crossing along with visual instructions on an embedded laptop or a supplementary pc/laptop (as before). Student creates flow chart on the laptop/pc.	Same as before, with added re-enactment of the target process by the robot.	Same as before.	None

Table 54: Learning experience example (ME) – Learning goal: Programming skills (improvement) > SLA: Flow control > LA: Develop a mimic flowchart

13.3.2 Learning goal: Mathematical competences: numbering[11]

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Subitizing and counting	Count and identify small amounts of objects	Robot (NAO)	Robot says a number of sounds and the pupil will count them.	Teacher initialises the system and the robot prompts learner interaction	Initial setup	None
				Robot asks: "how many sounds did I play?"	Challenge to enumeration	1 minute / 5 seconds Time decreases in response to progress
				Verbal response with right/wrong number	Feedback on success/failure/ inactivity	
		Robot (Turtlebot)	Groups of objects (e.g. 3 red balls, 3 blue balls, 2 red balls, 4 green balls) of different colours are scattered around a room. Robot asks the pupil to find the group of 3 red balls.	Teacher initialises the system and the robot prompts learner interaction	Initial setup	None
				Robot follows the pupil until it finds a red object. The user indicates the group when s/he finds it. The robot recognizes the group of objects and provides feedback.	Challenge to subitizing	1 minute / 5 seconds Time decreases in response to progress
				Verbal response with right/wrong number	Feedback on success/failure/ inactivity	
		IWB	In the screen appear a set of objects and	Teacher initialises the system and begins learner interaction	Initial setup	None

[11] Infant school and 1st and 2nd grade Primary School.

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
		Tablet PC	pupil will have to count them suddenly (at first sight).	System asks: "how many objects are there? And the objects disappear from the screen.	Challenge to enumeration	1 minute / 5 seconds Time decreases in response to progress
				Verbal response with right/wrong number	Feedback on success/failure/ inactivity	
Association of number to quantity	Relate number with a set of pictures	IWB Tablet PC	A set of objects and numbers appear on screen. The pupil matches the set of pictures with the correct number.	Teacher starts the system and begins student's interactions	Initial setup	None
				A random set of objects or numbers appear on the screen, asking "how many are there?	Challenge to enumeration	5 seconds / 1 minute Time increases in response to progress
				Student answers verbally with the correct number	Develops and exercises counting	
				Student answers verbally with the wrong number	Develops and exercises counting	
				System gives feedback, if the answer is wrong gives the student the correct one.	Feedback on success, failure or inactivity	
				Student have to achieve 3 correct answers in a row	100% achieved	
	Relate number with a set of objects	Robot (NAO)	Robot gives oral instructions about a number of objects near the pupil (e.g.	Teacher starts the system and the robot prompts student's interactions	Initial setup	None
				Robot asks for a random set of objects.	Challenge to enumeration	5 seconds / 1 minute

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
			"get five pencils")	Student places the correct number of objects in front of the robot (robot recognition)	Develops and exercises counting	Time increases in response to progress
				Student places the wrong number of objects in front of the robot (robot recognition)	Develops and exercises counting	
				System gives feedback, if the answer is wrong gives the student the correct one.	Feedback on success, failure or inactivity	
				Student achieves 3 correct answers in a row	100% achieved	
		Robot (Turtlebot)	Groups of objects (e.g. 3 red balls, 3 blue balls, 2 red balls, 4 green balls) of different colours are displayed on screen. Robot asks the pupil to show it an object that is the same colour as the group with X objects in it.	Teacher starts the system and the robot prompts student's interactions	Initial setup	None
				Robot asks pupil "Show me a ball the same colour as the group with X balls in it"	Challenge to enumeration	5 seconds / 1 minute Time increases in response to progress
				Student responds by showing the robot a coloured ball	Develops and exercises counting	
				System gives feedback, if the answer is wrong it shows the correct colour.	Feedback on success, failure or inactivity	
				Student achieves 3 correct answers in a row	100% achieved	
		Alternative Robot (Turtlebot)	Groups of objects of different colours are displayed on screen. The robot asks the	Teacher starts the system and the robot prompts student's interactions	Initial setup	None
				The robot says: "How many {colour} {object}s are there? Show me the number.	Challenge to enumeration	5 seconds / 1 minute

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
			pupil to show it the number of objects of a specific colour. The learner has a set of (physical) cards bearing the numbers being used in the exercise and shows a card to the robot.	The student shows a card to the robot	Develops and exercises counting	Time increases in response to progress
				System gives confirmation, correction or prompting	Feedback on success, failure or inactivity	
				Student achieves 3 correct answers in a row	100% achieved	
Discrimination of greater than / less than	Put the numbers in order (ascending / descending)	IWB Tablet PC	On the screen there are numbers in a random order. The pupil has to order these numbers correctly.	Teacher starts the system and begins student's interactions.	Initial setup	None
				The system says : "order the numbers rising" (it can be selected to order 2, 3, 4…10 numbers to order)	Challenge to sequencing correctly	1 minute / 5 seconds Time decreases in response to progress
				Verbal answer with the correct order	Develops and exercises	
				The system gives feedback	Feedback on success, failure or inactivity	
				Student achieves 3 correct answers in a row	SLA achieved	
		Robot (NAO)	The robot says 5 different numbers in	Teacher starts the system and the robot prompts for student's interactions.	Initial setup	None

