EduRob

Educational Robotics
for Students with Learning Disabilities

Lifelong Learning Programme

Robot-Based Pedagogy Requirements: Results from Stakeholder Interviews

EDUROB: Educational Robotics for Students with Learning Disabilities (EDUROB - 543577-LLP-1-2013-1-UK-KA3-KA3MP)

Deliverable	D3.2
Work Package Title	Learning Pedagogy Development
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Status	Live Document
File Name	Pedagogy Requirements Report.docx

The EDUROB (543577-LLP-1-2013-1-UK-KA3-KA3MP) project has been partially funded under the Lifelong Learning programme. This publication reflects the views only of the author(s), and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Executive Summary

This report presents the findings from partner countries from interviews and focus groups exploring the potential use of robotics within current teaching practice, the aim of which is to produce a set of pedagogical requirements that define the needs of robotic use. An interview protocol carried out in each partner country sought to gain data regarding current teaching practice, potential use of a robot in teaching and the barriers that must be overcome if robots are to be introduced.

A thematic analysis carried out on the data produced three key themes analysing student diversity, learning needs and methods and final the actual potential use of the robot. Within each of these key themes the commonalities and difference between partner countries is noted as a robot-based pedagogy will have to cater for both to be successful across all partners.

The first theme, diversity, illustrates a mixed classroom that must be catered for. Students may be organised into groups in some partner countries or taught one-on-one in others and they may have a variety of diagnosed learning difficulties that range in severity.

The second theme, learning needs, examines current practice in teaching across countries in term of success measures, methods and barriers to providing meaningful education within the context of SEN teaching. Findings suggest that a range of learning outcomes are required due, in part, to the diversity illustrated in the previous theme. These learning outcomes are required to be scalable such that they can deal with profound disabilities but also allow more able students to benefit from the teaching delivered. At a minimum, however, it was reported across partner countries that maintaining engagement is a vital success measure employed by teachers.

The final theme, robotic use, explores the potential use of robots within current teaching practice as proposed by stakeholders. After being shown a demonstration of the NAO robot, participants proposed potential learning activities that can be broadly classified within 5 areas of learning:

1. Imitation – reinforcing behaviour.
2. Cause and Effect – associating action with behaviour.
3. Problem solving – through spatial reasoning, coordination.
4. Speech – improving speaking and listening through robot interaction.
5. Social Learning – how to act, appropriate behaviour.

Furthermore, partners reported the potential barriers to introducing robots into their current teaching practice. These include access to the technology in terms of the required confidence and skill, readiness of learning tools in terms of pre-designed tasks and control of the technology if being used in varying ways. It is clear from these three themes that robots have the potential to introduce an engagement and new way of learning. However, they are an added complexity and the pedagogy must be able to flexible enough to make use of the technology in an accessible way.

From each of these three themes arise a series of requirements that can be used to guide the development and implementation of the robot based pedagogy. Using the pedagogical framework proposed by Monarch (2009) (and implemented in the ViPi project), these requirements can be summarised according to four dimensions: social, educational, organisational and technological.

Social

A robot-based pedagogy must:

- Be adaptable to the size of the class allowing for both group based teaching and single student cases.
- Be adaptable to the range of diagnosed SEN's that could be found within a student cohort across all partners.
- Be adaptable to the range of abilities that could be found within a student cohort across all partners (mild to profound disabilities that may be both cognitive and physical in nature).

Educational

A robot-based pedagogy must:

- Allow for a range of learning outcomes that are required for the student cohort.
- Maintain engagement across all ranges of ability.
- Activities which are customisable by age, SEN and difficulty required.
- Be able to "plug-in" to existing curriculum as well as provide quick informal sessions.

A robot-based pedagogy should:

- Provide activities within at least one of the following areas: Imitation, Cause and Effect, Problem solving, Speech, Social Learning.
- Allow for scalable learning outcomes suitable for the ranges in ability across the student cohort based on these areas.
- Encourage inclusion within mainstream education where appropriate.

Technological

A robot-based pedagogy must:

- Encourage interaction through a variety of tactile stimuli.
- Have a series of pre-defined activities that cover the learning outcomes required of the session.
- Have a series of pre-defined scalable activities that cover the abilities of the student cohort.
- Require little technical skill from the teacher.

A robot-based pedagogy should:

- Have a single input device for student interaction.
- Have a single input device for teacher interaction allowing set-up of activities.
- Have a single input device if multiple robots are used.
- Be accessible for teachers to implement from session to session.

Organisational

A robot-based pedagogy must:

- Be implementable across all partners which include the cost of the robot.
- Be clear in terms of its purpose and goals.

A robot-based pedagogy should:

- Have a clear user guide to allow for a low level of technical skill on behalf of the teacher – this should detail how to set-up, carry out and modify a session.

In summary, this report presents the key success factors that can guide a robot-based pedagogy and raises some significant research gaps that need to be addressed through this project which can be summarised as the following:

- How can scalable learning outcomes be introduced that are adaptable to the needs of the student in a diverse student cohort?
- How can this pedagogy be adapted to current curricula and teaching methods with a longitudinal view?
- How can the variation across teaching activities cater for variation across the student cohort?
- How can the technology be made accessible for teachers while maintaining the inherent complexity that makes it a potentially powerful teaching tool in the SEN domain?

Contents

1. Introduction

This report aims to contribute to the creation of a prototype robotic learning pedagogy that addresses the flexible needs of both the classroom and diverse student cohort.

Results from interviews and focus groups conducted across 6 partner countries with learning and teaching specialists are analysed according to the following broad themes:

- Diversity – What class sizes and student needs are currently encountered?
- Current teaching practice – what can be drawn from the current classroom activity?
- Proposed use of the robot – how do teachers see the robot being implemented?

Each of these are also broken down in to separate sub-themes during analyses in order to create a cohesive and informative set of pedagogy requirements. To that end the report details the methodology implemented to gather the data, provides and overview of the use of that methodology in partner countries including sample size and makeup, an analysis of the interview data gathered by all partners according to the pre-defined themes and a list of pedagogical requirements that should be adhered to when designing a robot based curriculum.

2. Methodology

Appendix A details the Interview Protocol developed to gather the qualitative data informing the pedagogy requirements. This protocol sought to gather data from key stakeholders in the learning process with a focus on teacher in special education. The developed included questions dealing with the following three areas: current teaching practice, robot-based practice and barriers to practice.

The first area, current teaching practice, sought to define the context in which the participant sat, exploring their teaching background and how they currently go about delivering their work. The purpose being to examine how a robot-based pedagogy can fit in with the needs of the modern classroom as any successful pedagogy will need to.

The second area, robot-based practice, asked teachers to suggest ways in which a robot could be integrated into the teaching practice just discussed. Participants are shown a brief video of a potential robot for educational use to use as the basis for their ideas. From this the interview enquired as to what kind of tasks the robot could be utilised for within the classroom. By relating back to the previous section a method for implementing a pedagogy that fits with current practice can be derived.

The final area is designed to explore the barriers that may be present when trying to implement robot-based teaching into current teaching practice. Any barriers that are reported will have to be overcome by the pedagogy in order for it to be successfully implemented by the wide and varied array of teachers found across all partners.

The protocol design allows for either individual 1-on-1 interviews or for focus groups where required when gathering participants. As per the project documents, participants are described as teachers or trainers of SEN students and a total of 8 were required as part of the data collection process.

Appendix B details the thematic analysis template provided for an initial thematic classification of the data gathered by partner. This template aimed to ensure consistency of data reporting across all partners.

3. Overview of Data Gathered

An overview of participant numbers per partner is provided in table 1.

Table 1 - Participant Overview across partners

	NTU	HITECO	AIAS	INTERPROJECTS	SSU	UoC
No. of Participants	20	9	8	15	10	20
Participants Sampled	Teachers from 3 schools	Teachers with a range of experience	Teachers and Specialists	Teachers & Academics	Teachers	Teachers, Psychologists and Therapists
Methodology Utilised	15 Interviews 2 Focus Groups	Interviews	2 Focus Groups 1 Interview	2 Focus Groups 3 Interviews	Interviews Focus Groups	Interviews
Related Appendix	Appendix C	Appendix D	Appendix E	Appendix F	Appendix G	Appendix H

3.1. Impact of Methodological Differences

From the overview of participants, it is notable that the samples obtained vary across partners in terms of occupation where not all practice teaching but also include academics and specialists. This has the added benefit of creating a richer data set offering varying view points on the implementation of this technology in partner countries.

While the report to follow will detail this where appropriate in the results analysis a greater amount of detail can be found in the appendices where those samples are reported in greater detail by the respective partners.

4. Analysis of Results

Pedagogical requirements are drawn from three themes and several accompanying sub-themes. Current teaching practice deals with the classroom make-up in terms of diversity in the student cohort and teaching methods currently applied to that cohort. This is intended to inform the pedagogical requirements by providing an understanding of the current teaching environment within which any robot pedagogy would need to be embedded.

Learning needs deals with how those teaching methods are assessed for success and the challenges that arise when designing methods and outcomes that meet the requirements of the student. This is intended to inform how an embedded robot pedagogy should meet the individual needs of the learner and how it can be assessed for effectiveness.

Finally, proposed robot use compiles the findings that outline how a robot based implementation may be used in the classroom. This is intended to inform the potential ways in which a robot based pedagogy could be implemented in the classroom.

4.1. Diversity

This main theme aims to illustrate the pre-robot teaching environment by identifying what the classroom make-up is across the sample provided in each targeted country. Commonality across partners is highlighted as requirements that must be addressed while difference is also noted for what requirements should address in a robot based pedagogy.

4.1.1. Class size and grouping

The number of participants in the classroom can vary across partner countries. NTU, for example, the class will consist of multiple students requiring it to be split into smaller groups to manage that size:

"I usually split the class into smaller groups … a big group can be quite chaotic".

A similar finding is reported by the UoC: "The class is very diverse in this regard. All of students have complex disability." A similar approach is then adopted to organise the class such that it is manageable during the course of a teaching session: "We use here: group, individual and team activities in for example 2-person teams every day. Such organization of educational-therapeutic and educational process comes directly from the needs of students, their capabilities and the general rules which regulate the class progress".

And, for HITECO:

"The class size does not exceed 10 pupils, with 6 being the minimum".

However, this is not the case for all partners were the educational practices differ in terms of common class sizes. SSU, for example, reports that the sessions employed deal with students on a one-to-one basis which would promote a different teaching practice to a more varied group based session seen across other partners.

From this small sub-theme the need for a robot-based pedagogy to be adaptable to the teaching environment is clear. The needs of a group based classroom compared to a one-on-one tutor sessions are likely to differ when it comes to the application of the robot as a teaching tool. A large classroom session would benefit from a robotic implementation that allows the teacher to manage the session as a whole, ensuring the students remain engaged with the learning mediator provided by the robot. A single student session may be more hands on and teacher directed allowing for interactions in the session to be carefully monitored and orchestrated by the teacher. The robot pedagogy must allow for both and should act as the focal point of learning in each instance in order for any pedagogical implementation to be a success.

4.1.2. Classroom Diversity

The range of disabilities and ages of students within the classroom is similarly diverse across all partners. NTU, for example, reports diversity with both cognitive and physical difficulties within a single classroom:

NTU - "Quite a mix… with a lot of individual needs" and "it is very hard to describe my students because everybody is so individual".

Similarly, SSU reports that teachers will deals with students (on one-to-one basis) that have a wide ranging diagnosed difficulty:

“I teach students who have … autism, Asperger, sensory impairment …”.

While the one-to-one interaction found in SSU lacks diversity within the classroom, the teacher is required to have a diverse toolkit to deal with each student case and can therefore be said to still have a diverse student cohort. Indeed, HITECO reports that while the classroom holds many students, there remains a desire to approach sessions on an individual level due to the varying difficulties and skill ranges exhibited by students in a single session.

Furthermore, INTERPROJECTS notes: “teachers should mind the diversity of the group of students included in the activities” suggesting that even within group based learning the needs of the students could vary and need to be planned for.

As well as variety across diagnosed disabilities, there exists diversity across the abilities of students where the effect of disability could range from mild to profound affecting both cognitive and physical capability. SSU for example, reports that a teacher could deal with student with mild, moderate or severe disability which may cover a wide variety of particular issues including: hearing loss, speech deficiency, motor impairment and the ability to focus. The question is therefore raised: how will the robot implementation be scalable such that the complexity of interaction is suitable for the wide range of capabilities exhibited in the student cohort?

Furthermore, diversity is not limited to the particular disability of the students within a teacher’s cohort but also with regard to age. AIAS, for example, typically deals with the assessment of autism in children aged between 3 years and 17 years old while SSU also deals with children aged 3-22. HITECO reports that students are assigned to classes based on age and then further assigned based on their particular ability in order to create cohesive student sub-groups and a teacher may work across a variety of these age ranges. A similar approach is reported by UoC: “Classes are customizes according to development needs. Students need physical, verbal and manual support, a lot of repetitions, many systematic experiments with a particular skill and learning new topics”.

Therefore, this diversity of age may not be present within a single classroom, however, it is across the range of students that a single teacher may have to instruct and could impact on the implementation of a learning session.

It is also worth noting that not all partner’s education systems include specialised schools using instead a full-inclusive system; AIAS for example. NTU also could use a mix of specialist schools and mainstream schools depending on the extent of disability of the student. There remains a need, therefore, for any implementation of a robot based pedagogy to be easily adaptable to multiple and profound disabilities and also to mainstream education such that inclusion is promoted within the student cohort.

This sub-theme highlights the diversity found within a typical classroom and across a teacher’s cohort in terms of the student Special Education Need (SEN), age and place within the partner’s particular education system. Typically, this diversity appears to be dealt with through the grouping of students to make a class manageable. Teaching methods can then be targeted to the needs of the represented by the group or single student in one-to-one cases. A robot-based pedagogy therefore

needs to be adaptable to this diversity of student need allowing for the use of a robot to be tailored to multiple and potentially profound disabilities.

4.1.3. Suggested Requirements

This main theme has highlighted the diversity with which teachers have to adapt their teaching methods to and with which a robot-based pedagogy must also be able to address. Teachers across partners may deal with a range of student disabilities that will also vary in severity. These could impact on both of a student's cognitive and physical abilities. Furthermore, classes across partners vary in size: from one student per session to many requiring the class to be split into sub-groups in order for teaching to take place. To address this, the following requirements are proposed for a robot-based pedagogy.

A robot-based pedagogy must:

- Be adaptable to the size of the class allowing for both group based teaching and single student cases.
- Be adaptable to the range of diagnosed SEN's that could be found within a student cohort across all partners.
- Be adaptable to the range of abilities that could be found within a student cohort across all partners (mild to profound disabilities that may be both cognitive and physical in nature).

A robot-based pedagogy should:

- Encourage inclusion within mainstream education where appropriate.

4.2. Learning Needs

This main theme deals with the impact of the diversity reported previously in terms of how it is dealt with by teachers in their current teaching practice and can be broken down into the following three sub-themes:

Assessing session success – this examines how teachers currently measure the success of a session using traditional teaching methods. Success measures may include learning outcomes but broader issues are discussed such as curriculum impacts.

Current methods – this examines how teachers currently approach their sessions in terms of what works for them.

Barriers – This examines the current barriers teachers face in their teaching. Any robot-based pedagogy must also overcome these barriers as well as any that it itself may introduce.

4.2.1. Assessing Session Success

This sub-theme analyses how teachers currently assess the success of their session taking into account the variety and diversity that is currently exhibited within their cohorts.

It is unsurprising that individually tailoring sessions to individuals is a common practice across partner's findings.

NTU - it is reported that success is different for each student: "… work based on the abilities of the student and educational targets".

HITECO – Success is measured according to the progress of each individual student … following a personalised curriculum.

AIAS – teachers are required to compile a sort of individualised educational plan for each child.

SSU – "I use personal development table for all students … "

UoC – "Classes are realized individually".

It is clear that the diversity found within a classroom comprised of SEN students presents an increased challenge when it comes to implemented learning and teaching due to a greater need to tailor activities to the individual. Indeed, this apparent even with group based classrooms found within some partner countries. HITECO for example reports that while students are put in classes based on age and further grouped based on ability, "almost all students work with a teacher individually". Furthermore, these tailored individual needs may be based on a variety of curricula depending on the country in question.

NTU – "We use … the earliest foundation levels … it tells you where the child should be …" and a comparison to P-levels (attainment prediction) to see if students are where they are supposed to be.

