Educational Robotics
for Students with Learning Disabilities

Learning with Robotics Curriculum and Learning Scenarios

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

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Executive Summary

This document outlines the learning robotics curriculum by describing a methodology of adapting robot based learning scenarios to the learning needs of a student based on the curriculum within which teaching is to take place. Interviews with key stakeholders identify key learning areas (understanding cause and effect, imitation, communication, problem solving and social learning) that can be used to classify the learning needs of a student. These learning areas were further used to identify base robotic interactions which were then utilised to develop a more complete range of robotic scenarios within these key learning areas. With these areas and robotic scenarios available there exists a need to identify when and how they should be implemented within existing and possibly diverse curricula. Such an approach, outlined in this document, utilises these generic learning areas to identify both the learning needs of the student, by mapping to whatever curriculum requirements may exist, and to identify suitable robotic learning scenarios for the student. This approach can be summarised as follows:

- Identify the learning needs of the student including their level of capability.
- Match these needs to the appropriate learning area outline above.
- Identify the learning objectives to be achieved within the appropriate curriculum.
- Identify the potential learning scenarios derived from that robotic learning area that allows the learning objective to be achieved.
- Map the curriculum requirements to the learning scenario (i.e. if necessary customise learning scenario elements to meet learning requirements).
- Utilise within a standardised lesson plan for implementation into everyday teaching activity.

Two examples of this method are provided that utilise the "P-Scale" (UK Department for Education, 2014[1]) criteria for students within UK education who are not yet ready to access the national curriculum. A student's defined P-Level as recorded by teachers is used to map to the appropriate learning area defined by the EDUROB project. For example, a student identified as P-scale 4 in physical education ("Pupils' movement patterns are established and they perform single actions") would have the following learning objective: Respond to simple commands. This would appear to map well to the learning area dealing with imitation and hence will allow the teacher to examine the appropriate learning scenarios that area classified within this learning area for use within curriculum based lesson plans.

[1] UK Department for Education (2014); Performance – P Scale – attainment targets for pupils with special educational needs; July 2014, Reference: DFE-00484-2014; available from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/329911/Performance_-_P_Scale_-_attainment_targets_for_pupils_with_special_educational_needs.pdf at 22/02/2017

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Definition:

This document consists of a set of the curriculum and learning scenarios based on the EDUROB pedagogy, interviews and survey carried out with stakeholders. It is expected that the content of the learning objects for the scenarios will be scoped by the user groups in each partner country. The first task is the mapping of learning areas identified in the interviews with teachers as being suitable for use with robots to established national curricula for special education needs in each of the partner countries. Many of the Example Learning Scenarios can be used in combination with the Customised Interface for Robotic Driven Interaction Model (D3.5).

Glossary of Terms:

The following describe the key terms used throughout this document.

Learning Area: a generic description of a learning domain that describes the intended focus of teaching. The learning areas described in this document can be considered hierarchical targeting the needs and capabilities of the students ranging from simple demonstration of cause and effect through to advanced problem solving. These can be used to classify learning scenarios and to identify the learning needs of a student thereby identifying appropriate learning scenarios.

Robotic Interactions: Statements of discrete student-robot interactions. These can be used as building blocks to create complex learning scenarios.

Learning Scenarios: An outline of a robotic teaching session that is made of robotic interactions along with curriculum content and will sit within one or more learning areas; the intention being that the learning scenario can be used in pursuit of fulfilling the objectives of that learning area. A set of Example Learning Scenarios have been defined as ELS A to V**.**

Curriculum Requirements from D3.2 Pedagogy Requirements:

In the EDUROB application the use of robots with our target groups in acquiring a range of social, communicational and work-related skills was envisaged.

Pedagogy requirements arising from interviews and focus groups exploring the potential use of robotics within current teaching practice gained data regarding the potential use of a robot in teaching students with learning disabilities. This theme examines current practice in teaching across countries and suggests that a range of learning outcomes is required that are scalable due to the heterogeneous nature of the target population, and that maintaining engagement is a vital success measure employed by teachers.

Other curriculum related requirements that have emerged from the interviews include that a robot-based pedagogy must:

- Allow for a wide range of learning outcomes that are required for the student cohort.
- Maintain engagement in target students.
- Consist of 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
- Encourage interaction through a variety of tactile, verbal and visual stimuli.

One of the interesting requirements here would be the ability to plug-in to existing curricula used in special education across the partner countries, where teachers adapt the learning scenario examples to produce a personalised curriculum to cope with the large within group variations in

skills and capabilities (e.g., Using P Scales in the UK, that of the Ministry of Education Directorate of Special Education in Turkey etc).