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
			random order. It asks the pupil to say the ascending or descending order of the numbers. The pupil has to tell back the numbers in the correct order.	The robot says 5 random numbers (non-repeating) and says : "order the numbers rising"	Challenge to sequencing correctly	1 minute / 5 seconds Time decreases in response to progress
				Verbal answer with the correct order	Develops and exercises	
				The system gives feedback	Feedback on success, failure or inactivity	
				Student achieves 3 correct answers in a row	SLA achieved	
		Robot (Turtlebot)	The robot indicates randomly 5 places in a room where numbered cards reside. It then asks the pupil to lead it to those 5 places according to the ascending/descending order of the cards. The pupil has go to each place in the correct order and call the robot to each spot.	Teacher starts the system and the robot prompts for student's interactions. The robot travels to 5 spots in the room (in random order), where 5 numbered cards reside.	Initial setup, problem indication	None
				The robot then returns to the student and says : "go to each spot, according to the number of the cards I showed you, rising, and call me to come each time you reach a spot".	Challenge to sequencing correctly	1 minute / 5 seconds Time decreases in response to progress
				Spatial answer/placement with the correct order	Develops and exercises	
				The system gives feedback	Feedback on success, failure or inactivity	
				Student achieves 3 correct answers in a row	SLA achieved	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Identify the largest / smallest number between two numbers.	IWB Tablet PC	The system displays two (or more) different numbers and asks the pupil to indicate which is the largest/smallest (alternating or randomly). The pupil has to click/tap on which is the correct number.	Teacher starts the system and begins student's interactions.	Initial setup	None
				The system shows notification: "Show me which is the smallest (or largest) number."	Challenge to identify the smallest (or largest) number	1 minute / 5 seconds Time decreases in response to progress
				Interaction (click/tap) on the correct number	Develops and exercises	
				System gives confirmation, correction or prompting	Feedback	
				Student achieves 3 correct answers in a row	Achieved identify the smallest (or largest) number	
				Student achieves both smallest & largest number identification tasks	SLA achieved	
		Robot (NAO)	Robot says two (or more) different numbers and pupil has to indicate which is the largest / smallest (alternating or randomly).	Teacher starts the system and begins student's interactions.	Initial setup	None
				The robot says: "Tell me which is the smallest (or largest) number, X or Y (or Z …)"	Challenge to identify the smallest (or largest) number	1 minute / 5 seconds Time decreases in response to progress
				Verbal answer with the correct number	Develops and exercises	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
				System gives confirmation, correction or prompting	Feedback	
				Student achieves 3 correct answers in a row	Achieved identify the smallest (or largest) number	
				Student achieves both smallest & largest number identification tasks	SLA achieved	
		Robot (Turtlebot)	Using the robot screen, two (or more) numbers are displayed. An avatar asks the learner (alternating or randomly) which is smallest / largest. (this command can be also verbal). The learner has a set of (physical) cards bearing the numbers being used in the exercise and shows a card to the robot in answer.	Teacher starts the system and begins student's interactions.	Initial setup	None
				The robot says: "Show me the smallest (or largest) number"	Challenge to identify the smallest / largest number	1 minute / 5 seconds Time decreases in response to progress
				The student shows a card to the robot	Develops and exercises	
				System gives confirmation, correction or prompting	Feedback	
				Student achieves 3 correct answers in a row	Achieved identify the smallest (or largest) number	
				Student achieves both smallest & largest number identification tasks	SLA achieved	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
		Alternative Robot (Turtlebot)	A number of groups of objects (e.g. 3 balls in one group and 5 blocks in another) are displayed on screen. Their equivalent real objects are placed around a room. The robot asks to be guided to the object that is in the largest / smallest group on its screen.	Teacher starts the system and begins student's interactions.	Initial setup	None
				The robot says: "Take me to the thing that is in the smallest (or largest) group on my screen"	Challenge to identify the smallest / largest number	1 minute / 5 seconds Time decreases in response to progress
				The student guides the robot to an object	Develops and exercises	
				System gives confirmation, correction or prompting	Feedback	
				Student achieves 3 correct answers in a row	Achieved identify the smallest (or largest) number	
				Student achieves both smallest & largest number identification tasks	SLA achieved	

Table 55: Learning experience example (ME) – Learning goal: Mathematical competences: numbering (from the Learning Experience outlined in Section 5.3.3)

13.3.3 Learning goal: Communication/Socialization skills

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Social perspective talking	Engage in a dialogue	Robot (NAO)	Robot says a predefined story, during which it frequently asks questions to the pupil. The questions are constructed in a way that the response is a choice from a finite set of options. Each choice changes the course of the story accordingly. The student responds (freely) and when he finishes talking, he taps the robot on the head. The robot recognizes a keyword in the response and continues its story accordingly.	Teacher initialises the system	Initial setup	None
				Robot starts the story.	Challenge to comprehension	None
				Robot asks: "… so as you can see, Nancy loved to go to the beach. What do you like to do most in the summer? Go to the beach and swim, go to the mountain and hike, go to the countryside and see nature, go to the forest and hike, visit relatives or something else?".	Challenge to engage in dialogue	None
				Student answers and taps the robot on the head to continue. Robot gives encouraging feedback. If keyword was not recognized/in the response, robot asks "I didn't understand you. You said beach, mountain, countryside, forest, visit or something else?"	Develops and exercises social perspective talking	30 seconds / 5 seconds Time decreases with increasing capability (OR vary period to determine optimum for the learner)
				Process repeats until end of story.	Completion => SLA achieved	None
		Robot	Robot travels to different	Teacher initialises the system	Initial setup	None

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
		(Turtlebot)	parts of the room (e.g. to the blackboard, a desk, the play corner, the bookshelves, etc.) and asks the student to describe what he sees there and what this involves.	Robot travels to parts of the room asking the student to go along, while talking to the student, and stops at predefined spots.	Challenge to socialisation	None
				Robot stops at the bookshelves and says: "Oh, I love reading. Tell me, what's in these bookshelves? Have you read anything from here? Do you like reading?"	Challenge to engage in dialogue	None
				Student answers and then prompts the robot to continue. Robot gives encouraging feedback.	Develops and exercises social perspective talking	30 seconds / 5 seconds Time decreases with increasing capability (OR vary period to determine optimum for the learner)
				Process repeats until end of the predefined travel plan.	Completion => SLA achieved	None
		IWB Tablet PC	Same as the 'Robot (NAO)' case, but with an avatar and/or pictures that accompany the story.	Same as the 'Robot (NAO)' case	Same as the 'Robot (NAO)' case	Same as the 'Robot (NAO)' case

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Emotional awareness	Identify emotional facial expressions	Robot (NAO)	Robot shows (physical) pictures of people/cartoons expressing different emotions to the student. It informs the student which emotion corresponds to each picture. It then shuffles the pictures (tutor-assisted) and picks one up. Student has to match and name the emotion on the picture.	Teacher initialises the system. The robot acquaints the pictures and corresponding emotions to the student.	Initial setup, problem comprehension	None
				The robot hands a picture to the student and asks, "How does this person feel? Happy, sad, scared, angry, surprised, disgusted or neutral?"	Challenge to emotion recognition	None
				Verbal identification of the emotion	Broadens and cements emotion recognition	10 seconds / 1 second Time decreases in response to progress
				System gives confirmation, correction or prompting	Feedback	None
				Student achieves 3 correct answers in a row	SLA achieved	None

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
		IWB Tablet PC Robot (Turtlebot)	System displays pictures of people/cartoons expressing different emotions to the student. Under each picture, the name of the emotion appears. It then shuffles the pictures and randomly shows one. Student has to match and name the emotion on the picture.	Same as before, with on-screen digital pictures	Same as before	Same as before
	Demonstrate understanding of different emotions	IWB Tablet PC Robot (Turtlebot)	System displays pictures of people/cartoons expressing different emotions to the student (no explanation of emotions). Student has to recognize and name the emotion.	Teacher initialises the system	Start of learning, initial setup	None
				The system displays a picture of a person/cartoon with a distinct facial or body expression of an emotion and asks, "How does this person feel? Happy, sad, scared, angry, surprised, disgusted or neutral?"	Challenge to emotion recognition	None
				Verbal identification of the emotion	Broadens and cements emotion recognition	10 seconds / 1 second Time decreases in response to progress
				System gives confirmation, correction or prompting	Feedback	None