SSU – "I also use the standard curriculum created by the Ministry of Education Directorate of Special Education".

UoC – "Outcomes are planned in IPET" (an individual education program).

It is important to note that a robot-based pedagogy should not replace pre-existing curricula and instead should be easily adaptable to be used as a teaching method within them. This adaptability must allow for the robot pedagogy to be used within the varying curricula across partners and where no established curriculum is formally present at all. Indeed, other partners report a less formal method of measuring success:

HITECO – "The formal assessment of curriculum achievements (1-10 rating) is part of the assessment instruments. Majority of teachers assess progress … autonomously".

AIAS – "… plan is developed in collaboration with the child's family… No validated instruments are used to measure progress… (which is) established in a subjective way".

There is therefore a further need for the robot-based pedagogy to be adaptable such that it can be used in these subjective planning processes for measuring success as well as allow for use within established curricula where appropriate.

Indeed, the need for such an approach is evidenced by UoC where it is prevalent in current practice: "Effectiveness (of teaching methods) is high because of adaptation to methods, forms, the entire day structure and also the month or the school year. We use methods which are adjusted to the capabilities and needs, which are mostly based on multisensory cognition and adaptation to the individual needs of the child - what is regularity and continuity of interaction."

In general success in a session appears to be measured against whether or not the pre-defined goals for a particular session or activity has been achieved; these goals, as mentioned, are required to be individually derived based on the student:

HITECO – "Success depends on the individually defined goal in a particular session".

However, it is also reported that teachers tend to measure factors such as engagement and awareness over the course of a session where low cognitive ability hinders the possibility of achieving higher order goals:

NTU – "For students who can't read or write it is about how much engagement they have shown".

UoC – "The most important task is to arouse students' motivation to learn and their curiosity connected with discussed topic.

This would suggest that a minimum a robot-based pedagogy must encourage, promote and maintain engagement with the learning curriculum for students with multiple and profound disabilities.

Potential learning outcomes and success measures are explored in greater detail in a following sub-theme where uses of the robot are proposed.

4.2.2. Current teaching methods

This sub-theme collates reports of current teaching methods that are utilised within the classroom. These could provide examples of how a robot-based pedagogy might be implemented within the current teaching practices utilised.

NTU, for example, provides numerous examples of what currently works for them in the classroom:

"We use a lot of hands on, practical teaching",

"They are very sensory, they need more … experiential learning",

"I use objects … visual aids, ICT … all based around how they can access different learning through these methods".

A similar range of activities is reported by SSU with the focus on active, tactile participation with learning material:

"Basic concepts (colours, comparatives, matching)",

"Activity based teaching"

HITECO also provides a comprehensive list of methods utilised throughout teaching of which the following is a sample:

"Students who can talk get related tasks others perform tasks related to their abilities to write, copy etc.

Methods include: imitation, video visualisations (when a task is demonstrated by a pre-recorded example), interactive session etc."

These reported teaching practices suggest that there is a need for tactile, experience based teaching, where the learning material encourages interaction in a variety of ways depending on the needs of the student. At first glance, robots would appear to be ideally suited to also implementing such teaching due to the multi-modal and interactive nature of the devices. A robot-based pedagogy, therefore, must ensure that such flexibility is possible so that the full range of potential teaching methods can be implemented by the instructor.

Also worth noting are the reported lengths of current teaching sessions. SSU reports that sessions are typically 45 minutes long with the session split into activity based learning and discovery based learning equally. INTERPROJECTS, however, suggests that sessions be 10 minutes in length with a singular, pre-defined goal to assess the success of the session.

This highlights that the way in which the robot-based pedagogy is implemented holds importance. The activity centred on interaction with the robot must satisfy the session length required by the teacher. However, there could be multiple short pre-determined robot based sessions within a larger teaching segment. This must be easy to manage with regard to the group based teaching that is favoured by some partners as mentioned earlier.

4.2.3. Barriers in current practice

The final sub-theme deals with the barriers teachers currently face with regard to carrying out their sessions. Any implementation of a robot based pedagogy musts also be able to overcome these barriers while also tackling any problems that the introduction of such pedagogy may introduce.

Barriers reported from the interviews are in line with points made earlier regarding the challenge of incorporating inclusive teaching while keeping in mind the wide and varied range of disabilities within the classroom. NTU, for example, reports: “you have to tailor everything down to them” which reinforces the need to tailor to the needs of the student cohort at an individual level. AIAS reports a similar finding: “Measuring outcomes … is difficult due to the complexities associated with the population”. Interestingly, the sample reports further that a formal method of assessing outcomes may negatively affect their work as it may be time consuming and too bureaucratic. Creating a balanced pedagogy that allows for flexible yet consistent application will represent a challenge. However, this can be overcome by making the tools the pedagogy creates easy to access and manipulate on the teacher side such that the transition into standard curricula and teaching practice is smooth.

To expand, NTU also discusses the barrier of accessibility: “what is appropriate and accessible for each student’s needs, objectives”. The complexity of the activities offered should therefore be simple enough implement within the classroom but also scalable and adaptable to a range of situations. A speak and repeat exercise, for example, may be simple sounds at the lowest end of the skill set up to more complex phrases and sentences structures. This must, however, be accessible for the teacher as well as the student.

Furthermore, NTU reports that the transition between sessions is often a challenge give the varying rate of progress among students; where some may progress more slowly depending mood or compared to peers. This would further suggest the need for short simple sessions that allow for flexible transitions.

SSU, however, reports challenges in terms of those faced by the student that the teaching sessions should address. Communication is one such listed challenge faced by the student where sessions need to focus on encouraging students to meaningfully relay information.

4.2.4. Suggested Requirements

This second major theme has discussed current teaching practice in terms of the success measures implemented, the methods utilised during sessions and the barriers typically faced in educating the teacher's respective cohorts. From the reported findings a robot-based pedagogies requirement can be summarised as follows:

A robot-based pedagogy must:

- Allow for a range of learning outcomes that are required for the student cohort.
- Be able to "plug-in" to existing curriculum as well as provide quick informal sessions.
- Maintain engagement across all ranges of ability.
- Encourage interaction through a variety of tactile stimuli.

A robot-based pedagogy should:

- Allow for scalable learning outcomes suitable for the ranges in ability across the student cohort.
- Be accessible for teachers to implement from session to session.

4.3. Robot Use

This major theme examines the use of the robot as proposed by teachers and experts in SEN learning. It is broadly split into the following sub-themes:

Benefits of the robot – what can be the impact of introducing robots to the classroom?

Proposed tasks – What are the areas of teaching where such a pedagogy could be successful and what are some example tasks?

Barriers – What could prevent such a pedagogy from being a success? This sub-theme explores pupil, teacher, organisational and robot-based barriers.

4.3.1. Potential Benefits

This short sub-theme summarise some of the potential benefits a robot-based pedagogy could have as highlighted by partners in the interview data. This may not feed directly into the requirements but is worth noting for information and could provide some success measures post-implementation.

NTU suggested that the robot would be "very engaging" as it is not an "intimidating presence" aided by the fact that the "robot is humanoid". This relates back to the requirement of the pedagogy to maintain engagement at all levels. Participants within this study believe robots to be well suited to providing this engaging learning experience as their students could find them naturally fascinating.

Furthermore, HITECO suggests that the NAO robot has the potential to be a very interesting tool that can be used in multiple capacities. Its role as a mediator and semi-friend is highlighted with the

ability for multiple types of feedback which reiterates previous points regarding the benefits of the multi-modal nature of the robot.

INTERPROJECTS highlighted the added dimension of the robot to support social learning and reinforce appropriate behaviour in a way which is more engaging that traditional pen and paper.

This section has served to re-inforce points made previously in the report and to demonstrate that a robot-based pedagogy is well suited to the challenge of special education.

4.3.2. Potentials Tasks and Robot Use

This sub-theme forms a major part of this report by compiling the ways in which the robot-based pedagogy could be introduced to the classroom in terms of pre-determined tasks and their intended learning outcomes.

In each partner country the NAO robot was demonstrate to participants where they then gave examples of potential tasks to be used with the that particular robot.

INTERPROJECTS suggest that such a pedagogy can be successful in the following areas: imitation (keeping attention, observing and replicating action), action and coordination (movement, spatial orientation, having to move through a space etc.) and symbolic play (associating symbols with actions for a variety of play types). These are areas that appear consistently across all partners.

AIAS also reports the use of the robot is improving spatial reasoning clarifying that it is important to teach the relationship between spatial concepts and corresponding movement, encouraging students to use such ideas to problem solve within a wider context. Understanding cause & effect can also be used as a general indicator of basic intellectual functioning. Furthermore, the area of speech therapy is suggested as an avenue for applying the pedagogy: “the robot could be used as a conversational partner in order to improve speech and comprehension”.

SSU also reports the potential use of the robot in speech therapy both in terms of talking and listening: “making sounds and words, making sentences, understanding what others say”.

The potential areas can therefore be summarised as follows:

6. Imitation – reinforcing behaviour.
7. Cause and Effect – associating action with behaviour.
8. Problem solving – through spatial reasoning, coordination.
9. Speech – improving speaking and listening through robot interaction.
10. Social Learning – how to act, appropriate behaviour.

The following are suggested example tasks within each of these areas:

Task 1: Receive commands
Reported by: NTU, AIAS, INTERPROJECTS, SSU.
Description: The robot can execute certain movements after having received instructions from the student either through speech or button presses on an input device thereby seeing the result of their actions.
Area: Cause and Effect.

To consider: It is suggested by numerous partners the target audience for such task would be students with multiple and profound disabilities with low functioning cognitive ability. The aim of such a task therefore would be to maintain engagement over a session and can be easily measured for success by the number of interactions completed. The input device needs careful consideration such that it can be set-up by teachers and easily accessed by students. The relationship between the input interaction and resulting robot behaviour must also be accurate and clearly defined such that cause and effect is clearly demonstrable to the student.

Task 2: Give Commands.
Reported by: NTU, HITECO, SSU and UoC.
Description: The robot can provide commands to the student which they have to follow ("stand-up, sit-down etc."). Successfully carrying out the command required by the robot provides the success measure for that particular session. UoC in particular describe this as the robot stating a word, the student imitates and assessed for a match.
Area: Imitation, speech
To consider: Such tasks based on this can be broadened to a wider range of student abilities. A single command and reaction would suit those students of lower cognitive ability, however, the number of commands can be increased such that a chain of reactions must be stringed together by the student if capable. Hence, such tasks are nicely scalable as per the requirements elicited thus far in this report. In such tasks the robot very much acts as a learning mediator, with the role of the teacher being to control the robots command in a behind the curtain fashion.

Task 3: Physical Behaviour Modelling
Reported by: NTU, HITECO, AIAS, INTERPROJECTS, SSU and UoC.
Description: Similar to the above task but in this instance the robot mimics a behaviour to be copied by the student, thereby providing an example of how to enact certain actions.
Area: Imitation
To consider: Again, the range of and sequence of required actions could be increased for more able students. The focus again, would be on the robot being a learning mediator; however, the aim of the session may more unclear. Hence, the role of the teacher may be slightly more involved in setting up the session whereby they provide an example of what the student's interactions should be. From then on the "behind the curtain" role can be taken up.

Task 4: Question and Answer
Reported by: NTU, HITECO, AIAS, SSU.
Description: The robot asks a question and the student responds either through speech or through motion.
Area: Speech, problem solving
To consider: The application of such a task is well suited to a variety of curriculum. The questions can be from a variety of sources; for example, asking maths questions or (as suggested by HITECO) asking students to locate body parts through either vocalising or pointing. Again, the task is well scalable given the complexity of number of questions that could be posed. There may be an additional challenge in programming the questions for the teacher which will be a barrier to overcome. Robot behaviours could be used as a reward for correct answers e.g. a dance or entertaining action so that the area of cause and effect can be promoted further.

Task 5: Robot Navigation
Reported by: NTU, HITECO, AIAS, SSU
Description: Using simple inputs, direct the robot around a maze.
Area: Problem Solving
To consider: Primarily this task would be aimed at students of a higher ability where decision making is important. The commands to the robot must be accurate and easily accessible such that the technology enables learning and does not frustrate.

Task 6: Speaking Turns,
Reported by: NTU, HITECO, AIAS, SSU and UoC
Description: A potential conversational exercise with the focus being on social interactions and how to react appropriately. The robot could, for example, be used to demonstrate social cues (laughter, clapping, and other emotions) and the student react/interact appropriately or be used to learn how to carry a conversation such that the content is not the focus but the protocol of conversation is learned.
Area: Social Learning
To consider: It is suggested that this would be a suitable task for high functioning students with little patience aiding them in practicing social conventions to an audience that they may be more comfortable with. Again, cues the robot can offer should be easily programmable and accessible while if the robot is expected to respond the student, the sensor must be accurate to avoid frustration.

The learning outcomes for the above task must adhere to the requirement elicited in the report. This document suggests that these learning outcomes stem from the areas of learning identified prior to the example tasks listed here. The tasks would then need to be open enough to satisfy the learning outcome from its particular area allowing for a "plug and play" style pedagogy that is quickly adaptable to the needs of the classroom.

HITECO, for example, suggests the following learning outcomes: "correctly implemented task given to student", "speed of assimilation of new content", "students involvement" etc.

NTU extends the argument for looking at student involvement and reiterates points made in pre-robot learning outcomes regarding engagement: "Success … for some would be to show awareness". Furthermore, participants responded here that learned skills should be transferable to daily situations, a measure which will only become evident through long term study of the effects of a robot-based pedagogy.

Indeed, AIAS suggests learning outcomes based on improvement which requires longitudinal studies to measure: "increased vocabulary, increased eye-contact".

4.3.3. Barriers to Robot Introduction

The final sub-theme examines the reported barriers that may prevent a robot-based pedagogy from being introduced to the classroom. The analysis template split the potential barriers into those which are teacher-based, robot-based, organisational-based and student-based.

4.3.4. Teacher-Based

The majority of partners reported that the teacher's lack of skill with using IT in the classroom could be a potential barrier.

NTU – "People are scared of IT", "It is necessary that the teacher can manipulate the robot without external support".

HITECO – "I won't be confident to begin".

AIAS – "Too much competencies needed".

SSU – "Lack of technical experience of SEN teacher".

UoC - "The lack of programming skills".

There is a general consensus that the training is important in using such a technology in the classroom, suggesting also that the activities must be easy to set-up by perhaps having some default options built in. User guides and post implementation care must also be provided such that external support is not required if anything goes wrong during a session.

4.3.5. Robot-Based Barriers

The reported robot-based barriers can be summarised into three areas: cost, reliability and deployment.

In terms of cost:

NTU – "they can be quite destructive (the students), the robot is not cheap".

HITECO – "Price of robot".

INTERPROJECTS – "Lack of financial resources of the schools to purchase robots".

SSU – "Cost of robot".

UoC – "Financial Barrier".

Reliability includes the consistency of the robot in terms of sensor readings, its durability/versatility and what happens if it breaks and whether or not the obvious benefits will indeed translate to the classroom:

NTU – "Unless the robot is versatile to plan interventions I won't use it" – this also confirms requirements elicited earlier regarding the range of interactions the robot should have available to the teacher. It is further reported that there is a need for "ready-made templates in (an) app" which would allow interventions to be less time consuming.

HITECO – "Can be broken by students".

UoC – "Delicate set construction – can be broken by students".

AIAS – "does it really work as seen in the video?"

SSU – “Speech and sound should be clear and understandable by students”.

Deployment covers the setting-up of the robot and tasks within the lesson:

NTU – “If it takes too long to set-up the robot or deliver the session, I won’t use it”.

HITECO – “Possibility to programme the robot”.

INTERPROJECTS – “Different scenarios are needed … e.g. a variety of learning tasks depending on the severity of disability”.

These suggest that deployment can be aided via a series of pre-design default lessons that must be easy to access, set-up and deliver. However, the must also be varied enough for the range of learning needs within the cohort as has been touched on earlier in this report. Furthermore, these pre-designed tasks cannot be static and must allow the teacher to alter and update as the classes curriculum develops.

4.3.6. Organisational Based Barriers

This barrier grouping covers the potential challenged that must be overcome from with the organisation itself. Few potential barriers in this category were reported by partners; however, INTERPROJECTS did discuss the integration into the curriculum and promotion of the robot within a wider context. As robots are not particularly prevalent within that partner’s country awareness of the benefits of their introduction may need to be raised for successful integration.