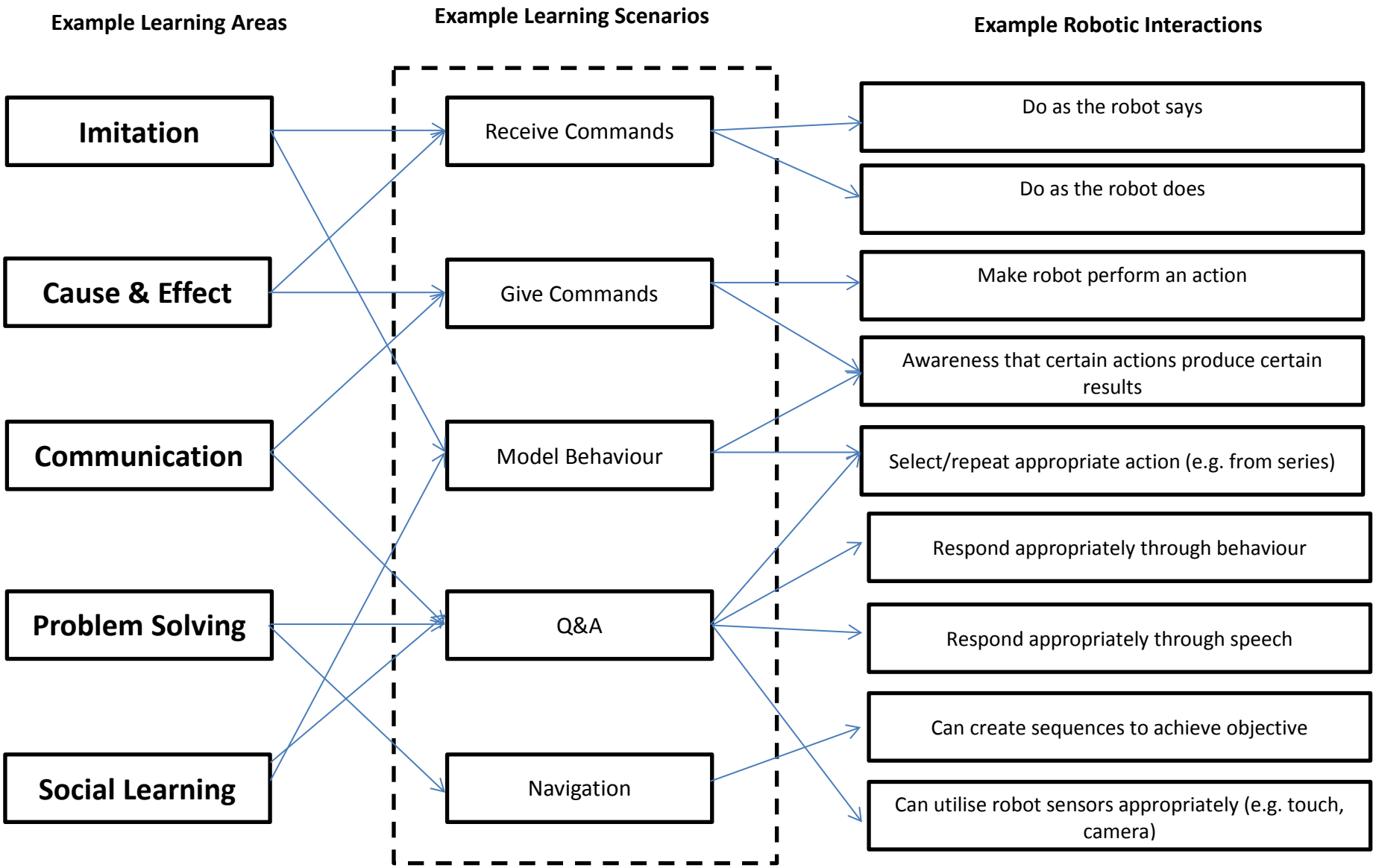
Flexible and scalable learning outcomes (LOs) should be provided under the 5 learning areas identified in the interviews with a series of associated tasks that enable these LO's to be reached. This method will allow for a "plug and play" approach to be achieved that is adaptable to fixed curriculum and also to less formal teaching sessions. In order to determine the way in which robots could be introduced to the classroom in terms of pre-determined tasks and their intended learning outcomes, the NAO robot was first demonstrated to participants (SEN teachers), who then gave examples of potential tasks that could be achieved. From these example tasks a range of learning scenarios were identified that cover the potential learning requirements of participants within this project. In summary these following **'Learning Areas'** were identified across the partner countries:

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

These key learning areas can be used to classify the capabilities and therefore the learning objectives of a student within this project but can also be utilised to develop a range of potential scenarios for robotic implementation, derived across the partner countries based on the needs and requirements of the curriculum in question. These learning areas in tandem with the example scenarios to develop a range of key robotic interactions which distil any potential activity into the base behaviours available the intention of which is to provide a framework for developing further learning scenarios and a method of adaption to curriculum based teaching activities across the diverse needs found in this project. An overview of this process is provided in the mapping figure found on the following page. To summarise the approach:

- Interviews with key stakeholders found the requirements for adapting robotics to curriculum across partner countries.
- These interviews also highlighted some example robotic scenarios which were commonly reported across partners.
- These common scenarios were used to derive both learning areas that the robots can be used within and core robotic interactions that can be used to develop other robotic learning scenarios. These generic **'robotic interactions'** are as follows:
    - Make the Robot perform an action with speech RI 1
    - Make the Robot perform an action with button press RI 2
    - Make the Robot perform a certain action from a range of options RI 3
    - Recognise Robot actions RI 4
    - Do as the Robot says RI 5
    - Do as the Robot does RI 6
    - Copy a sequence of robot actions RI 7
    - Follow a sequence of spoken robot instructions RI 8
    - Respond Appropriately through behaviour RI 9

- Respond Appropriately through Speech RI 10
- Can create sequences of input to achieve an objective RI 11
- Can utilise robotic sensors appropriately (e.g. touch, camera) RI 12


Example Learning Areas
Example Learning Scenarios
Example Robotic Interactions
Imitation
Cause & Effect
Communication
Problem Solving
Social Learning
Receive Commands
Give Commands
Model Behaviour
Q&A
Navigation
Do as the robot says
Do as the robot does
Make robot perform an action
Awareness that certain actions produce certain results
Select/repeat appropriate action (e.g. from series)
Respond appropriately through behaviour
Respond appropriately through speech
Can create sequences to achieve objective
Can utilise robot sensors appropriately (e.g. touch, camera)

These base robotic interactions provide the core building blocks for creating further robotic learning scenarios that fit within one or many of the pre-defined learning areas also developed from the stakeholder interviews. In total, 22 example learning scenarios were proposed by partners based on these learning areas and robotic interactions which can be “plugged” into existing partner countries curricula based on the specific needs of learners present within each. This collated list of learning scenarios can be found within the Example Learning Scenarios section of this document.

Each learning scenario, as described in this document, outlines the way in which the robots proposed for use in this project may be implemented in the classroom for teaching. To this end the sequence of robot interactions that are required to achieve a certain learning objective are outlined. These form exemplar specific robotic learning scenarios that can be adapted and utilised to the specific requirements of curricula and to specific learners within the project and beyond.