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
				Student achieves 3 correct answers in a row	SLA achieved	None
		Robot (NAO)	Robot shows (physical) pictures of people/cartoons expressing different emotions to the student (no explanation of emotions). Student has to recognize and name the emotion.	Same as before, with physical pictures	Same as before	Same as before
	Respond appropriately to different emotions	IWB Tablet PC Robot (Turtlebot)	System displays pictures of people/cartoons expressing different emotions to the student. Student has to produce the same emotion with his face and/or body.	Teacher initialises the system	Start of learning, initial setup	None
				The system shows a picture to the student and asks, "Can you express the same emotion as this person/character?"	Challenge to emotion recognition	None
				Visual identification of the emotion	Broadens and cements emotion recognition	None
				System gives confirmation, correction or prompting	Feedback	30 seconds / 5 seconds Time decreases with increasing capability (OR vary period to determine optimum for the learner)

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
				Student achieves 3 correct answers in a row	SLA achieved	None
		Robot (NAO)	Robot hands out pictures of people/cartoons expressing different emotions to the student. Student has to produce the same emotion with his face and/or body.	Same as before, with physical pictures	Same as before	Same as before

Table 56: Learning experience example (ME) – Learning goal: Communication/Socialization skills (from the Learning Experience outlined in Section 5.3.3)

13.4 Industrial Training Learning Experience examples

Although in the context of the MaTHiSiS pilots all industrial training is going to take place on a PC, options for adapting the same LAs to materialisations for other PAs are made available. Concerning robots, we can consider the actions happening on the Turtlebot (a screen-bearing robot) or a non-screen bearing robot like NAO narrating presentations or giving directions to follow on a side PC. For the first pilots (driver pilots) we will focus on implementations without robots.

13.4.1 Learning goal: Searching geo-data sets

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Understanding how the catalogue works	Follow presentation of the catalogue module (video, powerpoint, narrative etc.)	PC Mobile IWB Robot	A video is presented to the learner or a narration is performed by the non-screen-bearing robot (collectively with a video projector a individually on the computer screen)	Learners are shown the video/follow the narration of the robot Complementary explanation by the trainer or narrating robot if needed	None	TBD
	Take a catalogue understanding quiz	PC Mobile IWB Robot	A quiz (on screen or verbal on non-screen PA) on the different functionalities of the catalogue module is proposed to the learner	Learners begin the interaction with the PA Learners fill in/answer the quiz Once finished learners click a button/ask the robot to check their results	Success: SLA achieved	TBD
Searching datasets on	Access the web platform	PC	Learners are shown (video tutorial or robot	Learners access the platform home page on the internet	One successful attempt: SLA reached 35%.	TBD

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Terrahub	(login)	Mobile IWB Robot	narration with accompanying PC) how to access the web platform and how to login and then they perform it themselves.	Learners login	SLA achieved after 3 successful attempts.	
	Access the catalogue module	PC Mobile IWB Robot	Learners are shown (video tutorial or robot narration with accompanying PC) how to access the catalogue module within the web platform and then they perform it themselves.	Learners look for the dedicated tab on the web platform homepage	Success: SLA reached 30%	TBD
				Learners access the catalogue module. System verifies if they have accessed the right place.	One successful attempt: SLA reached 50%. SLA achieved after 3 successful attempts.	
	Make a keyword-based search query on Terrahub	PC Mobile IWB Robot	Learners are shown how (video tutorial or robot narration with accompanying PC) to do a word-based query on the catalogue module and then they perform it themselves.	Learners insert a basic query in the catalogue module (for instance: 'climate change'). System verifies if they have in fact made the right query.	One successful query: SLA reached 20%. SLA achieved after 5 successful different queries.	TBD
				Learners obtain a list of results. System verifies if they have received results for the right query.	Receiving successful a relevant list of results: SLA reached 20%. SLA achieved after 5 successful results for different queries.	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Refine a keyword-based search query on Terrahub	PC Mobile IWB Robot	Learners are shown (video tutorial or robot narration with accompanying PC) how to obtain more accurate results in respect with what they are looking for and then they perform it themselves.	Learners narrow down their research by adding complementary key words (for instance: 'La Réunion'). System verifies that they have made the right query.	One successful attempt: SLA reached 10%.	TBD
				Learners obtain a more precise list of results. System verifies if they have received results for the right query.	Receiving successful a relevant list of results: SLA reached 20%. SLA achieved after 5 results for different queries.	
	Read metadata from the dataset	PC Mobile IWB Robot	Learners are shown (video tutorial or robot narration with accompanying PC) how to read metadata	Learners are presented information on how to use the data set	Success: SLA reached 20% SLA achieved over 5 successful iterations	TBD
				Learners use the data set for a specific predefined purpose.		
				System informs them if their usage was correct		
Searching datasets on the web	Make a keyword-based search query on the web (google)	PC Mobile IWB Robot	Learners are shown (video tutorial or robot narration with accompanying PC) how to do a basic key word-based search on the web and then they perform it themselves.	Learners perform the search as requested System informs them if they made the correct search as requested.	Success: SLA reached 33% SLA achieved over 3 successful iterations	
				Learners obtain the appropriate result. System verifies if they have received results for the right query.	Success: SLA reached 33% SLA achieved over 3 successful iterations	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Visit recognized international web geodata portals	PC Mobile IWB Robot	Learners are taught (video tutorial or robot narration with accompanying PC) to do research on recognized web geodata portals and then they perform it themselves.	Learners search for several web geodata portals (for instance Copernicus). System informs them if their search was correct	Success: SLA reached 33% SLA achieved over 3 successful iterations	TBD
				Learners select the portal they deem the most adapted to their query. PA validates if in fact the portal is the most adapted to their query,	Success: SLA reached 33% SLA achieved over 3 successful iterations	
Getting information about the data sets	Follow presentation of why metadata are so important	PC Mobile IWB Robot	Learners are explained (video tutorial or robot narration with accompanying PC) the importance of metadata in comparison with raw data	Learners listen to the explanations of the robot or watch a video tutorial or read a short text on screen.	Understanding task	TBD
				Learners answer a series of questions to make sure they understood everything correctly. The system/PA gives appropriate feedback.	One successful answer: SLA reached 10%. SLA achieved after 10 successful answers.	
	Follow presentation on details about metadata (what is a metadata,	PC Mobile IWB Robot	Learners are given a general presentation (video tutorial or robot narration with accompanying PC) of metadata	Learners listen to the explanations of the robot or watch a video tutorial or read a short text on screen	Understanding task	TBD
				Learners answer questions about metadata. PA informs if answer is right or wrong.	One correct answer: SLA reached 20% SLA achieved over 5 successful answers	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	European directive INSPIRE)			Learners answer questions about European directive INSPIRE. PA informs if answer is right or wrong.	One correct answer: SLA reached 20% SLA achieved over 5 successful answers	
	Filter datasets according to certain characteristics	PC Mobile IWB Robot	Learners are shown (video tutorial or robot narration with accompanying PC) how to filter data sets using certain characteristics of the data	Learners select the appropriate filters according to their query. PA informs if they made the appropriate selection.	Success: SLA reached 33% SLA achieved over 3 successful iterations	TBD
				Learners apply those filters and obtain the expected list of results.	Success: SLA reached 33% SLA achieved over 3 successful iterations	