UoC discuss the lack of acceptance at a national, governmental level which could impact on the resources provided to schools to budget for the robots integration. There would appear to be a need therefore for stronger promotion of the benefits robots hold within such situations and outcomes from this project can go some way to provide this.

4.3.7. Student-Based Barriers

The final category deals with potential student based barriers to the introduction of robots in the classroom. Many of the reported barriers in this sub-theme reinforce points made throughout this report dealing with overcoming the disability of the student to deliver teaching but also expand to add more detail.

NTU, for example, states: “a couple of students may be fearful (of the robot)” and “if the robot was distracting from everything (it would be a problem)”. Similarly, from UoC: “stress and fear at first introduction (of the robot)”.

Hence, the technology of the robot must not add to the noise of the classroom and instead enable the learning process rather than impede it. However, NTU further reports that “if we had the robot all the time they would get used to it”. This would suggest that longitudinal exposure to the robot is required to both assess the success of the learning process and the robot pedagogy in terms of it added benefit.

The range of needs within the student cohort could also provide a barrier:

HITECO – “Not all students can speak”.

INTERPROJECTS – “their limitations of motor skills, “Difficulties with short term memory” etc.

SSU – “Poor fine motor skills”.

Again, the point regarding diversity in the classroom must be address by the pedagogy such that it can cater to a wide and varied audience without additional complexity to the teaching delivery.

INTERPROJECTS further suggest that the robot should be customisable by age, severity of learning difficulty, difficulty of assignment and include a diverse range of robots. Should this last point be implemented then the single control interface should allow for direct access to the chosen robot seamlessly.

Finally, a point made previously highlighted the student preference for tactile leaning through touch and play. HITECO reports: “it’s risky how pupils could use the robot – they want to touch, to play” and it was mentioned that this could break the robot causing distress on behalf of the student. It is unclear how such an eventuality could be planned for through the pedagogy, perhaps the tasks could limit direct interaction with the robot and instead focus on behaviour and sturdier input devices.

4.3.8. Conclusions and Requirements

This major theme has covered the way in which the robot based pedagogy could be implemented by looking at the areas it could cover and the example activities suggested by teachers. Barriers have been explored to provide an awareness of what should be overcome for a successful implementation of the pedagogy.

The following summarises the requirements from this section:

A robot-based pedagogy must:

- Have a series of pre-defined activities that cover the learning outcomes required of the session.
- Have a series of pre-defined scalable activities that cover the abilities of the student cohort.
- Activities which are customisable by age, SEN and difficulty required.
- Be implementable across all partners which include the cost of the robot.
- Require little technical skill from the teacher.
- Be clear in terms of its purpose and goals.

A robot-based pedagogy should:

- Provide activities within at least one of the following areas: Imitation, Cause and Effect, Problem solving, Speech, Social Learning.
- Have a single input device for student interaction.
- Have a single input device for teacher interaction allowing set-up of activities.
- Have a single input device if multiple robots are used.
- Have a clear user guide to allow for a low level of technical skill on behalf of the teacher – this should detail how to set-up, carry out and modify a session.

5. Conclusions and Summary of Pedagogy Requirements

This report has brought together the analyses conducted by partners on interview data gathered from teachers and SEN experts in their respective countries. Three broad themes are used to examine the data provided to ascertain the context in which the robot-based pedagogy should fit, what can be learned from current teaching methods and how might such a pedagogy could be implemented with example areas and tasks.

5.1. Requirements with Framework

These pedagogical requirements can be broken down into the four dimensions as proposed by the ViPi framework (Standen *et al*, 2013[1]) that prompts teachers to consider the pedagogical requirements in terms of how best to use the Intervention.

These four dimensions include:

1. Social – Issues relating to collaboration and group work.
2. Educational – Factors that have a bearing on learning and teaching.
3. Organisational – the way in which the institutions involved deal with the introduction of new technology.
4. Technological – Factors relating to access, implementation and maintenance of the tools and services.

Each of the pedagogical requirements provided throughout this report can be assigned to these dimensions giving a comprehensive overview of the needs of the interventions framework.

5.1.1. Social

The first of these dimensions, social, incorporates issues relating to group and collaborative learning. This report has highlighted the importance of allowing a robot-based pedagogy to be adaptable enough to enable teachers to implement group based learning in a mixed classroom but also allow one-on-one style sessions also.

A robot-based pedagogy must:

- Be adaptable to the size of the class allowing for both group based teaching and single student cases.
- Be adaptable to the range of diagnosed SEN's that could be found within a student cohort across all partners.
- Be adaptable to the range of abilities that could be found within a student cohort across all partners (mild to profound disabilities that may be both cognitive and physical in nature).

The ViPi framework explored the social factors that surround learning and in striking the correct balance between group and individual interaction while acknowledging the positive effects of learning in a group. Results here confirm that there is a need to strike a balance between the two methods of learning due to variation found in class size and make-up across partners. However, there is also a requirement from this project that the needs of the students are catered for based on

[1] Standen *et al* (2009), Virtual Portal for Interaction and ICT Training for People with Disabilities, (http://www.vipi-project.eu/wp-content/uploads/2014/02/D18-ViPi-Blended-Educational-Pedagogical-framework2.pdf) (Accessed: 21/05/15)

able to cater for the particular needs of their students particularly if they are being grouped based on their ability.

5.1.2. Educational

Secondly, the educational dimension deals with the factors that are directly related to the learning of individual students. In the case of this report there is are requirements covering learning outcomes and range of activities and these listed requirements in this report for this dimension are as follows:

A robot-based pedagogy must:

- Allow for a range of learning outcomes that are required for the student cohort.
- Maintain engagement across all ranges of ability.
- Activities which are customisable by age, SEN and difficulty required.
- Be able to "plug-in" to existing curriculum as well as provide quick informal sessions.

A robot-based pedagogy should:

- Provide activities within at least one of the following areas: Imitation, Cause and Effect, Problem solving, Speech, Social Learning.
- Allow for scalable learning outcomes suitable for the ranges in ability across the student cohort based on these areas.
- Encourage inclusion within mainstream education where appropriate.

In comparison to ViPi, there are some notable similarities: the need for a range of activities which are appropriate to student, learning outcomes which are scalable so the student can "go at their own speed" and the need to motivate or maintain engagement.

However, it is also clear for this project that certain gaps need to be addressed; specifically, the adaptability within traditional curriculum and within current teaching methods. In some partner countries current teaching is based on standard curricula while in others a more ad hoc approach is taken. Hence, the "plug-in" necessity of the robot-based pedagogy so that it can be adapted and implemented in the variety of broader contexts across partners.

Also clear from this dimension is potential impact the robots could have on the learning process for SEN students. The variety of different learning activities within the areas mentioned above suggest that robots have the ability to have strong impact in education due to the flexibility they offer. It is therefore vital that the produced pedagogy takes advantage of this flexibility to create a meaningful teaching tool for longitudinal use.

5.1.3. Technological

The technological dimension covers aspects of the robots technical implementations whereby it should not itself present a barrier to adoption by being overly complex and, furthermore, should add to the learning experience through its unique capabilities. The listed requirements found in this report can be categorised here as follows:

A robot-based pedagogy must:

- Encourage interaction through a variety of tactile stimuli.
- Have a series of pre-defined activities that cover the learning outcomes required of the session.
- Have a series of pre-defined scalable activities that cover the abilities of the student cohort.
- Require little technical skill from the teacher.

A robot-based pedagogy should:

- Have a single input device for student interaction.
- Have a single input device for teacher interaction allowing set-up of activities.
- Have a single input device if multiple robots are used.
- Be accessible for teachers to implement from session to session.

The main point raised here is access to the technology. Detailed previously is the complexity and range of learning required from the student cohort. If this need is to be met then the access to the device from the teacher must cater for the implementation of numerous kinds of activities; hence, the need for pre-built, quick to set-up activities and a single input device to control this range of behaviour.

5.1.4. Organisational

Finally, the organisational dimension covers the aspects of general access to the robot. These requirements are notable due to their close relation to the technological requirements dimension detailed earlier but provide a more general overview of technological access. The final requirements in this dimension area as follows:

A robot-based pedagogy must:

- Be implementable across all partners which include the cost of the robot.
- Be clear in terms of its purpose and goals.

A robot-based pedagogy should:

- Have a clear user guide to allow for a low level of technical skill on behalf of the teacher – this should detail how to set-up, carry out and modify a session.

Findings here match up to the ViPi framework well with a shared commonality regarding ensuring the appropriate support structure is in place to train and aid the teachers in implementing the technology.

However, also important is the cost of implementing the technology as a viable teaching for long term implementation. Given the differences in resources found across partners the kind of robot that could/should be implemented may be heavily dependent on the cost. Hence, the pedagogy should be adaptable to the kind of robot that can be implemented and equally successful between devices.

5.2. Summary

It is clear from these requirements that adaptability is key in delivering a successful pedagogy across the partner countries which contain variation in teaching style, class size, student cohort and institutional culture.

Flexible and scalable learning outcomes should be provided under the 5 learning areas with a series of built in tasks that enable these LO's to be reached. Such an approach will allow for a "plug and play" teaching session that will be adaptable to fixed curriculum and also less formal teaching sessions.

This report presents the key success factors that can guide a robot-based pedagogy and raises some significant research gaps that need to be addressed through this project which can be summarised as the following:

- How can scalable learning outcomes be introduced that are adaptable to the needs of the student in a diverse student cohort?
- How can this pedagogy be adapted to current curricula and teaching methods with a longitudinal view?
- How can the variation across teaching activities cater for variation across the student cohort?
- How can the technology be made accessible for teachers while maintaining the inherent complexity that makes it a potentially powerful teaching tool in the SEN domain?

6. Appendices

Appendix A – Interview Protocol

Aims

This protocol aims to:

- Explore the range of disabilities typically encountered within the classroom.
- How these disabilities shape the learning experience in terms of teaching tools, delivery, student perception and assessment (individual session success criteria).
- Present the potential robots to participants.
- Explore the possible uses for the robots as a teaching tool within the context of the participants (i.e. their students and session aims).
- Identify barriers to the introduction of robots into the classroom.

Overview

The protocol adopts a semi-structured interview approach with three phases. Phase 1 deals with identifying the teaching context in terms of the teacher, who they teach and what they expect from a typical day-to-day session in the classroom. Phase 2 shall deal with identifying/exploring potential uses of the robot and can be conducted one-to-one or in a focus group; this phase can be performed immediately following phase 1 or at a later time if conducting a focus group. A focus group approach may be more beneficial in generating ideas through group discussion with a minimum of 3 participants. A final phase dealing with the introduction of robots and how it can be done including an exploration of potential barriers.

Phase 1 – Context

1. How long have been a teacher of SEN students?
2. What kind of students do you teach?
   Interviewer note: prompts for answers here should include class size and class make-up; i.e. a class of one kind of student or diversity within the classroom, how much diversity is there?
3. Describe a typical teaching session, who is/are the student/s, what methods are involved?
4. How do you judge the success of a typical session?
   Interview note: lead into talking about session based learning outcomes or curriculum ones if appropriate.
5. To what extent do you use technology within your classroom in a typical session?
   Interview note: Depending on response, prompt on their general opinion of technology within the classroom; if not used a lot – why? Hard to integrate, not supported etc.
6. What do you perceive as your major challenge in teaching your students?

Phase 2 – Robot Based Teaching

Provide the participant/s with a short video/presentation of the robot and its core functionality then following up with the questions below. Repeat for as many robots as available/necessary.

1. For the robot just shown, write down an *(or 2?)* initial idea for using the robot in the classroom (no more than a sentence to be expanded on in following questions). *Interview note: either a version of a pre-existing session (if requiring a prompt) or a brand new idea; avoid discussion of barriers at this stage which will be covered later (i.e. try not to let a perceived barrier inhibit the idea)*.
2. For your idea who do you envision the student/s being (SENs involved, group based)? *Interview note: depending on their answer explore further; i.e. if one-on-one teaching preferable or easer or is group-work more likely given the practicality of the modern classroom setting.*
3. What will the students be doing?
4. What will the robot be doing?
5. What will the teacher be doing?
6. How might you judge the success of the session *(or what is the learning outcome and how can it be measured)*?
7. What things might make it difficult to use the robot in the way specified?

Phase 3 – Barriers to their use

1. Would you feel confident using robots in the classroom? *Interview note: maybe relate back to the ways/methods specified if appropriate but also get a general view of robot use.*
2. How do you believe students would react to the introduction of robots in the classroom? *Interviewer note: prompt for counter-points if they are not forthcoming; i.e. if positive student reactions, can they think of any negative ones and vice-versa.*
3. What would prevent you from using Robots in the classroom?

Would you be interested in hearing more about/getting involved in the second part of the study in which we implement robots in the classroom?

Thanks you for taking part in the study. We hope to be able to provide feedback before the end of [insert date].

Appendix B – Thematic Analysis template

The following is intended to provide a template to aid in the analysis of interview data gathered as part of work package 3.1.

For each interview conducted a transcription and a summary should be provided using this document. Further to this, a summary of all interviews conducted should also be provided, again using this document as a template. For each of the headings below pull out key messages from the interview transcripts. These key messages could be direct quotes or a summary of a point made.

For Individual Interviews

Date Conducted:
School Name:
File Reference (to video or audio file if available):

For Summary

Number of Participants (for summary document):

Thematic Analysis

Theme: Teaching Practice
Description: state a teaching practice; use any quotes dealing with diversity in the classroom and the effect this has as well as any unique challenges involved, are typical sessions group based or singular, why? Etc.

Key quotes or messages:

Theme: Pre-robot learning outcomes
Description: How do teachers currently devise the learning outcomes for their sessions? How is a session measured in terms of success? If appropriate summarise quotes into a single bulleted learning outcome or success measures.

Key quotes or messages:

Optional Theme: Learning outcome based challenges
Description: If success measures are difficult to pin down then put quotes dealing with this here. For example, it may be that LO's cannot be derived due to diversity in the classroom or that they need to be done ad hoc due to the particular SEN's of the students.

Key quotes or messages:

Theme: Robot Pedagogy
Description: State which robot was show to the participant and summarise (with quotes if necessary) according to the following headings.

Key quotes or messages:

Activity Title:
Description:
Student Profile/Involvement:
Teacher Involvement:

Extra equipment?:

Theme: Robot learning outcomes
Description: For the sessions discussed summarise the potential learning outcomes. If appropriate summarise quotes into a single bulleted learning outcome or success measures.

Key quotes or messages:

Theme: Reaction to introducing robots (including barriers)
Description: Summarise the key quotes/messages according to the sub-themes listed below.

Key quotes or messages:

Teacher based: *e.g. lack of skill, awareness etc.*

Robot-based: *e.g. too expensive, lack of sensors, control etc.*

Organisational based: *e.g. lack of support from management, lack of infrastructure etc.*

Pupil based: *e.g. would not respond well, would react well etc.*

Theme: Other
Description: Anything else throughout the course of the interview/s that deserves mention and could be an interesting talking point.

Key quotes or messages:

Appendix C – NTU Analysis

WAIAS.1 Thematic Analysis Template

The following is intended to provide a template to aid in the analysis of interview data gathered as part of work package 3.1.

For each interview conducted a transcription and a summary should be provided using this document. Further to this, a summary of all interviews conducted should also be provided, again using this document as a template. For each of the headings below pull out key messages from the interview transcripts. These key messages could be direct quotes or a summary of a point made.

For Summary

Number of Participants: 20 participants. 15 individual interviews and two group interviews with respectively 2 and 3 participants.

Participants (1-14) are teachers from the *Oak Field School*, a school for special education.
Participant 15 is a teacher from the *Sutherland house* schools: schools specialized in autistic students.
Group interview 1 and 2 are teachers from *Arnold Woodthorpe* Infant School, a mainstream school.

Author's note: I have tried to summarize the main points from each theme and support each one of them with quotes from the interview.

Thematic Analysis

Theme: Teaching Practice
Description: state a teaching practice; use any quotes dealing with diversity in the classroom and the effect this has as well as any unique challenges involved, are typical sessions group based or singular, why? Etc.

Key quotes or messages:

1. Most of the teachers describe their class as **very diverse**; where every student has different needs and the teachers have to adapt the class in order to support every student's learning development. Diversity in terms of different sorts of cognitive and physical disabilities.

    - Participant 2: "big mix, quite a lot of the students has difficulties with communications, following instructions; need support from symbols or signs."(02:38).
    - P 10: "it is quite a mix, it is quite diverse, with a lot of individual needs" (01:44)
    - P 13: "It very hard to describe my students because everybody is so individual" (1:27).

2. Students tend to **lose focus easily** due to the difficulty to motivate them, their low capabilities to stay focus for long periods, and for problematic behaviour issues. Due to this, teachers have to design the session in order to **keep them engaged and include all of the students**.

- P 8: “One of my challenges is changing the lesson to make it accessible to everybody in the class and also make it enjoyable for everybody in the class. Motivate them” (07:59).
- P 6: “To keep them engaged you plan activities according to their abilities; some would react better to tactile, explorations of material, textures” (06:50).
- Group interview 1:
  T1:“For the children who struggle more, I present the same material in a different way to keep them interested” (05:27), T3: “There is where ICT comes in, because it is so engaging” (05:29).

3. **Depending on** the class **diversity** and the content of the session; teachers would **organize the session for group activities or** instead divide the class into **smaller groups**.

   - P 3: “I usually split the group into smaller groups … a big group could be quite chaotic” (6:44).
   - P 5: “Small group work based on the abilities of the student and educational targets” (06:20).

4. Generally, teachers **implement technology** within the class dynamics as a tool to support learning and to document the students learning progress.

   - P 2: “We use technology all the time…, is something that they can engage with really well” (06:46).
   - P 5: “a lot of the students, not all, are engaged by different forms of ICT” (09:30).
   - Group 1:
     T3: the downside to ICT is that they access it too much, there is less colouring, painting, drawing.T1: another downside of ICT is the social development, they lack or not at same level.

5. Depending on the degree of cognitive development**, teachers use different methods to support every student’s learning process**. These methods are generally practical where they manipulate objects, use pictures, Makaton symbols, signs, etc. For some teachers it seemed very important to help the students to gain independence (e.g. being able to communicate to other people, maths to use on a daily basis).

   - P 2: “we use a lot of hands on practical teaching” (04:34)
   - P 3: “They are very sensory, they need more sensory, experiential learning”,” they would not engage working with paper” (08:04).
   - P 6: “To keep them engaged you plan activities according to their abilities; some would react better to tactile, explorations of material and textures” (06:50).
   - P 9: “I use objects, photographs, symbols, a lot of visual aids, ICT, switches, all based around how they can access different learning through these methods”(02:50).
   - P 2:”independence is a big thing” (5:30).

Theme: Pre-robot learning outcomes

Description: How do teachers currently devise the learning outcomes for their sessions? How is a session measured in terms of success? If appropriate summarise quotes into a single bulleted learning outcome or success measures.

Key quotes or messages:

1. **The learning outcomes are defined by the curriculum that applies to each class**. This curriculum defines global goals and shorter term goals. According to these goals the teachers design their classes in order to meet them; taking into account each student limitations.

    - P 6: “we use what is called the earliest foundation developmental levels...it tells you where the child should be developmentally at 3 months, 6 months , 18 months…”(04:00)
    - P 14: ”Looking at their p-levels are and goals and see if they have retain what they were supposed to retain what they were supposed to be doing” (04:35).

2. **To measure the success** from the students, teachers **collect evidence** based on pieces of work, observations and audio-visual material at the beginning of the term, week and session. This material is then compared to future session in order to assess success. (i.e. Do they look at the object like the first time? , Do they know how to manipulate it?).

    - P 8: “Asses how much of the piece of work have been done independently, how much support they needed” (04:08).
    - P 8: “you kind of know the students, so you know whether they understood it and how much they understood” (4:30).
    - P6: “we use cameras to track progress” (07:30).

3. Success is generally considered when they meet their pre-defined targets, however success is considered different for student, e.g., for low cognitive levels, engagement and awareness represent a success.

    - P 3: “I see the session as successful if there is a high level of engagement from the children and if they would behave” (09:34).
    - P 10: ““For students who can’t write or read it is about how much engagement they have shown” (04:05).
    - P 11: “For the more able students it would be to be creative, give more complex answers, showing understanding” (06:40).

Optional Theme: Learning outcome based challenges
Description: If success measures are difficult to pin down then put quotes dealing with this here. For example, it may be that LO's cannot be derived due to diversity in the classroom or that they need to be done ad hoc due to the particular SEN's of the students.

Key quotes or messages:

1. A class usually has students from different levels. When designing the activities, it is necessary to consider each exercise from each student capabilities and devising realistic goals for all them without excluding any from the activities. They all have different speed.

    - P 6: "If the level is not appropriate they would not stay focus, be interest and being able to move forward and show progress"(3:30)
    - P 5: "Students make very slow progress, they have to revisit and reinforce the contents from previous sessions. Being able to meet a target does not necessarily means that they would remember the next session" (07:50).
    - P 9: "It is about looking at accessibility, what is appropriate and accessible for each student's needs, objectives came to criteria as well**"** (05:40)

2. Sometimes it is difficult to assess what the students got from each session. Even though there is differentiation in the exercises and methods, it could tricky to see how much they got from each session.

    - P 8: "you could plan the lessons and maybe only get halfway through because that is how long it takes for certain students to grasp the concept… It could be the way around when you plan a lesson and they get it very quickly so then you have add thing on" (02:40)
    - P 3: "Success is different for every student"(31:29), "sometimes is difficult to read if they show awareness or just randomly pressing the robot to control the robot"(31:54).
    - P 12: "you have got to tailor everything down to them" (09:50).

Theme: Robot Pedagogy

Description: State which robot was show to the participant and summarise (with quotes if necessary) according to the following headings.

Every participant has been shown a video where they could watch the Nao Robot in action, furthermore they were informed about the robot's wide range of functionality.

Key quotes or messages:

1. ***Activity Title:*** Cause and effect
   - ***Description:*** The robot will execute certain movements , dances and say things after the students give it the command by pressing a button(in the tablet), by voice command or any other input that could trigger the robot's action(symbols, pictures, sounds).
   - ***Student Profile/Involvement:*** Students with low cognitive abilities, conceived as an individual activity or as a group activity where other students can observe and learn from their peers.
   - ***Teacher Involvement:*** Facilitator. Make sure the students are engaged and leading the group or asking a TA (teacher assistant) to do it instead.
   - ***Extra equipment?:*** Tablet with app or any material necessary to make the robot react.

2. ***Activity Title:*** Modelling an action.
   - ***Description:*** The robot shows the students how to perform a certain action such as sitting down, pick things from the floor, dance, doing some morning stretchers, saying good morning, etc.
   - The robot could also show prepositional language by performing actions (e.g., picking a ball ON the table, put it UNDER the table).
   - **Student Profile/Involvement:** Students could observe and copy what the robot does. The prepositional language variation would specially benefit Children with English as an additional language.
   - ***Teacher Involvement:*** Facilitator. Lead the interaction, modelling the interaction and then hand it over to the children.
   - ***Extra equipment?:***

3. ***Activity Title:*** Giving sequential orders to the robot or receiving orders from the robot.
   - ***Description:*** Program the robot to give it sequential orders following a set of instructions given to them or receive sequential orders from the robot. The robot would give instructions to the children. Such as" sit down, lift your pencil". It will progressively increase the number of instructions they have to carry out.
   - ***Student Profile/Involvement:*** Conceived as an individual or group activity
   - ***Teacher Involvement:*** Facilitating the activity.P8: "Be there for support but let them interact" (14:25), "quite a lot of the activities are led by the staff, it would be interesting to see how they would lead the activity"(14:30).

- **Extra equipment:** Tablet *with an app or other software to* program the sequence. Instructions to the robot in text, pictures, Makaton symbols.

4. ***Activity Title:*** Questions and answer (optional: with two pieces of information).
   - ***Description:*** The robot would ask something like "*Where is the BLUE BEAR?* ", students would have to understand the colour and the object. Processing two pieces of information rather than having just a direct question such as "Where is the bear?" Increase difficulty adding number two the previous equation.
     The robot could also deliver quizzes regarding the topic is was taught that day
   - ***Student Profile/Involvement:*** Every child could access if interventions could be personalised and adapted to each.
   - ***Teacher Involvement:*** The teacher would prompt if necessary to show what they have to do.
   - ***Extra equipment:*** Pictures or drawings.

5. ***Activity Title:*** Navigating the robot.
   - ***Description:*** Having left, right, forward and backward input for the robot. The students would navigate the robot through a simple maze or the school. Could also be controlled by voice.
   - ***Student Profile/Involvement:*** Students with higher abilities. Students would have to make decisions, verbalise them.
   - ***Teacher Involvement:*** Make sure the students are engaged, leading the group or asking the TA to lead the group. Controlling problematic behaviours.
   - ***Extra equipment:*** Tablet with app that control the robot's movements.

6. ***Activity Title***: The listener and the speaker
   - ***Description***: The robot is listening to what the children are reading**.** It would be useful for the phonics tests where they have to read words which different combinations of letters that make different sounds. The robot would be listening and check if they do it properly.

     The robot could also "read" certain groups of letters the children show it and make the corresponding sound.
   - ***Student Profile/Involvement:***
   - ***Teacher Involvement:*** Facilitator. Lead the interaction, modelling the interaction and then hand it over to the children.
   - ***Extra equipment:***

7. ***Activity Title***: Speaking turn taking exercise
   - ***Description***: Turn taking exercises. Playing a conversational game with the robot where the student has to respect turn taking to interact successfully with the robot.
   - ***Student Profile/Involvement:*** High functional students, students with no patience. It would also help students that have problems with clear speech and will have to make an effort to be understood by the robot.

- ***Teacher Involvement:*** Facilitator. Lead the interaction, modelling the interaction and then hand it over to the children. Controlling problematic behaviours.
- ***Extra equipment?***

8. ***Activity Title***: Bullying game
   - ***Description***: The robot would say something and the students would have to respond to that. Maybe the robot is bullying approaching the students and they have to respond appropriately in order to make him stop walking towards him and keep bullying him.

     There would be some sort of indicator about how many steps are left towards the student. So the student can look at the number and training another skill (maths).
   - ***Student Profile/Involvement***: It would be a one to one activity. Maybe other students could be looking and learn from others.
   - ***Teacher Involvement:*** Supporting the students in the activity. They might need some prompting at the beginning.
   - ***Extra equipment:***

Theme: Robot learning outcomes

Description: For the sessions discussed summarise the potential learning outcomes. If appropriate summarise quotes into a single bulleted learning outcome or success measures.

Key quotes or messages:

- NTU5: Devise how to train skills that can be transferable to daily situations." Are they using the skills they learn with the robot with other people?"(13:30)
- Interact and communicate with the robot or working as a team to interact or communicate with the robot.
  - P8: "Group sessions will help, promote interaction between the peers and get them to interact with each other"(12:00)

- Showing awareness or just being engaged by the activity.
  - AIAS: "success is different for every student", " for some would be to show awareness or following the robot, for other would be showing awareness that they have been made a choice" (31:29).

- HITECO: Help them design clear instructions to control the robot. Improve their understanding of sequencing instructions.
- NTU1: How much information are they retaining from the robot intervention?, This would show clearly the outcome from the intervention
- The robot will support the learning of many subjects such as ICT, Maths, communication skills, social skills, etc.

Theme: Reaction to introducing robots (including barriers).

Description: Summarise the key quotes/messages according to the sub-themes listed below.

Key quotes or messages:

Teacher based: *e.g. lack of skill, awareness etc.*

- The lack of teaching knowledge can make it difficult to use robots.
    - P5: "People is scared of IT (Teachers and TAs)… because they lack confidence" (29:30).

- In general they would feel confident if they received training and tools to use it in the best way possible.
    - P8: "It is necessary that the teacher can manipulate the robot without needing external support".
    - Group2: "as long as I'd be trained how, I would be confident to use it"(28:30).
    - P13: "I would be willing to try" (19:20).

Robot-based: *e.g. too expensive, lack of sensors, control etc.*

- The **time** that it takes to deploy the robot and to program it, is crucial for them to decide to use it or not.
    - P13: " if it is takes too long to set up the robot or deliver a lesson, won't use" (20:30)

- **The reliability and versatility** of the robot could be an issue. Will it break easily? Will it not respond? Some see this as an issue and talk about needing to have a backup plan if the robot fails.
    - P5: "Unless the robot is versatile to plan interventions, people would get bore of it"(34:50)

- The **cost** of the robot is an issue for many teachers as it could get damaged.
    - P3: "they can be quite destructive, the robot is not cheap"(32:45)

Organisational based: *e.g. lack of support from management, lack of infrastructure etc.*

- P4: Ready-made templates in app would help plan robot interventions according to classes and be less time consuming .Allowing upload pictures for buttons, so it could be flexible enough to do it quickly and easy.

- Group1: To implement the robot, look at the class medium term planning, and see the things in the planning where the robot could be used. And develop the robot interactions more specifically in this way.
    - Group2: They suggest that maybe to save time, the robot could have generic interventions stored to use easily.
    - Group 1: "start with the long term planning and look for the opportunities to use the robot" (31:06).
    - P5: To help teachers how to use the roots, he suggests giving the teachers practical suggestions about how to use it.

Pupil based: *e.g. would not respond well, would react well etc.*

- Generally, they think the robot will be very **engaging.**
    - Group 1: "it is obvious the children will be engaged because it is so fascinating" (15:50)."It is not an intimidating presence for them" (15:52).
    - Group 2: "I think that they are fascinated by the fact that the robot is humanoid" (11:31).
    - P4: *"*They would love it*"(23:40)*

- The robot could **distort the structure of the class** if the students are too excited.
    - Group 2: "if the robot was distracting from everything else(it would be a problem)"(28:00). "If we had the robot all the time they would eventually get used to it" (25:50).
    - P2: Some students could get over excited and need support from the staff to understand what is going on.

- Some teachers are not sure if the students would understand and embrace the robot.
    - P10 " a couple of students might be little fearful of it, and not understand what it is"(15:33), "they might not understand the concept of being a robot"(15:55).
    - P 12: "He thinks the robot is very good if you have visual learners, because it is difficult to understand if you can't see it".(27:00)
    - P 13: "picking it up, kick it, if they are scared they would move away from it"(19:50)

Theme: Other

Description: Anything else throughout the course of the interview/s that deserves mention and could be an interesting talking point.

Key quotes or messages:

- The application on the tablet helps many students to access the robot. **P8: "**The tablet app makes the robot very accessible for the students"(15:25)
- Robot and autistic children:
    - Group2: "During the robot demo, one of the children who responded most was my autistic people" "he sometimes find interaction difficult because he is very literal, but robot can be very literal too" (23:00)

    - P2: "some of our children that have difficulty with social interaction(from autistic spectrum), find working with people difficult sometimes, they can respond better to technology)"(18:10)

Appendix D – HITECO Analysis

INTERPROJECTS HITECO

Date Conducted: 19 02 2015, 03 03 2015
School Name: Vilnius ATGAJA Specialised School, Lithuania

File Reference (to video or audio file if available):
Copies of scanned documents (interview sheets)

Summary

The interviews were done in a group discussion and individual conversations with the SEN teachers. The interviewed SEN teachers included junior specialist (working 2 – 6 months), experienced (2-5 years) and senior professionals – working 8, 14, 17 years.
All interviewed teachers are working with students with significant and complex severe intellectual disabilities. The class size not exceed 10 pupil, the smallest consist of 6 students. Students are assigned to the same class according their age (with variety 1-2 years older or younger).

Number of Participants (for summary document): 9
The interviewed SEN teachers included junior specialist (working 2 – 6 months), experienced (2-5 years) and senior professionals – working 8, 14, 17 years.

SEN Students profile:
Classrooms are composed of students with significant and complex severe intellectual disabilities; some classes include mild disabilities students.
The class size not exceed 10 pupil, the smallest consist of 6 students.
Students are assigned to the same class according their age (with variety 1-2 years older or younger)

Thematic Analysis

Theme: Teaching Practice

Description: *state a teaching practice; use any quotes dealing with diversity in the classroom and the effect this has as well as any unique challenges involved, are typical sessions group based or singular, why? Etc.*

The teachers are training all subject for one class from 1 to 12 grades. Students assigned to the class according the same age and then grouping according similar abilities (creating temporary groups for specific subject). All students have individual curriculum individualised and differentiated according student abilities and skills. Almost all students work with teacher individually. More advanced students are provided with more complex tasks. The tasks are individualised, simplified considering as well students' mood in certain lesson. Group work is possible using a lot of visual material or during experimental tests. Almost all students work with the teacher individually.