Table 57: Learning goal (IT) – Searching geo-data sets

13.4.2 Learning goal: Data visualization and manipulation

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Data visualization: spatial navigation	Zoom in/out	PC Mobile IWB Robot	Learners are shown (video tutorial or robot narration with accompanying PC) how to use the zoom feature on the portal	Learners zoom in using the zoom feature	Success: SLA reached 33% SLA achieved over 3 successful iterations	TBD
				Learners zoom out using the zoom feature	Success: SLA reached 33% SLA achieved over 3 successful iterations	
	Zoom to the layer	PC Mobile IWB Robot	Learners are shown (video tutorial or robot narration with accompanying PC) how to use the zoom feature in relation to the layer of the data	Learners watch the tutorial video or listen to the explanation of the robot regarding layers and the functionalities thereof	Understanding the task	TBD
				Learners use the zoom feature to go to the layer	Success: SLA reached 33% SLA achieved over 3 successful iterations	
Data visualization: display attributes	Get information from a feature (identify tool)	PC Mobile IWB Robot	Learners are taught (video tutorial or robot narration with accompanying PC) how to decrypt the information obtained through the 'identify' feature of the portal	Learners watch the tutorial video or listen to the explanation of the robot about the identify tool	Understanding the task	TBD
				Learners use the identify tool to get information from a feature	One successful attempt: SLA reached 33% SLA achieved over 3 successful attempts	
	Open the attribute table	PC Mobile IWB	Learners are shown (video tutorial, presentation or robot narration with accompanying PC) how to	Learners watch the tutorial video or see a short presentation or listen to the explanation of the robot of the attribute table	Understanding the task	TBD

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
		Robot	open the attribute table	Learners open the attribute table. PA informs if s/he opened the right component.	One successful attempt: SLA reached 33% SLA achieved over 3 successful attempts	
	Navigate on the attribute table	PC Mobile IWB Robot	Learners are shown (video tutorial or robot narration with accompanying PC) how to navigate within the attribute table	Learners navigate in the attribute table	Understanding the task	TBD
				Learners get to the point within the attribute table they have been asked to reach. PA validates.	One successful attempt: SLA reached 20% SLA achieved over 5 successful attempts	
Layer manager manipulation	Manage the order of the layers overlay	PC Mobile IWB Robot	Learners are shown (video tutorial or robot narration with accompanying PC) how to manage the order of the layers overlay	Learners watch the tutorial video or listen to the explanation of the robot of layers overlay	Understanding the task	TBD
				Learner performs the management of the layers overlay as instructed by the system. PA validates if performed correctly.	One successful attempt: SLA reached 20% SLA achieved over 5 successful attempts	
	Identify options related to a layer	PC Mobile IWB Robot	Learners are taught (video tutorial or robot narration with accompanying PC) about the different options available on the platform regarding a specific layer	Learners navigate all the options related to a specific layer. PA validates if performed correctly.	One successful attempt: SLA reached 10% Three successful attempts: SLA reached 30%	TBD
				Learners select the requested options as indicated by the system. PA validates if selected correctly.	One successful attempt: SLA reached 50% SLA achieved over 5 successful attempts	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Style manager manipulation	Modify the style of the layer	PC Mobile IWB Robot	Learners are taught (video tutorial or robot narration with accompanying PC) how to modify the style of a layer	Learners watch the tutorial video or read a short text or listen to the explanation of the robot	Understanding the task	TBD
				Learners select the appropriate style from the style lists. PA validates if selected correctly.	One successful attempt: SLA reached 10% Three successful attempts: SLA reached 30%	
				Learners apply the new style as requested by the system. PA validates if performed correctly.	One successful attempt: SLA reached 50% SLA achieved over 5 successful attempts	
	Export style layer	PC Mobile IWB Robot	Learners are shown (video tutorial or robot narration with accompanying PC) how to export the style of the layer	Learners watch the tutorial video or read a short text or listen to the explanation of the robot	Understanding the task	TBD
				Learners select the style of the layer. PA validates if selected correctly.	One successful attempt: SLA reached 20% Three successful attempts: SLA reached 50%	
				Learners export the style of the layer. PA validates if performed correctly.	One successful attempt: SLA reached 75% SLA achieved over 2 successful attempts	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Import style layer	PC Mobile IWB Robot	Learners are shown (video tutorial or robot narration with accompanying PC) how to import the style of the layer	Learners select the style of the layer. PA validates if selected correctly.	One successful attempt: SLA reached 20% 3 successful attempts: SLA reached 50%	TBD
				Learners import the style of the layer. PA validates if performed correctly.	One successful attempt: SLA reached 75% SLA achieved over 2 successful attempts	
Query manager manipulation	Make SQL queries	PC Mobile IWB Robot	Learners are shown (video tutorial or robot narration with accompanying PC) how to perform SQL queries on the portal	Learners watch the tutorial video or read a short text or listen to the explanation of the robot	Understanding the task	
				Learners perform various SQL requests.	SLA reached 30%	
				Learners perform the appropriate SQL request as demanded by the system. PA validates if performed correctly.	One successful attempt: SLA reached 50% SLA achieved over 5 successful attempts	
	Display features using queries	PC Mobile IWB	Learners are shown (video tutorial or robot narration with accompanying PC) how display features using such	Learners watch the tutorial video or read a short text or listen to the explanation of the robot about the display of features using queries	Understanding the task	TBD

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
		Robot	SQL queries	Learners perform the SQL query in order to display the requested feature. PA validates if performed correctly and requested feature was in fact shown.	One successful attempt: SLA reached 20% SLA achieved over 5 successful attempts	
Data editing	Modify geometry / drawing new features	PC Mobile IWB Robot	Learners are taught (video tutorial or robot narration with accompanying PC) to modify the geometry of features and to draw new features	Learners watch the tutorial video or listen to the explanation of the robot or read a short text about geometry and drawing of features	Understanding the task	TBD
				Learners modify the geometry of a feature as requested by the system. PA validates if performed correctly.	One successful attempt: SLA reached 10% 5 successful: SLA reached 50%	
				Learners draw new features as requested by the system. PA validates if performed correctly.	One successful attempt: SLA reached 60% SLA achieved over 5 successful attempts	
	Modify attributes on the table	PC Mobile IWB Robot	Learners are taught (video tutorial or robot narration with accompanying PC) to modify attributes in the attribute table	Learners watch the tutorial video or listen to the explanation of the robot or read a short text	Understanding the task	TBD
				Learner selects the appropriate attributes. PA validates if selected correctly.	One successful attempt: SLA reached 15% 3 successful attempts: SLA reached 40%	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
				Learner modifies the attributes as requested by the system. PA validates if performed correctly.	One successful attempt: SLA reached 50% SLA achieved over 5 successful attempts	

Table 58: Learning goal (IT) – Data visualization and manipulation

13.5 CGDL Learning Experience examples

Although in the context of the MaTHiSiS pilots all industrial training is going to take place on a PC, options for adapting the same LAs to materialisations for other PAs are made available. Concerning robots, we can consider the actions happening on the Turtlebot (a screen-bearing robot) or a non-screen bearing robot like NAO narrating presentations or giving directions to follow on a side PC. For the first pilots (driver pilots) we will focus on implementations without robots.