During activities are used various methods - story telling, listening to music, explanatory conversation, demonstration etc., visual material demonstration, practical task (hands on), video visualisations (when task is demonstrated by pre-recorded example), alternative communication using digital applications, repetition , practical exercises (writing in language lessons), imitation, visual tools, interactive lessons, structured lessons.

ICT tools are used rarely. It is related mainly to modest equipment resources at school premise – there are one PC per classroom and one computer lab with quite old PC equipment. However ICT is used for presentations of visual materials, sometimes with beamer assistance. In some classes are used tablets but only bought by parents in agreement with teacher. Those have possibility to use educational games (mainly iPad based). One teacher indicated activities with ICT approximately once a week.

Key quotes or messages:
The lessons are provided to all students at the class.
The tasks are individualised and differentiated according student abilities and skills.
Topics are repeated several times in order to embed skills.
The lesson participants are different special needs students, the tasks are individualised, i.e. methods chosen according pupil needs.
The tasks are individualised, simplified. It considers students' abilities and mood.
All students are the same age and similar abilities.
More advanced students are provided with more complex tasks.
Almost all students work with teacher individually.
Task are individualised, students at the lesson are the same age.
Students with more complex disabilities are implementing tasks with assistance, but in majority cases all class working together.
The tasks in most cases are individualised. Group work is possible using a lot of visual material or during experimental tests.
During native language and mathematic lessons students are divided in temporary groups according abilities.
All students participate in the lesson. Students who can talk, get related tasks, other perform tasks according they abilities to write, to copy, to edge and etc. Students are grouped according the age, but as well there are two classes divided according the capacity level.
Class groups are formed according age and then students are grouped according level of abilities.

The methods used during lessons:
- story telling,
- pictures,
- listening to music,
- explanatory conversation,
- demonstration etc.,
- explanations,
- visual material demonstration,
- practical task (hands on),
- video visualisations (when task is demonstrated by pre-recorded example)
- alternative communication, repetition , practical exercises (in language lessons)
- imitation,
- visual tools,
- interactive lessons
- Structured lessons

ICT are used not much/not enough.
ICT are used little, I don't have PC at classroom

ICT are used rarely. If used – in most cases for review of photos, to memorize visual material and sometimes for educational games.
ICT is used only for presentations of visual material
ICT in sports are used very little
Sometimes PC + beamer, tablets – usually (bought by parents)
Depends on topic (in language lessons) – approximately once a week
Mobile games in tablets
LT specialised software for alternative communication (tablet based)
Video material

The main challenge:

- to motivate, activate pupil, to correct negative behaviour;
- It depends from the student as all of them have different special needs. In one case it can be difficult to communicate (to talk), in other case – pupil acts aggressively, etc.;
- To engage student;
- To find individual contact with each student, to "pull out" from him his best
- To get students interested (engagement)
- To understand student and to adapt appropriate special programme.
- To engage and to motivate student to work.
- To engage students in learning and clearly explain educational content
- Variety in abilities
- Improvement of motivation
- To engage student,
- To find the best ways to understand and to assimilate content fro students

Theme: Pre-robot learning outcomes
Description: *How do teachers currently devise the learning outcomes for their sessions? How is a session measured in terms of success? If appropriate summarise quotes into a single bulleted learning outcome or success measures.*

In majority cases teachers prioritize lesson goal achievement and individual progress vs. general curriculum. As teachers have freedom to differentiate curriculum, the learning outcomes strongly related to individual progress, including students' self-evaluation. Beside the progress in educational content, the assessment as well is provided in areas of behaviour, engagement, self-satisfaction with implemented task.
The formal assessment of curriculum achievements (rating work in marks from 1-10) is part of assessment instruments. Majority teachers assess progress on personal progress and ability implement skills autonomously.

Measures of success:

- Success is measured according progress of each individual student because they are trained following personalised curriculum.
- According engagement in learning process, if he/she succeeded to achieve certain goal, if there were any progress (from starting level before lesson)
- Success depends from the individually defined goal in particular lesson. Majority of the lessons can be adapted to pupil' special needs and abilities.

Key quotes or messages:
Students are assessed at the end of the lesson. Each student is assessed.

Assessment consists from student's behaviour (because many of pupils have behaviour issues) and achieved outcomes during the lesson according his/her individualised tasks.
It is used 10 grade scale.

If student is able to perform skills according planned lesson – it is a success.
Mostly I focus on student's improved abilities, the curriculum is individualised.

Optional Theme: Learning outcome based challenges
Description*: If success measures are difficult to pin down then put quotes dealing with this here. For example, it may be that LO's cannot be derived due to diversity in the classroom or that they need to be done ad hoc due to the particular SEN's of the students.*

Key quotes or messages:

- Students who succeed the task are priced – with a compliment, encouraging, permission to choose what to do else, or even a sweet;
- Using 10 grade scale;
- Visual pictures with smiling faces (scale)
- Proportion of archived lesson aims;
- Students his own perception of his success (self-assessment)
- Success is measured according the achievements during the lesson. I use symbols (smiles) and verbal prise

Theme: Robot Pedagogy

Description: *State which robot was show to the participant and summarise (with quotes if necessary) according to the following headings.*
The workshop was dedicated to NAO robot presentation.

The teachers accepted NAO robot as very interesting ICT tool, with wide range of capacity to use in almost all learning subjects. Some ideas and descriptions with participants' roles are provided below. In majority cases NAO was seen as attractive, engaging 'semi-friend' – mediator which could be good instructor giving precise orders to pupils and providing enhanced feedback (using various media channels). The robot slow movement was appreciated and valued – as students with mental difficulties need slow presentation and persistence of repetition the same action.
The variety of ideas included sports activities, food preparation (proper action with kitchen tools), pronunciation improvement and learning ordinary daily routine sequences.

Key quotes or messages:

Activity Title	***Description:***	***Student Profile/Involvement:***	***Robot role:***	***Teacher Involvement:***
Robot as a price for properly implemented tasks, well behaviour.	The activity could be implemented individually with one student or with a group of students.	Active participant, task implementer	To relax	Coordinator of the activity, generator and implementer of pedagogy ideas
Robot – teacher: to show if a task was	The picture with different objects	Student checks the picture and tells	Class "mate", participant of the	Teacher could assist to robot (showing the

implemented properly (eg. in the group of students, robot tells name of student, who answered to the question properly)	could be shown to students and he has to tell correct name.	name	lesson	pictures)
Robot - information provider and demonstrator of examples: to give information, to do one or another task.	Students with more severe needs could be trained during individual sessions, other students – in groups.	Student would follow instructions told by robot	Robot could ask questions and give feedback (according the certain task)	Teacher would generate ideas for the activity
Robot - information provider and demonstrator of examples: to give information, to do one or another task.	Students could observe how the task is implemented by robot and to follow all the tasks together.	They would be happier to copy robot instead of teacher.	Robot could be an initiator - to show action (to move had, head, leg) which has to be followed by pupil.	Would observe the student progress (success), encourage him, would tell a compliment for a correctly implemented task, would lead to correct implementation if student faces obstacle
To learn recognize pictures and names of the presented objects	Robot could mediate in awareness of names of objects - requesting pupil to touch certain object.			Teacher would be observer
To learn parts of the body		Student is requested to point at head, to move head, to clap or etc.		
To recognise emotions		Student has to recognize when robot is laughing, when is clapping or other emotion.		
To learn daily routine tasks				
In daily nutrition lessons robot could assist in such tasks: to press cookies forms , to mix salad, to show how to cut, etc.		Student could observer at first, and then becomes main implementer of the task.	Robot could demonstrate practical tasks (to form cookies using form – pressing on the pastry; cutting a carrot, mixing	

			salad)	
To train pupils with sport movements at sports lessons	The student can observe movements of the robot and repeat his movements slowly.	Student would be engaged to concentrate (which is difficult for SEN students) and to repeat (copy) demonstrated movement.	Robot would demonstrate movement and will describe what he is doing.	Teacher would help to make proper movement to student (to correct and assist) and would follow with further task to students where they should do the same movements autonomously.
For understanding the physical space	Robot could assist in space understanding by requesting to move to certain directions (to find a treasure using directions on the map).	For learning space can be used all students group together Student can be involved individually or in the group.	Robot would give instructions, would encourage to act.	Would monitor the process and, if needed, would correct process and provide help to students.
For understanding the words Learning correct words, correct pronunciation	For learning sounds and pronunciation – individual activities.	Listening, repetition of sound	Robot would provide instructions/ orders to tell certain sound.	Teacher would observe group work.
For learning to construct sentence and connect related meaning	Student would need to select proper colour and object	Actively interact with provided set of objects and colours; would get feedback from robot to follow tasks	Robot would implement instructions given by pupil in case of proper connection of two separate groups	Programming and student observation.

Extra equipment?:

Theme: Robot learning outcomes
Description: *For the sessions discussed summarise the potential learning outcomes. If appropriate summarise quotes into a single bulleted learning outcome or success measures.*

As the main learning outcome was mentioned – better memorisation of skills, better focus on tasks, concentration, improvement in behaviour, positive emotions, faster assimilation of new content.

Key quotes or messages:

- Student would remember information better – it would be easer to repeat it next lesson
- Students' involvement,
- Speed of assimilation of new content;
- Correctly implemented task assigned to student;
- According student positive emotions;

- Success would be measured according student ability to concentrate till the end of the task, efforts to replicate the movement – those would be perfect achievements
- If student after while can replicate movements autonomously (without looking at robot) – it would be incredible!
- The success would be measured by the level of correctly understood and implemented instructions

Theme: Reaction to introducing robots (including barriers)
Description: *Summarise the key quotes/messages according to the sub-themes listed below.*

Key quotes or messages:
Teacher based: *e.g. lack of skill, awareness etc.*

*In general overview all **teachers** liked NAO robot and his range of functions.*
The main concerns were related to the technical maintenance of the robot – programming, basic or advanced ICT skills needed to use it. Language barrier was pointed as well.

Positive:
I would like to have NAO at my class
I would be confident to use (3)

Barriers:
Lack of teacher skills
I won't be confident at begin, but most likely after a while – yes.
I think, at begin there would be a lot of obstacles, how to use it. Because it is a new thing.
I would feel partly confident.
If I knew and learn how to use and programme new topics and my ideas with robot, I would be confident
I'm missing skills how to use robotics
Missing skills to programme robot
Can be difficult to programme
It would take a lot of time to programme, and there is not always enough time
No, I would not feel confident; I don't know how to programme
Programming skills of teachers
Lack of skills about robot capacity

Robot-based: *e.g. too expensive, lack of sensors, control etc.*
Robot itself was accepted as very attractive character – as real character from computer or cartoon game. Primary barrier was related to equipment price. Other technical concerns: can be broken by students, if it can perform enough movements, if the voice of robot is not too much artificial, if it is possible to assure quality of proper native pronunciation.

Positive:
It looks like a character from the computer game

Price of robot (3)
Can be broken by students or by itself.
Robot batteries can get off too soon (time of usage in the task).
Possibility to programme robot to perform various movements and provide enough audio texts

Artificial robot voice - it can take time for pupils to accept the tune of voice, to listen to, to understand and to follow robot's orders
Audio pronunciation quality
It can take too much time to programme

Organisational based: *e.g. lack of support from management, lack of infrastructure etc.*

No one teacher mentioned barriers from organisational side. The school administration is considered rather initiating and forcing to take challenge in new advanced technologies in education.

Pupil based: *e.g. would not respond well, would react well etc.*
Robot introduction to students was perceived as very positive, attractive, motivating and engaging tool. Teachers mentioned engagement, motivation and behaviour improvement trough positive emotions and enjoyment.
The concerns related to students' primary were related to risk breaking the robot, to get too much entertained losing discipline. As well mentioned concern to get scared at first introduction which can cost pupil's total exclusion from communication.

Positive:
Would respond with big interest
I think they would like it
They would react as to the new toy
They would be positively surprised
It would motivate them a lot
Pupils would be very interested, they would like to use robot often
Pupils are eager for new technologies
It would be a lot of emotions,
Students behaviour would improve
Motivation would increase

Barriers:
Can try to broke, can get scared and isolated.
Not all students can speak. Some of them are not talking, only pronouncing separate sounds.
Students could lose discipline
Its risky how pupils use robot – they want to touch, to play, but all of them can control own kinaesthetic movements.

Theme: Other
Description: *Anything else throughout the course of the interview/s that deserves mention and could be an interesting talking point.*

Key quotes or messages:
I would like to know more about it (haft of interviewed teachers)

Appendix E – AIAS Analysis

WAIAS.1 Thematic Analysis Template

AIAS – 1st focus group summary

Date Conducted: 29/1/2015
Service Name: Istituto Comprensivo Fiorenzuola [elementary to high school] (Piacenza, Italy)
File Reference (to video or audio file if available): audio recording

For Summary

Number of Participants (for summary document):

- 4 (2 regular teachers; 2 teacher assistants)

Thematic Analysis

Theme: Teaching/intervention Practice

Description: state a teaching practice; use any quotes dealing with diversity in the classroom and the effect this has as well as any unique challenges involved, are typical sessions group based or singular, why? Etc.

- *Italy has a full inclusive system, that is, there are no special schools. A child with any type of disability (CD) attends mainstream schools and is included in mainstream classrooms together with his/her peers without disabilities (CwD). However, depending on the type and severity of the disability, CD may attend special teaching activities with his/her social educators or teaching assistants. Thus, over a typical school day, teaching activities involving CD may be conducted both in mainstream classrooms and, during particular moments of the day, in separate rooms with special equipment that allow the conduction of specific interventions. During these specific interventions, CD may be alone (together with the educators) or with other CD having similar disabilities. The teachers involved in the present focus group deal with several types of disabilities, from intellectual disability (including autism) to neuromotor disabilities (e.g. cerebral palsy). Participants were mainly interested in discussing their current and future work with children with autism spectrum disorder (ASD).*

Key quotes or messages:

- *There is the need to employ a tool on the basis of which the teachers could develop learning activities with different levels of complexity. Further, the tool should be able to engage any type of student (that is students with disabilities as well students without disabilities) in order to make it possible for the teachers to develop group activities involving the entire classroom, thus exploiting as much as possible the potentials of a full inclusive system.*

Theme: Pre-robot learning outcomes
Description: How do teachers currently devise the learning outcomes for their sessions? How is a session measured in terms of success? If appropriate summarise quotes into a single bulleted learning outcome or success measures.

- *The teachers describe that at the beginning of the academic year, the teachers are required to compile a sort of individualized educational plan for each child with a disability (PEI). This plan is developed in close collaboration with the child's family. The plan illustrates the level of functioning of the child and the learning outcomes to be achieved over the academic year. The achievement of the learning outcomes is then recorded by teachers at the end of the academic year. No validated instruments are used to measure progresses of the child over the year. The achievement of outcomes is established in a subjective way. Any time the child is engaged in a learning activity at school, the teachers do not measure in an objective way (ie by means of specific tool or indicators) the success of the activity. Achievement of success is measured in a global way, at the end of the academic year, and not session per session. Of course, the teacher monitors whether the proposed activity is meaningful for the child and if it produces some sort of positive outcomes. However, as already said, the evaluation is highly subjective and not supported by validated tools.*

Key quotes or messages:

- *Achievement of success is measured in a global way, it is highly subjective and is not supported by validated tools nor by a pedagogical framework which could help the teachers to interpret the observed behaviours.*

Optional Theme: Learning outcome based challenges
Description: If success measures are difficult to pin down then put quotes dealing with this here. For example, it may be that LO's cannot be derived due to diversity in the classroom or that they need to be done ad hoc due to the particular SEN's of the students.

- *Teachers report that each student has specific needs and is involved in different types of teaching activities. This variability makes it difficult for the teachers to develop specific outcomes measures by means of which they could evaluate in an objective manner the child's progresses towards the learning outcomes established in the individualized educational programme. Further, teachers are not trained for doing this kind of evaluations and they feel they don't have the competence to develop something from scratch.*

Key quotes or messages:

- *Measuring outcomes of the learning activities is difficult due to both the complexities associated to the population and the skills and competences of the teachers. Further, form the discussion, it emerges that cultural factors also play an important role in preventing the use of validated instruments in school settings. Teachers indeed do believe that evaluating continuously the outcomes of each teaching session with structured protocols would negatively affect their work (i.e., it is perceived as a "time consuming" and "bureaucratic activity").*

Theme: Robot Pedagogy
Description: State which robot was show to the participant and summarise (with quotes if necessary) according to the following headings.