13.5.1 Learning goal: Create an e-career portfolio

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Mother language skills	Follow a tutorial on demonstrating mother language skills in e-portfolio	PC TABLET / SMARTPHONE IWB (ROBOT)	PA presents an age appropriate (adolescent / adult) tutorial to the learner	Learner watches the tutorial	Completion of the tutorial = 30% of the SLA (learner understood how to demonstrate mother language skills in e-portfolio)	none
	Take a mother language skills validation test in e-portfolio		PA presents a quiz with adaptable questions (Multiple-choice questions AND scaffolded questions with only 2 answers: right or wrong)	Learner answers quiz questions. If multiple choice question is answered wrongly, a scaffolded question is supplied	If answers are correct - and scaffolded questions are not needed - learner is positively progressing to reach the goal If scaffolded questions are used - learner is progressing at a slower pace	none
				Learner completes the quiz	The number of obtained correct answers vs. the achievement threshold will determine the level of achievement Completion of the quiz = 60% of the SLA (learner demonstrated mother language skills in e-portfolio)	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Create an example demonstrating mother language skills in e-portfolio		PA asks the learner to prepare an example	1) Learner reads the assignment 2) Learner works on the assignment 3) Learner submits the assignment	3) If the assignment is assessed as correct, the learner has achieved the SLA	none
Foreign language skills	Follow a tutorial on demonstrating foreign language skills in e-portfolio	PC TABLET / SMARTPHONE IWB (ROBOT)	PA presents an age appropriate (adolescent / adult) tutorial to the learner	Learner watches the tutorial	Completion of the tutorial = 30% of the SLA (learner understood how to demonstrate foreign language skills in e-portfolio)	none
	Take a foreign language skills validation test in e-portfolio		PA presents a quiz with adaptable questions (Multiple-choice questions AND scaffolded questions with only 2 answers: right or wrong)	Learner answers quiz questions. If multiple choice question is answered wrongly, a scaffolded question is supplied	If answers are correct - and scaffolded questions are not needed - learner is positively progressing to reach the goal If scaffolded questions are used - learner is progressing at a slower pace	none
				Learner completes the quiz	The number of obtained correct answers vs. the achievement threshold will determine the level of achievement Completion of the quiz = 60% of the SLA (learner demonstrated foreign language skills in e-portfolio)	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Create an example demonstrating foreign language skills in e-portfolio		PA asks the learner to prepare an example	1) Learner reads the assignment 2) Learner works on the assignment 3) Learner submits the assignment	3) If the assignment is assessed as correct, the learner has achieved the SLA	none
Numeric skills	Follow a tutorial on demonstrating numeric skills in e-portfolio	PC TABLET / SMARTPHONE IWB (ROBOT)	PA presents an age appropriate (adolescent / adult) tutorial to the learner	Learner watches the tutorial	Completion of the tutorial = 30% of the SLA (learner understood how to demonstrate numeric skills in e-portfolio)	none
	Take a numeric skills validation test in e-portfolio		PA presents a quiz with adaptable questions (Multiple-choice questions AND scaffolded questions with only 2 answers: right or wrong)	Learner answers quiz questions. If multiple choice question is answered wrongly, a scaffolded question is supplied	If answers are correct - and scaffolded questions are not needed - learner is positively progressing to reach the goal If scaffolded questions are used - learner is progressing at a slower pace	none
				Learner completes the quiz	The number of obtained correct answers vs. the achievement threshold will determine the level of achievement Completion of the quiz = 60% of the SLA (learner demonstrated numeric skills in e-portfolio)	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Create an example demonstrating numeric skills in e-portfolio		PA asks the learner to prepare his example	1) Learner reads the assignment 2) Learner works on the assignment 3) Learner submits the assignment	3) If the assignment is assessed as correct, the learner has achieved the SLA	none
Digital literacy (computer skills)	Follow a tutorial on demonstrating computer skills in e-portfolio	PC TABLET / SMARTPHONE IWB (ROBOT)	PA presents an age appropriate (adolescent / adult) tutorial to the learner	Learner watches the tutorial	Completion of the tutorial = 30% of the SLA (learner understood how to demonstrate digital literacy (computer skills) in e-portfolio)	none
	Take a computer skills validation test in e-portfolio		PA presents a quiz with adaptable questions (Multiple-choice questions AND scaffolded questions with only 2 answers: right or wrong)	Learner answers quiz questions. If multiple choice question is answered wrongly, a scaffolded question is supplied	If answers are correct - and scaffolded questions are not needed - learner is positively progressing to reach the goal If scaffolded questions are used - learner is progressing at a slower pace	none
				Learner completes the quiz	The number of obtained correct answers vs. the achievement threshold will determine the level of achievement Completion of the quiz = 60% of the SLA (learner demonstrated digital literacy (computer skills) in e-portfolio)	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Create an example demonstrating computer skills in e-portfolio		PA asks the learner to prepare his example	1) Learner reads the assignment 2) Learner works on the assignment 3) Learner submits the assignment	3) If the assignment is assessed as correct, the learner has achieved the SLA	none
Lifelong learning skills	Follow a tutorial on demonstrating lifelong learning skills in e-portfolio	PC TABLET / SMARTPHONE IWB (ROBOT)	PA presents an age appropriate (adolescent / adult) tutorial to the learner	Learner watches the tutorial	Completion of the tutorial = 30% of the SLA (learner understood how to demonstrate lifelong learning skills in e-portfolio)	none
	Take a lifelong learning skills validation test in e-portfolio		PA presents a quiz with adaptable questions (Multiple-choice questions AND scaffolded questions with only 2 answers: right or wrong)	Learner answers quiz questions. If multiple choice question is answered wrongly, a scaffolded question is supplied	If answers are correct - and scaffolded questions are not needed - learner is positively progressing to reach the goal If scaffolded questions are used - learner is progressing at a slower pace	none
				Learner completes the quiz	The number of obtained correct answers vs. the achievement threshold will determine the level of achievement Completion of the quiz = 60% of the SLA (learner demonstrated lif long learning skills in e-portfolio)	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Create an example demonstrating lifelong learning in e-portfolio		PA asks the learner to prepare his example	1) Learner reads the assignment 2) Learner works on the assignment 3) Learner submits the assignment	3) If the assignment is assessed as correct, the learner has achieved the SLA	none
Flexibility skills	Follow a tutorial on demonstrating flexibility skills in e-portfolio	PC TABLET / SMARTPHONE IWB (ROBOT)	PA presents an age appropriate (adolescent / adult) tutorial to the learner	Learner watches the tutorial	Completion of the tutorial = 30% of the SLA (learner understood how to demonstrate flexibility skills in e-portfolio)	none
	Take a flexibility skills validation test in e-portfolio		PA presents a quiz with adaptable questions (Multiple-choice questions AND scaffolded questions with only 2 answers: right or wrong)	Learner answers quiz questions. If multiple choice question is answered wrongly, a scaffolded question is supplied	If answers are correct - and scaffolded questions are not needed - learner is positively progressing to reach the goal If scaffolded questions are used - learner is progressing at a slower pace	none
				Learner completes the quiz	The number of obtained correct answers vs. the achievement threshold will determine the level of achievement Completion of the quiz = 60% of the SLA (learner demonstrated flexibility skills in e-portfolio)	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Create an example demonstrating flexibility skills in e-portfolio		PA asks the learner to prepare his example	1) Learner reads the assignment 2) Learner works on the assignment 3) Learner submits the assignment	3) If the assignment is assessed as correct, the learner has achieved the SLA	none