Key quotes or messages:

Activity Title:

- *"Spatial reasoning"*

Description:

- *One of the activities proposed by teachers with children is aimed at stimulating spatial reasoning, that is learning the relation between spatial concepts (e.g., "left"; "right"; "up", etc) and corresponding movements in the physical space. Currently, they are using Bee-Bot (usually in on-to-one sessions) to stimulate learning of spatial relations in a physical environment. Teachers, for example, ask the child to program the Bee-Bot in order to let tit follow a specific path.*
- *During the discussion the teachers complained that these activities have a "short-life", that is, fail to engage the child for more than few minutes. Thus, they would like to develop activities using technological applications that could be more engaging and that could involve also the peers without disabilities. In this view, NAO robot could be used as a "tool" that could be moved by means of a tablet (a device already in use in the school for other activities with ASD children). Indeed, we showed the teachers the tablet application developed by Maria Trigo and were enthusiast about the possibility to couple the tablet and the NAIO robot.*

Student Profile/Involvement:

- *During the discussion, participants referred in particular to 2 children with ASD (low-functioning) they are working with and aged 10 and 11 years.*

Teacher Involvement:

- *Teachers have the role to plan and monitor the activities. First sessions should be one-to-one sessions aimed at introducing the robot to the child and let him/her learn the basic functionalities. Activities should be thought in terms of increasing complexity. The final step should be developing group activities involving the entire classroom.*

Extra equipment?:

- *Tablet*

Theme: Robot learning outcomes
Description: For the sessions discussed summarise the potential learning outcomes. If appropriate summarise quotes into a single bulleted learning outcome or success measures.

- Two main outcomes:
    - Cognitive level: spatial reasoning (e.g., the child is able to move the robot following some instructions)
    - Social level: the child is able to use the acquired ability to move the robot in the classroom and interact with his/her peers.

Key quotes or messages:

Theme: Reaction to introducing robots (including barriers)
Description: Summarise the key quotes/messages according to the sub-themes listed below.

Key quotes or messages:

Teacher based: *e.g. lack of skill, awareness etc.*

- *Lack of robot*
- *Lack of time needed to develop the activities*

Robot-based: *e.g. too expensive, lack of sensors, control etc.*

- *"does it really work as we saw in the video?"*
- *" what if it stops working"?*

Organisational based: *e.g. lack of support from management, lack of infrastructure etc.*

- *none*

Pupil based: *e.g. would not respond well, would react well etc.*

- *Lack of collaboration from the child's side*
- *Lack of interest*

Theme: Other
Description: Anything else throughout the course of the interview/s that deserves mention and could be an interesting talking point.

Key quotes or messages:

WAIAS.1 Thematic Analysis Template

AIAS – 1st focus group summary

Date Conducted:

- 22/1/2015 (focus group with 3 participants)
- 26/2/2015 (face to face interview with 1 participant)

Service Name:

- Centre for Autism Spectrum Disorder, Bologna Local Health Authority
- Unit for Rehabilitation Medicine, Bologna Local Health Authority

File Reference (to video or audio file if available): audio recordings

For Summary

Number of Participants (for summary document):

- Centre for Autism Spectrum Disorder, Bologna Local Health Authority: focus group with 3 participants (1 psychologist; 2 child psychiatrists)
- Unit for Rehabilitation Medicine, Bologna Local Health Authority 8face to face interview with one child psychiatrist)

Thematic Analysis

Theme: Teaching/intervention Practice

Description: state a teaching practice; use any quotes dealing with diversity in the classroom and the effect this has as well as any unique challenges involved, are typical sessions group based or singular, why? Etc.

- *The sample involved both in the focus group and in the interview comes from a clinical setting with which AIAS has a strong relationship;*
- *The Centre for Autism Spectrum Disorder (CASD) works as a mediator between the so called "territorial services", the school, and the families of children with autism spectrum disorder. Its main activities are:*
    - *Assessing children (aged 3-17) who are suspected (by territorial services) having autism and formulate an official diagnosis. Usually the assessment lasts 3-4 working days;*
    - *Once a diagnosis of autism is produced, CASD has the responsibility to develop an intervention plan together with the family and other stakeholders (e.g., the child psychiatrist from the territorial service);*
    - *Performing an intervention plan activating the available psychologists/social educators from the public health system. The cost of the intervention targeting children with autism are covered by the national Health System. However, due to limited resources available, interventions are offered (max) 2 days a week for a limited period of time (1-2 years, it depends on the specific situation). For this reason, (some) families decide to pay an additional educator who perform an intervention other than that provided by the National health System. The CASD interventions are performed both in dedicated facilities within the CASD structure and at the child's*

school. Interventions are not performed at child's home. Usually CASD performs one-to-one sessions and rarely conducts group sessions.

- *The Unit for Rehabilitation Medicine (URM) deals exclusively with children (aged 3-17) with neuromotor disabilities (e.g., cerebral palsy). Its main activities are:*
    - *to assess perceptual, motor and cognitive functions of children with neuromotor disabilities with the aim to plan rehabilitative interventions (e.g., motor rehabilitation; provision of electronic wheelchairs);*
    - *Assessment and rehabilitation interventions are centre-based.*

Key quotes or messages:

- **None**

Theme: Pre-robot learning outcomes
Description: How do teachers currently devise the learning outcomes for their sessions? How is a session measured in terms of success? If appropriate summarise quotes into a single bulleted learning outcome or success measures.

- *During the discussion, professionals from CASD were mainly interested in discussing their work during the intervention phase of their service delivery process. The most used approach is Applied Behaviour Analysis. Interventions are planned according to the age and severity of the pathology. During the intervention sessions usually observational scales are used which help the professional to record the manifestation/frequency of behaviors object of the intervention;*
- *The professional from URM, instead, was mainly interested in discussing the methodology employed during the assessment of children with neuromotor disabilities, focusing mainly on the assessment of cognitive abilities. To date, no standardized tools are available for evaluating the cognitive abilities of children with motor disorders. For this reason, evaluations are mainly based on observation of child's behaviour and the cognitive abilities are "estimated" on the basis of the "clinical expertise" of the professional.*

Key quotes or messages:

- **None**

Optional Theme: Learning outcome based challenges
Description: If success measures are difficult to pin down then put quotes dealing with this here. For example, it may be that LO's cannot be derived due to diversity in the classroom or that they need to be done ad hoc due to the particular SEN's of the students.

Key quotes or messages:

Theme: Robot Pedagogy
Description: State which robot was show to the participant and summarise (with quotes if necessary) according to the following headings.

- *NAO robot and LEGO Mindstorms were shown to both groups (CASD & URM). A strong preference emerged in both groups for the NAO robot as it has been perceived more "simple",*

"friendly" and "versatile". Thus, activities described below refer to NAO only. It resulted difficult for professionals to imagine which kind of activities could be performed with NAO since none of them never saw it before this interview.

Key quotes or messages:

- **CASD**
    - ***Activity Title:***
        - *Vocabulary/conversational development*
        - *Eye contact*
    - ***Description:***
        - *Vocabulary/conversational development: the robot could be used as a conversational partner in order to improve speech and comprehension abilities of children with autism. Very simple activities could be structured to stimulate the spontaneous production of speech (i.e., the child asks the robot to do something) or to teach the child associating pictures with words. In the latter case, it would be the robot that asks the child to take a picture relative to a specific word/object (as in the example of the video shown).*
        - *Eye-contact: the robot could be used to stimulate the child to direct his/her gaze to that of the robot, and then transfer this new acquired skill to other persons. Thus, the robot could be used as a mediator in strict sense. However, no clue were provided as how to plan an activity to stimulate child's eye-contact.*
    - ***Student Profile/Involvement:***
        - *Low-functioning children with autism aged 6-8 yrs.*
    - ***Professionals Involvement:***
        - *It is fundamental the presence pf the professional for the whole duration of the first sessions. Then, the professionals should reduce his/her involvement leaving the child interacting with the robot in autonomy. "However – as clearly stated by one professional - the scope of any activity is not to let the child interact with the robot but use the robot to facilitate the child's interaction with other persons".*
    - ***Extra equipment?:***
        - *None*
- **UMR**
    - ***Activity Title:***
        - *Cognitive assessment*
    - ***Description:***
        - *The robot could be used to assess a series of fundamental cognitive abilities including:*
            - *Basic cognitive skills*
                - *Understanding the cause-effect relationship (e.g., activating the robot using a switch)*
            - *Communication:*
                - *Pointing (understanding which object in a scene is indicated by the robot)*

        - *Receptive vocabulary (e.g., understanding which object the robot is naming)*
    - ***Student Profile/Involvement:***
        - *Children with cerebral palsy aged 6-11 yrs*
    - ***Professionals Involvement:***
        - *Professionals are fundamental in these activities. They have also the role to record the child's responses/behaviours*
    - ***Extra equipment?:***
        - *None*

Theme: Robot learning outcomes
Description: For the sessions discussed summarise the potential learning outcomes. If appropriate summarise quotes into a single bulleted learning outcome or success measures.

- Increased spontaneous speech (e.g., by measuring the length of the utterances)
- Increased vocabulary size (e.g., by measuring the number of words recognized)
- Increased eye-contact (e.g., by measuring the frequency of eye-contact with robots and persons)
- Development of a child's cognitive profile

Key quotes or messages:

Theme: Reaction to introducing robots (including barriers)
Description: Summarise the key quotes/messages according to the sub-themes listed below.

Key quotes or messages:

Professionals based: *e.g. lack of skill, awareness etc.*

- *Too difficult using the robot*
- *Too much competences needed*

Robot-based: *e.g. too expensive, lack of sensors, control etc.*

- *Child's voice is not recognized properly*

Organisational based: *e.g. lack of support from management, lack of infrastructure etc.*

- *None*

Pupil based: *e.g. would not respond well, would react well etc.*

- *"Scared by the robot and the noise produced by it" (children with autism)*

Theme: Other
Description: Anything else throughout the course of the interview/s that deserves mention and could be an interesting talking point.

Appendix F – INTERPROJECTS Analysis

EduRob

Educational Robotics
for Students with Learning Disabilities

Lifelong
Learning
Programme

EDUROB: Educational Robotics for Students with Learning Disabilities (EDUROB - 543577-LLP-1-2013-1-UK-KA3-KA3MP)

INTERPROJECTS

Partner: INTERPROJECTS, BULGARIA

WAIAS.1 Thematic Analysis Template

The following is intended to provide a template to aid in the analysis of interview data gathered as part of work package 3.1.

For each interview conducted a transcription and a summary should be provided using this document. Further to this, a summary of all interviews conducted should also be provided, again using this document as a template. For each of the headings below pull out key messages from the interview transcripts. These key messages could be direct quotes or a summary of a point made.

For Individual Interviews

Date Conducted:

- **Organisation of focus group of 6 representatives from Special VET school part of Social Complex "St. George" – Plovdiv (09.02.2015)**
- **Organisation of focus group with 6 teachers from SOU "Paisii Hilendarski" and SOU "Kniaz Boris I" – Plovdiv (10.02.2015)**
- **Interview with Dipl. Eng. Alexander Chobanov – National School of robotics for students and parents – Plovdiv (18.02.2015)**
- **Interview with Prof. Mihail Petrov, Technical University of Plovdiv, Department of electronics and robotics (23.02.2015)**
- **Interview with Yavor Sofronov, PhD, Technical University of Sofia, Department of Robotics (22.02.2015)**

File Reference (to video or audio file if available): written notes in Bulgarian

For Summary

Number of Participants (for summary document): 15

Thematic Analysis

Theme: Teaching Practice
Description: state a teaching practice; use any quotes dealing with diversity in the classroom and the effect this has as well as any unique challenges involved, are typical sessions group based or singular, why? Etc.

Key quotes or messages:

The focus groups started with the presentation of video cases where NaO and Lego Mindstorm robots are used in education of students with disabilities. For the individualised interviews this step was not included because the respondents are technicians and developers who are aware with the specific characteristics of the above mentioned robots.

As a summary the professionals shared that the inclusion of robots in the mainstream and special education is a possibility which still needs to be explored in Bulgaria. Only few of the respondents (the three academicians who are developers mentioned just few initiatives to integrate them for educational purposes of people with mild learning difficulties) have knowledge and some preliminary thoughts about how the robots can improve the educational process.

The school and VET teachers shared that students with learning difficulties (for example children with Down syndrome and those from Autistic spectrum disorders), might have trouble playing with robots because of their cognitive limitations. Those students have reduced ability to retain attention and might not understand the meaning of proposed play, and/or the meaning of the language (words) used to play. It was highlighted that some students also have speech limitations which could be a challenge in terms of voice recognition by the robot itself.

The respondents also shared that some students (physical impairments, multiple disabilities) could experience challenges in their ability to interact with robots due to the limitations of their movements and interaction.

As conclusion the respondents agreed that singular repetitive sessions with each student with learning difficulty could be more useful instead of classroom usage. The reasons for that is their individual abilities cause by the disability, their distraction will be less intensive in singular session and also the noise could increase in case of group sessions which will make worst recognition of the voice by the robot.

Theme: Pre-robot learning outcomes
Description: How do teachers currently devise the learning outcomes for their sessions? How is a session measured in terms of success? If appropriate summarise quotes into a single bulleted learning outcome or success measures.

Key quotes or messages:

The respondents concluded on the following possible topics:

Imitation, Action, Coordination which are playing a major role in the development of students with disabilities.

Imitation:

- Activities involve attention keeping and observation, the physical control to replicate and reciprocal coordination.
- Students might be able to focus their attention on the behaviour of the robot, creating a model of this behaviour to replicate with their own abilities.

Action & Coordination:

- Activities which involve movement, spatial orientation and coordination.
- Students might be able to navigate the surrounding space, detect the presence and the movement of the robot and autonomously move, or ask to be moved through the space.

The academicians shared also the possibility of **Symbolic play**. Such activities could involve attention, imagination and role-playing. Individuals engaged with Symbolic Play might be able to start playing with symbols and objects with symbolic values. Of course the involvement in such activities is depending on the level of their learning difficulties (mild to severe).

Optional Theme: Learning outcome based challenges
Description: If success measures are difficult to pin down then put quotes dealing with this here. For example, it may be that LO's cannot be derived due to diversity in the classroom or that they need to be done ad hoc due to the particular SEN's of the students.

Key quotes or messages:

Possible subjects into the mainstream school curricula (robot could have the power to capture the imagination of youngsters with learning difficulties) where the robot could support have been mentioned as following:

- Math – it was mentioned that students frequently have difficulties in calculation and in understanding concepts of time and space.

  Possible scenario was suggested: to make the classroom mini-economy in which students are required to sell products using a school-based currency.

- Physics - learning a particular concept.
- Natural science
- Language learning - the majority of students with learning difficulties (the academician mention the study by Lerner 1997 where 80% are mentioned to have this challenge) have difficulty with reading. The robot could support basic vocabulary improvement or spelling words) or encouraging the student to process short sentences or a short story.

Furthermore the robots could support the learning about appropriate social behaviour – some students with learning difficulties have problems with making and keeping friends due to the fact that their social interactions are often immature and impulsive. The robots could support the lack of appropriate social skills necessarily for cooperative relationship.

Robots could help students to grasp the fundamentals better than usage of traditional pen/paper, white/black boards etc.

Theme: Robot Pedagogy
Description: State which robot was show to the participant and summarise (with quotes if necessary) according to the following headings.

Key quotes or messages:

The respondents saw examples of usage of Nao and Lego Mindstorm robots with short oral translation in Bulgarian about the content of the activity. The real presentation was not possible due to the lack of existing purchase robots in Bulgaria and not existing pedagogical methodology for the implementation of activities.

Activity Title: N/A
Description: N/A
Student Profile/Involvement: N/A
Teacher Involvement: N/A

Extra equipment?: N/A

Theme: Robot learning outcomes
Description: For the sessions discussed summarise the potential learning outcomes. If appropriate summarise quotes into a single bulleted learning outcome or success measures.

Key quotes or messages:

See above suggestions.

They also think that the following social competence could be improved by integration of the robots:

- Communication
- Problem solving
- Prioritizing
- Motivation
- Self-control
- Self-confidence
- Self-esteem
- Self-efficacy
- Self-care

It was mention also that sometimes the learning scenario could not support to content acquisition but rather to stimulate the development of social skills.

As a conclusion also the respondents said that the support of robots into mainstream education could increase the level of development of:

- Memory
- Perception
- Executive functions

- Reading
- Writing
- Calculation
- Mental persistence
- Intellectual growth

The robots' learning support could enable the students with learning difficulties:

- Better to understand collaboration;
- Develop good level of problem solving skills;
- Transfer of knowledge from the "virtual" world to the real world.

Theme: Reaction to introducing robots (including barriers)
Description: Summarise the key quotes/messages according to the sub-themes listed below.

Key quotes or messages:

Teacher based: *e.g. lack of skill, awareness etc.*

The majority of the respondents during the focus groups concluded that the robots cannot replace human teachers but they are expected the added value that robots can bring to the classroom in the form of a stimulating, engaging and instructive teaching aid.

The robots could support both intra and extra-curricular activities, but there is also a predominant group of interviewees which rather see the advantages of the robots in extra-curricular activities where individual sessions are possible to be organised.

Robot-based: *e.g. too expensive, lack of sensors, control etc.*

As **potential challenges** they concluded on:

- Lack of financial resources of the schools / VET centres to purchase robots.
- Not existing funding programmes in Bulgaria which could provide financial resources for purchase of robots.
- Lack of companies who are providing guidance of robots usage in Bulgaria
- Lack of companies who could maintain the robots or assist in case of problems

Case-based approach – short sessions (up to 10 minutes) to be predefined by performance based scenario (e.g. a singular task/activity to be predefined as scenario)

Potential challenge – different scenarios are needed (e.g. variety of involvement of the robot and student, variety of learning tasks depending on the severity of the disability).

Clear definition of the learning scenario should be predefined by the methodology as well as the learning outcome which the learner will gather at the end of repetitive sessions (clearly defined objectives!).

Two possible types of robot involvement:

- Robot can take a passive role and be used as a learning tool/teaching aid.

- Robot can take the role of co-learner, peer or companion and have active spontaneous participation or even care receiver (e.g students learnt English along the way as they taught the Nao robot).

- Robot to be a mentor.

Customisation:

- By age of the students
- By severity of their learning disability
- By duration of the assignment (easy, intermediate, difficult levels)
- By development of common robotic platform which supporting a number of less expensive robots as well. (the investment in the technology is seen to have cost benefits)

Organisational based: *e.g. lack of support from management, lack of infrastructure etc.*

The inclusion of the robots into the curricula required approval by the Ministry of Education and science in Bulgaria. In Bulgaria the awareness still should be raised in terms of robots useful supporting teaching aid. The results from piloting of EDUROB could serve as important step towards this action.

Pupil based: *e.g. would not respond well, would react well etc.*

Potential challenge could be less interaction of Lego robots in comparison to Nao who have better expressions (Moderate and Severe Motor Impaired student require a more expressive face and personalisation of the facial expressions ; Autistic students could require a robot face with physically embedded parts like eyelids that can be manually opened or closed during play).

Furthermore robot such NaO with a human body-like appearance could engage betters the students especially in activities of imitation.

Potential challenges for students with learning difficulties involved in activities with robots could be (to be considering while preparing learning scenarios of EDUROB platform):

- their limitation of motor skills which cause problems with general coordination,
- oral language deficit – important for the ability of the robot to recognize their responses
- difficulties with spatial organisation,
- processing auditory and visual information,
- difficulties with short-term memory,
- experience difficulties following oral directions
- lack of metacognitive strategies for planning, organizing and executing activities,
- Sometimes those students are not active part in the learning process and required others to provide the structure that they cannot bring to bear on the task.
- The students should clearly understand the objective of each activity (the academician mentioned the study by Rosenberg and O'Shea 1991). Students who clearly understand objectives and expectations are more likely to remain focused and benefit from the robots (one of the academicians mentioned the study by Smith and Lucasson 1995).

- Group activities (cooperative learning experience) – the teachers should mind the diversity of the group of students included in the activities. Sometimes when such activities are involving diverse group of students with learning difficulties could cause distraction of learners so such activities should be conducted by focused and purposeful activities.
- Challenge to use LEGOs – small and very numerous items of the robot which could be destroyed or difficult for assembling.

Theme: Other
Description: Anything else throughout the course of the interview/s that deserves mention and could be an interesting talking point.

Key quotes or messages:

Appendix G – SSU Analysis

WAIAS.1 Thematic Analysis

by Suleyman Sah University

Date Conducted: 07/01/2015
School Name: Tercih Ozel Egitim ve Rehabilitasyon Merkezi (Tuzla, Istanbul/TURKEY)

Number of Participants: 4

Thematic Analysis

Theme: Teaching Practice
Description: state a teaching practice; use any quotes dealing with diversity in the classroom and the effect this has as well as any unique challenges involved, are typical sessions group based or singular, why? Etc.
Key quotes or messages:
I teach students who has mental difficulties, autism asperger, sensory impairment, motor impairment, learning difficulties.

Details of typical teaching session:
Each teaching duration is 1 class time (45 minutes) with only 1 student.
Students age are between 3 and 22 years old.
Typical teaching session includes
- Activity based teaching
- Learning through discovery
- Modeling
- Using ICT tools (tablet, special software, video)

I start with activity based teachings for 20 minutes, continue with instructions for main activities (communication, precision, social learning). Last 20 minutes is learning through discovery and/or using ICT tools (tablet, special software, video).

Our school is a VET job school for disabled students. We follow Ministry of Education curriculum and teach as 2 teachers in classroom. We mostly use practical training for our students who are between 9th and 12th class. Job shadowing and repeating of the tasks with facilitators are main methods here.

Theme: Pre-robot learning outcomes
Description: How do teachers currently devise the learning outcomes for their sessions? How is a session measured in terms of success? If appropriate summarise quotes into a single bulleted learning outcome or success measures.
Key quotes or messages:
I follow a curriculum created by Ministry of Education for students over 7 years old.
I follow session based learning outcomes for students under 7 years old.
We are making training to reach the main outputs of the training modules.

We have a check list and also use development tables. I fill personal development tables monthly.

I also make notes for parents to see what we did at school and we they should do at home.

I use technology within your classroom in a typical session with games, interactive board, tablet, animations, simulations, computer.

Optional Theme: Learning outcome based challenges
Description: If success measures are difficult to pin down then put quotes dealing with this here. For example, it may be that LO's cannot be derived due to diversity in the classroom or that they need to be done ad hoc due to the particular SEN's of the students.
Key quotes or messages:
My major challenge in teaching the students are:
Thinking strategies (on educational level)
Detailed knowledge (on educational level)
Communication skills (on educational level)

Task management skills (on social level)
Social learning (on social level)

Theme: Robot Pedagogy
Description: State which robot was show to the participant and summarise (with quotes if necessary) according to the following headings.
Key quotes or messages:
Description:

1. It is possible to use the robot to make exercise for cognitive development. It should be good idea for developing motor skills for students in preschool years. Student can try, repeat and learn with robot the actions below:
   clap hands
   touch fingers
   paste things onto paper
   open and close a button
   build a tower of many blocks
   complete puzzles with four or more pieces
   manipulate pencils and pastels well enough to color and draw
   draw a circle onto a paper

2. Robots can be use for speech and language delay and disorder.
   Robots can be programmed for tell a story, speak with sentence length of 4-5 words, use its vocabulary of about more than 250 words, ask name and last name, name of street, repeat several nursery rhymes, identifies colors, shapes, asks many questions like "what?" and "who?" and give feedback.

3. We can use robot for the lessons below:
   Handcraft lesson

Painting lesson
Music lesson

4. Robots can be use for speech and language delay and disorder. Robots can help students to build social and comminication skills .

Student Profile/Involvement:

1. Students listen and watch the robot actions.
2. Students listen the robot speak: a story, sentence, nursery rhymes.
   Student give answer to the questions about name and last name, name of street, "what?" and "why?" questions.
   Students give answer of the questions colors, shapes etc. and see/listen robot's feedback.
3. Students listen and watch the robot actions for handcraft, painting and music lesson.
   Student can give answer for colors, shapes and drawing questions of robot.
   Students gave repeat the music with robot and be active for dance.
4. Students listen the robot speak: a story, sentence, nursery rhymes.
   Student give answer to the questions about name and last name, name of street, "what?" and "why?" questions.
   Students give answer of the questions colors, shapes etc. and see/listen robot's feedback.

Teacher Involvement:

1. After SEN teacher motivation, he/she will start to try, repeat and do them.
2. Follow student's speaking, reactions and answers.
   There must be a lof of repeating if outcomes are not enough or not satisfied.
3. Positive reinforcement to make different things
   Encouragement for student
4. Control student's speaking, reactions and answers.

Theme: Robot learning outcomes
Description: For the sessions discussed summarise the potential learning outcomes. If appropriate summarise quotes into a single bulleted learning outcome or success measures.
Key quotes or messages:

1. Robot will show the actions for each motor skills exercise but actions must be very slow and teacher also can pause it to explain deeper, if necessary.

For motor skills, it is easy to check the results/outcomes.
SEN teacher should check the activities and if something is not totally true, robot should repeat and should try again.

2. Robot will be active mostly to start conversation and ask different questions and give feedback to student.
3. Robot will make a music and dance with music.
   Robot will draw shapes, use different color pen and ask them to students.
   Robot will explain how to use tools for handcraft. It must be very enjoyable if robot will give the tools (scissor, gripper, rope, glue) to our students as an assistant.
4. Robot will start conversation
   Ask and repeat different questions
   Give answer to student.

Theme: Reaction to introducing robots (including barriers)
Description: Summarise the key quotes/messages according to the sub-themes listed below.
Key quotes or messages:
Teacher based:
Lack of technical experience of SEN teacher
The level of teacher's competence
Lack of my capacity to program of robot for different reactions and answers
Programming and active using of robot as high-technology product
Robot-based:
Cost of the robot
Robot with sound and actions will be attractive tool for students
Robot with dance, actions, music sound will be attractive for student
Robot can demonstrate how to perform set of tasks and ask to perform tasks
Records of parents voice can be interesting to start reaction with student
Organisational based:
The level of school provision of high-tech equipment
Our organisation culture is conventional so it is difficult to use robot in classroom for us
Technical requirements (software, wifi, bateries)
Pupil based:
Positive reinforcement to make different things
Encouragement for student
Broken down or damaging robot by students

WAIAS.1 Thematic Analysis

by Suleyman Sah University

Date Conducted: 17/01/2015
School Name: Gokkusagi Ozel Egitim ve Rehabilitasyon Merkezi (Kartal, Istanbul/TURKEY)

Number of Participants: 3

Thematic Analysis

Theme: Teaching Practice
Description: state a teaching practice; use any quotes dealing with diversity in the classroom and the effect this has as well as any unique challenges involved, are typical sessions group based or singular, why? Etc.
Key quotes or messages:
I teach students:
infants with injuries due to complications at birth, feeding and swallowing difficulties, including dysphasia
Children with mild, moderate or severe:

Genetic disorders that adversely affect speech, language and/or cognitive development including cleft palate,
Down syndrome
Attention deficit hyperactivity disorder
Autism
Developmental delay
Feeding disorders, including oral motor deficits
Hearing loss
Craniofacial anomalies that adversely affect speech, language and/or cognitive development
Language delay
Specific language impairment
Specific difficulties in producing sounds, called articulation disorders,
Developmental verbal dyspraxia

Details of typical teaching session:
Each teaching duration is 1 class time (45 minutes) with only 1 student in classroom.

Typical teaching session includes
- Activity based teaching
- Basic concepts (colours, comparatives, matching)
- Articulation
- Phonological process
- Sounds
- Learning through discovery
- Modelling

Theme: Pre-robot learning outcomes
Description: How do teachers currently devise the learning outcomes for their sessions? How is a session measured in terms of success? If appropriate summarise quotes into a single bulleted learning outcome or success measures.
Key quotes or messages:
I follow mixture of session based learning outcomes and curriculum. I continue according to the curriculum after student completely success the learning outcomes.
I use personal development table for all students for learning outcomes.
I use technology in a typical session with games, tablet, animations, simulations, videos with dub, speech cards.

Optional Theme: Learning outcome based challenges
Description: If success measures are difficult to pin down then put quotes dealing with this here. For example, it may be that LO's cannot be derived due to diversity in the classroom or that they need to be done ad hoc due to the particular SEN's of the students.
Key quotes or messages:
My major challenge in teaching the students are:
Sensory awareness related to communication, swallowing, or other upper aero digestive functions
Basic key competences skills (on educational level)
Memory skills (on educational level)
Task management skills (on social level)
Social learning skills (on social level)

Theme: Robot Pedagogy
Description: State which robot was show to the participant and summarise (with quotes if necessary) according to the following headings.
Key quotes or messages:
Description:

1. It is possible to use the robot to make exercise for speech and language therapy that include difficulties with fluency (stuttering)
   making sounds and words
   making sentences
   understanding what others say
   using language socially.
2. It is possible to use the robot for following instructions to develop the ability of students to act on requests. Student can listen the robot to find something in classroom.
   Hearing
   Understanding
   Attention and concentration
   Working memory
   Follow steps (number of steps depends on students age)
3. It is possible to use the robot for balance and coordination to maintain a controlled body position during task performance.

Student Profile/Involvement:

5. Students listen and watch the robot actions.
6. Students listen robot to follow instructions.
   Students listen very carefully to instructions to find something (example: go 3 steps forward, then 1 step to the right). This can be reversed so that the child has to give someone else the instructions)
   After SEN teacher motivation, he/she will start to try, repeat and do them.
7. Students listen and see robot and repeat the actions together to develop the abilities to maintain controlled positions during both static (still) and dynamic (moving) activities.
   After SEN teacher motivation, he/she will start to try, repeat and do them.

Teacher Involvement:

5. Robot should be supported tool for oral motor skills exercise and for speech and language therapy. It can make sound and speech processing to check the results/outcomes and ask him/her to repeat and try again but final correction and articulation will be done by SEN teacher.
6. SEN teacher should check the followed instructions and if something is wrong or is not totally true, robot should repeat and students should try again.
7. Check those below:
   Attention and concentration
   Body awareness
   Bilateral integration
   Hand-eye coordination
   Hand dominance
   Muscular strength
   Self regulation
   Postural control
   Proprioception
   Sensory processing
   Isolated movement

Theme: Robot learning outcomes
Description: For the sessions discussed summarise the potential learning outcomes. If appropriate summarise quotes into a single bulleted learning outcome or success measures.
Key quotes or messages:

1. Robot will start to talk student for oral motor skills exercise but actions must be understandable and similar to human voice. Teacher will pause it to repeat it and then robot should check the pronunciation of student.
2. Robot will help student to follow instructions and commands and help student to understand and complete routine and unfamiliar tasks around home and school.
3. Robot can start to dance to improve attention to task and alertness levels in readiness to respond quickly by students when they lose their balance.