Communication skills	Follow a tutorial on demonstrating communication skills in e-portfolio	PC TABLET / SMARTPHONE IWB (ROBOT)	PA presents an age appropriate (adolescent / adult) tutorial to the learner	Learner watches the tutorial	Completion of the tutorial = 30% of the SLA (learner understood how to demonstrate communication skills in e-portfolio)	none
	Take a communication skills validation test in e-portfolio		PA presents a quiz with adaptable questions (Multiple-choice questions AND scaffolded questions with only 2 answers: right or wrong)	Learner answers quiz questions. If multiple choice question is answered wrongly, a scaffolded question is supplied	If answers are correct - and scaffolded questions are not needed - learner is positively progressing to reach the goal If scaffolded questions are used - learner is progressing at a slower pace	none
				Learner completes the quiz	The number of obtained correct answers vs. the achievement threshold will determine the level of achievement Completion of the quiz = 60% of the SLA (learner demonstrated communication skills in e-portfolio)	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Create an example demonstrating communication skills in e-portfolio		PA asks the learner to prepare his example	1) Learner reads the assignment 2) Learner works on the assignment 3) Learner submits the assignment	3) If the assignment is assessed as correct, the learner has achieved the SLA	none
Problem-solving skills	Follow a tutorial on demonstrating problem-solving skills in e-portfolio	PC TABLET / SMARTPHONE IWB (ROBOT)	PA presents an age appropriate (adolescent / adult) tutorial to the learner	Learner watches the tutorial	Completion of the tutorial = 30% of the SLA (learner understood how to demonstrate problem solving skills in e-portfolio)	none
	Take problem-solving skills validation test in e-portfolio		PA presents a quiz with adaptable questions (Multiple-choice questions AND scaffolded questions with only 2 answers: right or wrong)	Learner answers quiz questions. If multiple choice question is answered wrongly, a scaffolded question is supplied	If answers are correct - and scaffolded questions are not needed - learner is positively progressing to reach the goal If scaffolded questions are used - learner is progressing at a slower pace	none
				Learner completes the quiz	The number of obtained correct answers vs. the achievement threshold will determine the level of achievement Completion of the quiz = 60% of the SLA (learner demonstrated problem solving skills in e-portfolio)	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Create an example demonstrating problem-solving skills in e-portfolio		PA asks the learner to prepare his example	1) Learner reads the assignment 2) Learner works on the assignment 3) Learner submits the assignment	3) If the assignment is assessed as correct, the learner has achieved the SLA	none
Creativity skills	Follow a tutorial on demonstrating creativity skills in e-portfolio	PC TABLET / SMARTPHONE IWB (ROBOT)	PA presents an age appropriate (adolescent / adult) tutorial to the learner	Learner watches the tutorial	Completion of the tutorial = 30% of the SLA (learner understood how to demonstrate creativity skills in e-portfolio)	none
	Take creativity skills validation test in e-portfolio		PA presents a quiz with adaptable questions (Multiple-choice questions AND scaffolded questions with only 2 answers: right or wrong)	Learner answers quiz questions. If multiple choice question is answered wrongly, a scaffolded question is supplied	If answers are correct - and scaffolded questions are not needed - learner is positively progressing to reach the goal If scaffolded questions are used - learner is progressing at a slower pace	none
				Learner completes the quiz	The number of obtained correct answers vs. the achievement threshold will determine the level of achievement Completion of the quiz = 60% of the SLA (learner demonstrated creativity skills in e-portfolio)	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Create an example demonstrating creativity skills in e-portfolio		PA asks the learner to prepare his example	1) Learner reads the assignment 2) Learner works on the assignment 3) Learner submits the assignment	3) If the assignment is assessed as correct, the learner has achieved the SLA	none
Teamwork skills	Follow a tutorial on demonstrating teamwork skills in e-portfolio	PC TABLET / SMARTPHONE IWB (ROBOT)	PA presents an age appropriate (adolescent / adult) tutorial to the learner	Learner watches the tutorial	Completion of the tutorial = 30% of the SLA (learner understood how to demonstrate teamwork skills in e-portfolio)	none
	Take teamwork skills validation test in e-portfolio		PA presents a quiz with adaptable questions (Multiple-choice questions AND scaffolded questions with only 2 answers: right or wrong)	Learner answers quiz questions. If multiple choice question is answered wrongly, a scaffolded question is supplied	If answers are correct - and scaffolded questions are not needed - learner is positively progressing to reach the goal If scaffolded questions are used - learner is progressing at a slower pace	none
				Learner completes the quiz	The number of obtained correct answers vs. the achievement threshold will determine the level of achievement Completion of the quiz = 60% of the SLA (learner demonstrated teamwork skills in e-portfolio)	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Create an example demonstrating teamwork skills in e-portfolio		PA asks the learner to prepare his example	1) Learner reads the assignment 2) Learner works on the assignment 3) Learner submits the assignment	3) If the assignment is assessed as correct, the learner has achieved the SLA	none
Initiative and entrepreneurship skills	Follow a tutorial on demonstrating initiative and entrepreneurship skills in e-portfolio	PC TABLET / SMARTPHONE IWB (ROBOT)	PA presents an age appropriate (adolescent / adult) tutorial to the learner	Learner watches the tutorial	Completion of the tutorial = 30% of the SLA (learner understood how to demonstrate initiative and entrepreneurship skills in e-portfolio)	none
	Take initiative and entrepreneurship skills validation test in e-portfolio		PA presents a quiz with adaptable questions (Multiple-choice questions AND scaffolded questions with only 2 answers: right or wrong)	Learner answers quiz questions. If multiple choice question is answered wrongly, a scaffolded question is supplied	If answers are correct - and scaffolded questions are not needed - learner is positively progressing to reach the goal If scaffolded questions are used - learner is progressing at a slower pace	none
				Learner completes the quiz	The number of obtained correct answers vs. the achievement threshold will determine the level of achievement Completion of the quiz = 60% of the SLA (learner demonstrated initiative and entrepreneurship skills in e-portfolio)	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Create an example demonstrating initiative and entrepreneurship skills in e-portfolio		PA asks the learner to prepare his example	1) Learner reads the assignment 2) Learner works on the assignment 3) Learner submits the assignment	3) If the assignment is assessed as correct, the learner has achieved the SLA	none
Professional (hard) skills	Follow a tutorial on demonstrating professional (hard) skills in e-portfolio	PC TABLET / SMARTPHONE IWB (ROBOT)	PA presents an age appropriate (adolescent / adult) tutorial to the learner	Learner watches the tutorial	Completion of the tutorial = 30% of the SLA (learner understood how to demonstrate professional (hard) skills in e-portfolio)	none
	Take professional (hard) skills validation test in e-portfolio		PA presents a quiz with adaptable questions (Multiple-choice questions AND scaffolded questions with only 2 answers: right or wrong)	Learner answers quiz questions. If multiple choice question is answered wrongly, a scaffolded question is supplied	If answers are correct - and scaffolded questions are not needed - learner is positively progressing to reach the goal If scaffolded questions are used - learner is progressing at a slower pace	none
				Learner completes the quiz	The number of obtained correct answers vs. the achievement threshold will determine the level of achievement Completion of the quiz = 60% of the SLA (learner demonstrated professional (hard) skills in e-portfolio)	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Create an example demonstrating professional (hard) skills in e-portfolio		PA asks the learner to prepare his example	1) Learner reads the assignment 2) Learner works on the assignment 3) Learner submits the assignment	3) If the assignment is assessed as correct, the learner has achieved the SLA	none