Theme: Reaction to introducing robots (including barriers)
Description: Summarise the key quotes/messages according to the sub-themes listed below.
Key quotes or messages:
Teacher based:
Lack of technical experience of SEN teacher
The level of teacher's competence
Lack of my capacity to program of robot for different reactions and answers
Programming and active using of robot as high-technology product
Comprehensive programming for speech and language therapy activities
Robot-based:
Cost of the robot
Price
Problems to get real human voice for exercises if we can not record parent's or teacher's vioce
Robot with sound and actions will be attractive tool for students
Robot with dance, actions, music sound will be attractive for student
Robot can demonstrate how to perform set of tasks and ask to perform tasks
Records of parents voice can be interesting to start reaction with student
There should be sequential multi-step tasks and activity performance to achieve a well defined result by students. Also speech and sound of robot should be clear and understandable by students.
It is possible to introduce robot for static balance with “freeze” or “statue” games). For dynamic balance running of robot can use to introduce balance and coordination actions.
Organisational based:
The level of school provision of high-tech equipment
Our organisation culture is conventional so it is difficult to use robot in classroom for us
Technical requirements (software, wifi, bateries)
Technical support
Pupil based:
Student can refuse to listen to instructions and/or engage in another activity of their choosing. Students can fail to comprehend instructions of robot and unable to complete work and fail to meet the task requirements.
Negative reinforcement to make different things
Less encouragement for student
Broken down or damaging robot by students
Struggles with following longer instructions and commands
Fails to follow instructions accurately
Looks at SEN teacher or around blankly when robot give students an instruction
Avoids carrying out instructions Would you be interested in hearing more about/getting
Students can falls easily or can’t recover quickly from being off balance.
Students move stiffly and lacks fluid body movement (example: runs like the robot).
Students avoid physical activity (example: playground use, sports participation).
Students can be slower than the robot in physical skills.
Students can push harder, move faster
Students can be fearful of new physical games
Social isolation as students will struggle to participate activities
Poor self esteem when they realise students skills don't match

Poor fine motor skills
Difficulties on strong base to support the use of their arms and hands
Inability to repeat robot actions which will limit the options for play with robots a means of catching up it

WAIAS.1 Thematic Analysis

by Suleyman Sah University

Date Conducted: 23/02/2015
School Name: Dilgem – Dil Gelisimi ve Egitim Merkezi (Pendik, Istanbul/TURKEY)

Number of Participants: 3

Thematic Analysis

Theme: Teaching Practice
Description: state a teaching practice; use any quotes dealing with diversity in the classroom and the effect this has as well as any unique challenges involved, are typical sessions group based or singular, why? Etc.
Key quotes or messages:
I teach students who have mental difficulties, autism, asperger, sensory impairment, motor impairment, learning difficulties, dyslexia, pervasive developmental disorder
Details of typical teaching session:
Each teaching duration is 1 class time (45 minutes) with only 1 student.

Students age are between 3 and 15 years old.
Typical teaching session includes
- Activity based teaching
- Learning through discovery
- Modeling
- Using ICT tools (tablet, special software, video)

Theme: Pre-robot learning outcomes
Description: How do teachers currently devise the learning outcomes for their sessions? How is a session measured in terms of success? If appropriate summarise quotes into a single bulleted learning outcome or success measures.
Key quotes or messages:
I use personal development table for all students for learning outcomes. Those tables send to public - advise research center every month.
If my student go to regular school (inclusive education), I am also using the standard curriculum created by Ministry of Education Directorate of Special Education.
I use technology within your classroom in a typical session with games, tablet, animations, computer

Optional Theme: Learning outcome based challenges
Description: If success measures are difficult to pin down then put quotes dealing with this here. For example, it may be that LO's cannot be derived due to diversity in the classroom or that they need to be done ad hoc due to the particular SEN's of the students.
Key quotes or messages:
My major challenge in teaching the students are:
Executive functions (on educational level)

Thinking strategies skills (on educational level)
Perception skills (on educational level)
Social learning skills (on social level)
Self-presentation skills (on social level)

Theme: Robot Pedagogy
Description: State which robot was show to the participant and summarise (with quotes if necessary) according to the following headings.
Key quotes or messages:
Description:

1. It is possible to use the robot to make exercise for receptive language skills to understand words and language.
   Building blocks can be good exercise with robots. By this way, students can develop receptive language with:
   attention and concentration
   pre-language skills
   social skills
   play skills
2. It is possible to use the robot to make exercise for play skills and social skills.
   - amusing, pretend or imaginary, constructive, interpersonal interactions
   - verbal and non-verbal communication, such as speech, gesture, facial expression and body language
3. Robots can be supported equipment with teacher for for teaching social and behavioral skills.

Student Profile/Involvement:

1. Students listen and watch the robot actions.
   After SEN teacher motivation, he/she will start to try, repeat and do them.
   - sustained effort, doing activities without distraction and being able to hold that effort long enough to get the task done
   - communicate without using words and include things such as gestures, facial expressions, imitation, joint attention and eye contact
   - engage in reciprocal interaction with others (either verbally or non-verbally), to compromise with others, and be able to recognize and follow social norms
   - voluntary engagement in self motivated activities that are normally associated with pleasure and enjoyment where the activities may be, but are not necessarily, goal oriented.
   2. Students will learn about the environment, their bodies and their place in the world around them.
   For social skills, they will learn how to behave in social situations and understand implied rules when communicating.

Teacher Involvement:

1. SEN teacher should check the activities and if something is not totally true, robot should repeat and should try again.

2. See the results of cooperating, sharing, taking turns and participating

Theme: Robot learning outcomes
Description: For the sessions discussed summarise the potential learning outcomes. If appropriate summarise quotes into a single bulleted learning outcome or success measures.
Key quotes or messages:

1. Robot will show the actions for building blocks but actions must be very slow and teacher also can explain deeper, if necessary.
2. Robot will show the steps simple sorting and matching and ask students to do them for sensory play (experience objects through students'senses), exploratory play (experience to figure out functions and limitations of objects), symbolic and imaginative play (learning to substitute one object for another or coming up with a new function for an object).
   Robot will help to
3. Robot will
   start conversations (greetings, talking, resolving problems)
   develop emotions (identifying, interpreting, predicting, acting and responding)
   control behaviors (meanings, emotions)

Theme: Reaction to introducing robots (including barriers)
Description: Summarise the key quotes/messages according to the sub-themes listed below.
Key quotes or messages:
Teacher based:
Lack of technical experience of SEN teacher
The level of teacher's competence
Lack of my capacity to program of robot for different reactions and answers
Programming and active using of robot as high-technology product
Comprehensive programming for speech and language therapy activities
I don't know how to practice social interaction in a safe environment
I don't know how our students interact with and learn from a social robot
I need a research-based developed curriculum
I need an inservice-training to use robot and curriculum modules
Robot-based:
Cost of the robot
Price
Problems to get real human voice for exercises if we can not record parent's or teacher's vioce
Robot with sound and actions will be attractive tool for students
Robot with dance, actions, music sound will be attractive for student
Robot can demonstrate how to perform set of tasks and ask to perform tasks
Records of parents voice can be interesting to start reaction with student
There should be sequential multi-step tasks and activity performance to achieve a well defined result by students. Also speech and sound of robot should be clear and understandable by students.
It is possible to introduce robot for static balance with “freeze” or “statue” games). For dynamic balance running of robot can use to introduce balance and coordination actions.

Robot with sound and actions will be attractive tool for students for attention and concentration (doing activities without distraction, being able to hold that effort long time to do task), auditory processing (ability to hear sounds), planning and sequencing (sequential multi-step task/activity performance to achieve).
Robot should stand in front of student so he/she can look at the robot.
Robot should start to communicate with student and offer student to play together.
Ask him/her to start by copying what robot is doing, then add to the activity.
If he/she doesn't copy the robot, it should encourage to play.
Robot should know when to stop or change the play, it is also important.
Robot with sound and actions will be attractive tool for students for attention, auditory processing, planning.

Organisational based:

The level of school provision of high-tech equipment
Our organisation culture is conventional so it is difficult to use robot in classroom for us
Technical requirements (software, wifi, bateries)
Technical support

Pupil based:

Student can refuse to listen to instructions and/or engage in another activity of their choosing. Students can fail to comprehend instructions of robot and unable to complete work and fail to meet the task requirements.
Negative reinforcement to make different things
Less encouragement for student
Broken down or damaging robot by students
Struggles with following longer instructions and commands
Fails to follow instructions accurately
Looks at SEN teacher or around blankly when robot give students an instruction
Avoids carrying out instructions Would you be interested in hearing more about/getting
Students can falls easily or can't recover quickly from being off balance.
Students move stiffly and lacks fluid body movement (example: runs like the robot).
Students avoid physical activity (example: playground use, sports participation).
Students can be slower than the robot in physical skills.
Students can push harder, move faster
Students can be fearful of new physical games
Social isolation as students will struggle to participate activities
Poor self esteem when they realise students skills don't match
Poor fine motor skills
Difficulties on strong base to support the use of their arms and hands
Inability to repeat robot actions which will limit the options for play with robots a means of catching up it
Difficulties can vary depending on the student's age.
Difficulty attending and listening to robot.
Does not pay attention sometimes.
Is not following instructions that others the same age would be able to follow.
Forming friendships and engaging in positive interactions with robot
Completing tasks effectively with robot

Following instructions and directions step by step
Find it difficult to listen, watch and repeat the robot
Engagement with robot can be problem about the play behaviour of students
Not good reflection of the level of play and social skill development
Student can not independently transition to and start a play activity
Students can not choose something to play
Students can not communicate when they need

Appendix H – UoC Analysis

EDUROB

"Educational Robotics for Students with Intellectual Disabilities"

The project is coordinated by prof. David Brown of NTU

Subjects:
There were conducted 20 individual interviews with teachers, psychologists and therapists of children with disabilities.
Examined people from 25-65 years of age had various working experience**:** Working experience: 7 persons- junior specialist (working 1 –5 years), 4 persons- experienced (6-10 years); 9 persons - senior (more then 11 years).
The participants of the study were the employees of special kindergartens, various types of schools (special, integrated, mass) as well as school-educational centres run by NGO.

Working place:
Integrated kindergarten – 3
Integrated school – 4
Special school – 5
Centre for disabled children – 4 (1 for blind)
Psychological Centre – 2
Sanatorium school - 2

Method and procedure:
There was conducted individual semi-structured interview in reference to the developed schema in the work place
NAO record was presented for the subjects.
Studies were realized from 01 March to 20 May 2015

Thematic Analysis

1. **Theme: Teaching Practice**

Subjects worked as special teachers at different levels of educational system and in different types of schools. In the examined group there were psychologists realizing rehabilitation with using various methods and technics which support pupils development. Therapeutic classes are held in an individual contact whereas teaching happen in various forms – individually towards students with ASD, a mulitiple and complex disability or in home teaching/sanatorium. In small groups up to 4 people (in case of severe intellectual disability or visual impairment) or in classes up to 20 students (integrated classes, special education classes for people with mild intellectual disabilities or with learning disabilities).

Therapeutic and school groups are usually constituted by the level of development and not by the age. The school program is individually adjusted to adaptive and cognitive capabilities of each student.

Regardless of ongoing activities, there are used various methods and techniques which stimulate certain cognitive functions. There are also used techniques which provide concentration and students involvement in the activity and also any ways of visualization the

content of programs. Mostly, teachers prepare teaching aids for particular students on their own.

Key quotes or messages:

- *Classes are realized individually. Most important are: communication skills, singing, introduction of elements of English and logo rhythmic games.*
- *Pupils independent functioning in society is the main aim on the course.*
- *The class is very diverse in this regard. All of students have complex disability. Three of them have prominent intellectual disability, one student has moderate mental retardation and autism. The other three have movement disorders and vision problems. One of the female student has drug-resistant epilepsy and her sudden tantrums and aggression are a big problem. All the people in the class do not speak the active language.*
- *Classes are customizes according to development needs. Students need physical, verbal and manual support, a lot of repetitions, many systematic experiments with a particular skill and learning new topics.*
- *We use here: group, individual and team activities in for example 2-person teams every day. Such organization of educational-therapeutic and educational process comes directly from the needs of students, their capabilities and the general rules which regulate the class progress.*
- *Educational activities generally take place in the whole class with all the students, however we also have rehabilitation classes which can be individual or in 2-persons teams.*

The methods used during lessons:

- Work-centre method
- Demonstration and visual means
- Learning through experience and practical activity
- Developmental Methods – for example Sherborn
- Alternative communication

2. **Theme: Pre-robot learning outcomes**
   Description: How do teachers currently devise the learning outcomes for their sessions? How is a session measured in terms of success? If appropriate summarise quotes into a single bulleted learning outcome or success measures.

Main conclusion:

Effectiveness of teaching depends on students motivation and positive affect. The most important task is to arouse students' motivation to learn and their curiosity connected with discussed topic. The use of modern technology, a combination of lectures, talks with a film, photos and multimedia presentation help to realize it. Teaching will be more effective if a teacher finds students' needs and areas in which he functions worse or better.

Teachers who realize the core curriculum have to verify its realization through evaluation of students' progress, even though it is individually adjusted to the students' abilities. Teachers and therapists of students with more serious level of disability evaluate the efficiency of their actions from the individual perspective of developmental change. In this case, any progress in terms of achieving independence is a success.

Measures of success:

- Outcomes are planned in IPET
- teaching effects are strongly related to individual limitations
- effects are rather small and postponed
- Usually general curriculum aims as well as lesson goal achievement are less important than individual progress
- Progress is evaluated in the context of:
    - educational content
    - Behaviour modification
    - Social and communication skills improvement
    - Personal engagement and adjustment

Key quotes or messages:

Effectiveness is high because of adaptation to methods, forms, the entire day structure and also the month or the school year. We use methods which are adjusted to the capabilities and needs, which are mostly based on multisensory cognition and adaptation to the individual needs of the child - what is regularity and continuity of interaction.

3. Theme: Robot Pedagogy

Description: State which robot was show to the participant and summarise (with quotes if necessary) according to the following headings

Main conclusion:

- 14 professionals accepted NAO robot as very interesting ICT tool, with wide range of capacity to use in almost all teaching and therapeutic activities
- 6 persons were sceptical about NAO

Key quotes or messages:

Now, children are focused on technology. They see the simplicity of the technology but this technology has to be given in one way – a wise way, that it won't become the only determinant of activity.

4. **Robot learning outcomes teacher found:**
   - Better memorisation of skills
   - Better focus on tasks
   - Improved concentration
   - Improvement in behaviour
   - Positive emotions
   - Faster assimilation of new content

NAO was seen as:

- attractive teaching mediator
- model of accepted behaviours
- speech therapy tool
- patient and calm teacher
- an instructor giving precise orders and quick feedback
- an attractive toy

5. **Robot pedagogy – pros: NAO was seen as:**
   - attractive teaching mediator
   - model of accepted behaviours
   - speech therapy tool
   - patient and calm teacher
   - an instructor giving precise orders and quick feedback
   - an atractive toy

Possible methods with NAO robot:

Imitation (for ASD and ID as well as CD pupils)
Space orientation training (vision impaired pupils)
Social interaction (communication, social adjustment)
Instructional lessons

Main teachers proposals:

Activity	description	Students involvement	Robot role	Teacher involvement
Model of behaviour	Robot presents particular behaviour	imitatation	Positive influence	Controling, coordination
Robot –speech therapist	Robot presents particular verbal	Imitate and answer in adequate way	Active teacher	Controling, coordination assistance

	behaviour			
discrimination	Robot names the picture	Active participants Task implementer	Active leader	Implementer of main teaching goals
To demonstrate, to give information	Robot present some action and give information how do the task	Student observe and follow the information or instruction	To communicate, to teach,	Organize the teaching goals and Observe the students' progress
Social engagement	Robot move among students in reference to some rules and regulations	Students do the tasks and communicate with classmates	Stimulate the engagement and positive affect	Organizes the goals, and the rules, follows the progress
Social skills	Robot move among students to stimulate their social skills	Students communicate with classmates	Stimulate the engagement and positive affect	Organizes the goals, and the rules, follows the progress
Challenge behaviour control	Robot presents positive behaviours	Imitation and improvement of emotional and behavioural personal control	Stimulate accepted behaviours	Observes the students and follows the progress

robot pedagogy – cons; NAO was seen as:

- Potential danger for psychological and social development
- Technological teaching mediator
- The toy catching child attention
- The gadget stimulating hyperactivity

6. Theme: Reaction to introducing robots (including barriers)

Description: Summarise the key quotes/messages according to the sub-themes listed below.

a) ***Teacher based:***

- In general overview all professionals liked NAO robot and his range of functions and would be happy to have the possibility to train activities with robots.

Barriers:

- *The lack of programming skills –*
- *fear and emotional stress*

b) ***Robot-based:***:

- *Robot was accepted as very attractive object*

Barriers:

- *financial barrier !*
- *Delicate set construction- can be broken by students*
- *voice and gestures are not natural*

c) Organisational based:

- *The school administration is not allowed to decide about the expanses and have limited resources*
- *Financial limitations in education*
- *the lack of acceptance at governmental level*
- *the space limitations in particular schools*

d) Pupil based:

- *Robot as motivating and engaging set*
- *Teachers mentioned engagement, motivation and behaviour improvement trough positive emotions and enjoyment.*

Barriers:

- *Increasing challenging behaviour*
- *Decreasing motivation and discipline*
- *Stress and fear at first introduction*
- *Empowerment of bad habits*

7. Theme: Other

Main conclusion: The robot is an interesting tool for the boys.

Key quotes or messages: *"I have boys in the group who would cut themselves for a robot, they would simply do with it everything"*