Table 59: Learning goal (CGDL) – Create an e-career portfolio

13.5.2 Learning goal: Draft your Europass CV

Table 60: Learning goal (CGDL) – Draft your Europass CV

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Personal details (comprehension)	Follow a tutorial on how to complete the personal details section of a Europass CV	PC TABLET / SMARTPHONE IWB (ROBOT)	PA presents an age appropriate (adolescent / adult) tutorial to the learner	Learner watches the tutorial	Completion of the tutorial = 30% of the SLA (learner understood how to complete the personal details section of a Europass CV)	none
	Take a test on completing the personal details section of a Europass CV		PA presents a quiz with adaptable questions (Multiple-choice questions OR scaffolded questions with only 2 answers: right or wrong)	Learner answers quiz questions. If multiple choice question is answered wrongly, a scaffolded question is supplied	If answers are correct - and scaffolded questions are not needed - learner is positively progressing to reach the goal If scaffolded questions are used - learner is progressing at a slower pace	none
				Learner completes the quiz	The number of obtained correct answers vs. the achievement threshold will determine the level of achievement Completion of the quiz = 60% of the SLA (learner demonstrated ability to complete the personal details section of a Europass CV)	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Complete the personal details section of a Europass CV		PA asks the learner to complete the personal details section of their Europass CV	1) Learner reads the assignment 2) Learner works on the assignment 3) Learner submits the assignment	3) If the assignment is assessed as correct, the learner has achieved the SLA	none
Application type (comprehension)	Follow a tutorial on how to complete the application type section of a Europass CV	PC TABLET / SMARTPHONE IWB (ROBOT)	PA presents an age appropriate (adolescent / adult) tutorial to the learner	Learner watches the tutorial	Completion of the tutorial = 30% of the SLA (learner understood how to complete the application type section of a Europass CV)	none
	Take a test on completing the application type section of a Europass CV		PA presents a quiz with adaptable questions (Multiple-choice questions OR scaffolded questions with only 2 answers: right or wrong)	Learner answers quiz questions. If multiple choice question is answered wrongly, a scaffolded question is supplied	If answers are correct - and scaffolded questions are not needed - learner is positively progressing to reach the goal If scaffolded questions are used - learner is progressing at a slower pace	none
				Learner completes the quiz	The number of obtained correct answers vs. the achievement threshold will determine the level of achievement Completion of the quiz = 60% of the SLA (learner demonstrated ability to complete the application type section of a Europass CV)	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Complete the application type section of a Europass CV		PA asks the learner to complete the application type section of their Europass CV	1) Learner reads the assignment 2) Learner works on the assignment 3) Learner submits the assignment	3) If the assignment is assessed as correct, the learner has achieved the SLA	none
Educational history (comprehension)	Follow a tutorial on how to complete the educational history section of a Europass CV	PC TABLET / SMARTPHONE IWB (ROBOT)	PA presents an age appropriate (adolescent / adult) tutorial to the learner	Learner watches the tutorial	Completion of the tutorial = 30% of the SLA (learner understood how to complete the educational history section of a Europass CV)	none
	Take a test on completing the educational history section of a Europass CV		PA presents a quiz with adaptable questions (Multiple-choice questions OR	Learner answers quiz questions. If multiple choice question is answered wrongly, a scaffolded question is supplied	If answers are correct - and scaffolded questions are not needed - learner is positively progressing to reach the goal If scaffolded questions are used - learner is progressing at a slower pace	none

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
			scaffolded questions with only 2 answers: right or wrong)	Learner completes the quiz	The number of obtained correct answers vs. the achievement threshold will determine the level of achievement Completion of the quiz = 60% of the SLA (learner demonstrated ability to complete the educational history section of a Europass CV)	
	Complete the educational history section of a Europass CV		PA asks the learner to complete the educational history section of their Europass CV	1) Learner reads the assignment 2) Learner works on the assignment 3) Learner submits the assignment	3) If the assignment is assessed as correct, the learner has achieved the SLA	none
Professional experience (comprehension)	Follow a tutorial on how to complete the professional experience section of a Europass CV	PC TABLET / SMARTPHONE IWB (ROBOT)	PA presents an age appropriate (adolescent / adult) tutorial to the learner	Learner watches the tutorial	Completion of the tutorial = 30% of the SLA (learner understood how to complete the professional experience section of a Europass CV)	none

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Take a test on completing the professional experience section of a Europass CV		PA presents a quiz with adaptable questions (Multiple-choice questions OR scaffolded questions with only 2 answers: right or wrong)	Learner answers quiz questions. If multiple choice question is answered wrongly, a scaffolded question is supplied	If answers are correct - and scaffolded questions are not needed - learner is positively progressing to reach the goal If scaffolded questions are used - learner is progressing at a slower pace	none
				Learner completes the quiz	The number of obtained correct answers vs. the achievement threshold will determine the level of achievement Completion of the quiz = 60% of the SLA (learner demonstrated ability to complete the professional experience section of a Europass CV)	
	Complete the professional experience section of a Europass CV		PA asks the learner to complete the professional experience section of their Europass CV	1) Learner reads the assignment 2) Learner works on the assignment 3) Learner submits the assignment	3) If the assignment is assessed as correct, the learner has achieved the SLA	none
Personal skills (comprehension)	Follow a tutorial on how to complete the personal skills section of a Europass CV	PC TABLET / SMARTPHONE IWB	PA presents an age appropriate (adolescent / adult) tutorial to the learner	Learner watches the tutorial	Completion of the tutorial = 30% of the SLA (learner understood how to complete the personal skills section of a Europass CV)	none

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Take a test on completing the personal skills section of a Europass CV	(ROBOT)	PA presents a quiz with adaptable questions (Multiple-choice questions OR scaffolded questions with only 2 answers: right or wrong)	Learner answers quiz questions. If multiple choice question is answered wrongly, a scaffolded question is supplied	If answers are correct - and scaffolded questions are not needed - learner is positively progressing to reach the goal If scaffolded questions are used - learner is progressing at a slower pace	none
				Learner completes the quiz	The number of obtained correct answers vs. the achievement threshold will determine the level of achievement Completion of the quiz = 60% of the SLA (learner demonstrated ability to complete the personal skills section of a Europass CV)	
	Complete the personal skills section of a Europass CV		PA asks the learner to complete the personal skills section of their Europass CV	1) Learner reads the assignment 2) Learner works on the assignment 3) Learner submits the assignment	3) If the assignment is assessed as correct, the learner has achieved the SLA	none

13.5.3 Learning goal: Present yourself well at an interview

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Types of interviews (understanding)	Follow a tutorial on the various types of interviews	PC TABLET/ SMARTPHONE IWB (ROBOT)	PA presents an age appropriate (adolescent / adult) tutorial to the learner	Learner watches the tutorial	Completion of the tutorial = 30% of the SLA (learner understood about the various types of interview)	none
	Take a test on the various types of interviews		PA presents a quiz with adaptable questions (Multiple-choice questions OR scaffolded questions with only 2 answers: right or wrong)	Learner answers quiz questions. If multiple choice question is answered wrongly, a scaffolded question is supplied	If answers are correct - and scaffolded questions are not needed - learner is positively progressing to reach the goal If scaffolded questions are used - learner is progressing at a slower pace	none
				Learner completes the quiz	The number of obtained correct answers vs. the achievement threshold will determine the level of achievement Completion of the quiz = 100% of the SLA (learner demonstrated understanding of the various types of interview)	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Interview target (job position, education program etc.) preparation	Follow a tutorial on preparing for a type of interview (job position, education program etc.)	PC TABLET/ SMARTPHONE IWB (ROBOT)	PA presents an age appropriate (adolescent / adult) tutorial to the learner	Learner watches the tutorial	Completion of the tutorial = 30% of the SLA (learner understood about preparing for a type of interview)	none
	Take a test on the preparing for a type of the interview (job position, education program etc.) quiz		PA presents a quiz with adaptable questions (Multiple-choice questions OR scaffolded questions with only 2 answers: right or wrong)	Learner answers quiz questions. If multiple choice question is answered wrongly, a scaffolded question is supplied	If answers are correct - and scaffolded questions are not needed - learner is positively progressing to reach the goal If scaffolded questions are used - learner is progressing at a slower pace	none
				Learner completes the quiz	The number of obtained correct answers vs. the achievement threshold will determine the level of achievement Completion of the quiz = 100% of the SLA (learner demonstrated an understanding of the need to prepare for interview)	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
Answering interview questions preparation **(comprehension)**	Follow a tutorial on preparing for interview questions	PC TABLET/ SMARTPHONE IWB (ROBOT)	PA presents an age appropriate (adolescent / adult) tutorial to the learner	Learner watches the tutorial	Completion of the tutorial = 30% of the SLA (learner understood about preparing for interview questions)	none
	Take a test on preparing for interview questions		PA presents a quiz with adaptable questions (Multiple-choice questions OR scaffolded questions with only 2 answers: right or wrong)	Learner answers quiz questions. If multiple choice question is answered wrongly, a scaffolded question is supplied	If answers are correct - and scaffolded questions are not needed - learner is positively progressing to reach the goal If scaffolded questions are used - learner is progressing at a slower pace	none
				Learner completes the quiz	The number of obtained correct answers vs. the achievement threshold will determine the level of achievement Completion of the quiz = 60% of the SLA (learner demonstrated an understanding of the need to prepare for interview questions)	
	Play a role-play simulation on		PA presents the learner with a role-play simulation	Learner engages with challenges presented by the simulation	If the learner passes challenges successfully, he is progressing If scaffolded activities are used - learner is progressing at a slower pace	none

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	answering interview questions		***(This part of the design will be further refined as part of the pilot preparation)***	Learner completes the simulation	The number of successful challenges obtained vs. the Achievement threshold will determine the level of achievement. If the simulation is assessed as correct. The learner achieved the SLA	
Asking questions in an interview preparation **(comprehension)**	Follow a tutorial on preparing to ask questions in an interview	PC TABLET/ SMARTPHONE IWB (ROBOT)	PA presents an age appropriate (adolescent / adult) tutorial to the learner	Learner watches the tutorial	Completion of the tutorial = 30% of the SLA (learner understood about preparing to ask questions in an interview)	none
	Take a test on preparing to ask questions in an interview		PA presents a quiz with adaptable questions (Multiple-choice questions OR scaffolded questions with only 2 answers: right or wrong)	Learner answers quiz questions. If multiple choice question is answered wrongly, a scaffolded question is supplied	If answers are correct - and scaffolded questions are not needed - learner is positively progressing to reach the goal If scaffolded questions are used - learner is progressing at a slower pace	none
				Learner completes the quiz	The number of obtained correct answers vs. the achievement threshold will determine the level of achievement Completion of the quiz = 60% of the SLA (learner demonstrated an understanding of the preparation needed to ask questions in an interview)	

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
	Play a role-play simulation on asking questions in an interview		PA presents the learner with a role-play simulation ***(This part of the design will be further refined as part of the pilot preparation)***	Learner engages with challenges presented by the simulation	If the learner passes challenges successfully, he is progressing If scaffolded activities are used - learner is progressing at a slower pace	none
				Learner completes the simulation	The number of successful challenges obtained vs. the achievement threshold will determine the level of achievement. If the simulation is assessed as correct. The learner achieved the SLA	
Body language (awareness)	Follow a tutorial on using the right body language	PC TABLET/ SMARTPHONE IWB (ROBOT)	PA presents an age appropriate (adolescent / adult) tutorial to the learner	Learner watches the tutorial	Completion of the tutorial = 30% of the SLA (learner has an awareness of body language)	none
	Take a test on using the right body language		PA presents a quiz with adaptable questions (Multiple-choice questions OR	Learner answers quiz questions. If multiple choice question is answered wrongly, a scaffolded question is supplied	If answers are correct - and scaffolded questions are not needed - learner is positively progressing to reach the goal If scaffolded questions are used - learner is progressing at a slower pace	none

SLA	Learning Actions	PA	Materialization	Key Moments	Relation to Achievement	Time Threshold
			scaffolded questions with only 2 answers: right or wrong)	Learner completes the quiz	The number of obtained correct answers vs. the achievement threshold will determine the level of achievement Completion of the quiz = 60% of the SLA (learner demonstrated an awareness of body language)	
	Play a role-play simulation about using the right body language in an interview		PA presents the learner with a role-play simulation ***(This part of the design will be further refined as part of the pilot preparation)***	Learner engages with challenges presented by the simulation	If the learner passes challenges successfully, he is progressing If scaffolded activities are used - learner is progressing at a slower pace	none
				Learner completes the simulation	The number of successful challenges obtained vs. the achievement threshold will determine the level of achievement. If the simulation is assessed as correct. The learner achieved the SLA	

Table 61: Learning goal (CGDL) – Present yourself well at an interview