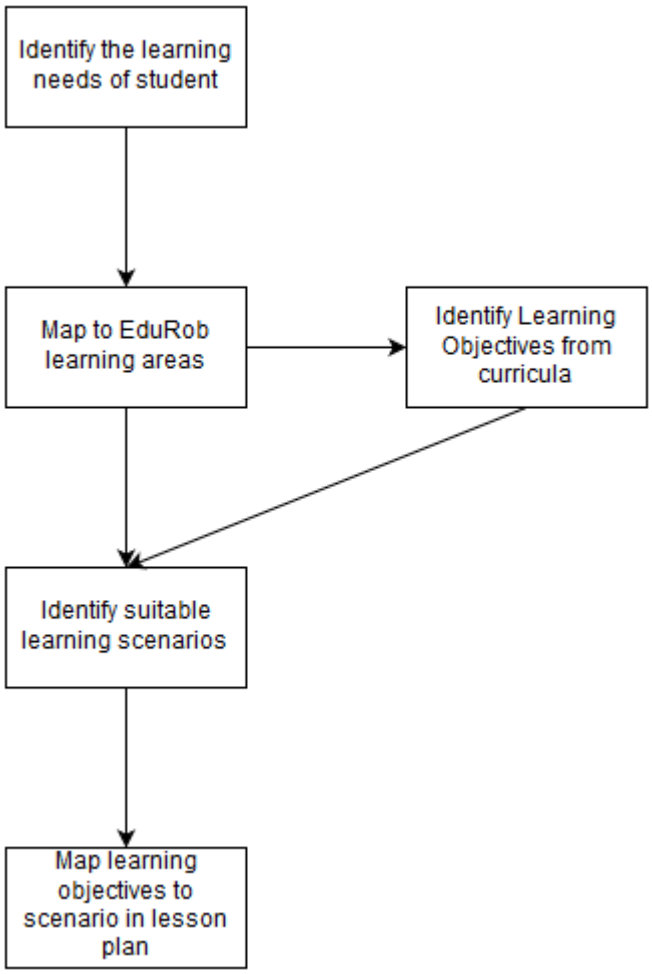
Mapping to Partner Curricula

While the learning scenarios described in the appendices provide an overview of examples of implementation - they do not demonstrate adaptation to the curriculum needs across a diverse target audience. Given the unique demands found across teaching institutions a specific outline of a robotic curriculum is impractical. Instead, this document seeks to provide a methodology to adaption that utilises the robotic learning scenarios derived from the key stakeholder surveys and interviews.

This methodology can be described in the following steps:

- Identify the learning needs of the student including their level of capability.
- Match these needs to an appropriate learning area.
- Identify the learning objectives to be achieved within the appropriate curriculum.
- Identify the potential learning scenarios derived from that robotic learning area that allows the learning objective to be achieved.
- Map the curriculum requirements to the learning scenario (i.e. if necessary customise learning scenario elements to meet learning requirements).
- Utilise within a standardised lesson plan for implementation into everyday teaching activity.

This can be outlined as the following figure:



Example Implementation of Approach

Special education within the UK utilises "P-scales" (UK Department for Education, 2014[2]) which supplement the national curriculum by specifying performance attainment targets and performance descriptors for pupils aged 5-16 with special educational needs (SEN) who 'cannot access' the national curriculum. Please see the document reference below for more complete guidance.

In the first step of the proposed methodology, P-scales may be utilised by teachers to gauge the capabilities and learning needs of a student in a particular national curriculum subject. For example, a student identified as working towards P-scale 4 in physical education ("Pupils' movement patterns are established and they perform single actions") would have the following learning objective:

- Respond to simple commands

This would appear to map well to the imitation learning areas identified through stakeholder

[2] UK Department for Education (2014); Performance – P Scale – attainment targets for pupils with special educational needs; July 2014, Reference: DFE-00484-2014; available from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/329911/Performance_-_P_Scale_-_attainment_targets_for_pupils_with_special_educational_needs.pdf at 22/02/2017

interviews allowing for robotic learning scenarios dealing with imitation to be examined for suitability within a standard lesson plan and teaching activity. A full set of P-Scale mapping can be found in Appendix 2, and also each Example Learning Scenario given in this document is mapped against a set of specific p-scale criteria it may help a student to achieve.

A number of potential scenarios may be appropriate for encouraging imitation and choice would

Context & Profile				
Author: THR	**Title:** Practise movements when commanded to do so.	**Timescale:** 20 Minutes	**Year group:** 10-11	**No in group:** One
Relevant contextual information on learners: Multiple and profound disabilities. Aims to successfully perform physical movement with purpose and under direction.				
How does this lesson fit into the subject curriculum or the wider curriculum?		Prior learning of learners		
Main subject area: Physical Education **Wider Curriculum:** Addressing and working toward P-Level 4.		Has interacted with the robots before and is familiar with the activity. Focus in the past was on motor movement of the upper body.		
The Learning				
Groups	Intended progress (Learning Objectives)	How will this progress be demonstrated?	Assessment of progress by…	
N/A	Successfully imitate the movement of the robot. Repeat imitation under instruction to demonstrate reinforcement	Imitate movement when commanded to do so with repetition.	Teacher	
Organisation				
Resources: NAO robot Robot Control Application on Android device Robotic Interaction: RI 6 – Gross Motor Imitation Example Learning Scenario ELS 4 – Gross Motor Imitation		**Learners:** Individual learner with multiple and profound disabilities.		

Timings	**Content**		
To start with…		**Cognitive / Behavioural**	**Learning scenario***
5Mins	Robot Set-up and demonstration by teacher	B	ELS 4
Main learning			
10Mins	Robotic Activity: robot demonstrates movement to be imitated and the student imitates – Focus on lower body movement (sit down, stand-up etc). Successful imitation will elicit reward behaviour from the robot. This is to be repeated until imitation upon command is clearly demonstrated by the student.	B	ELS 4
Plenary / extension			
5Mins	End of session: Check learner fatigue. Elicit final reward behaviours prior to concluding session. Initiate appropriate robot behaviour to finish prior to packing up the robot (e.g. wave goodbye).	B/C	ELS 4

ultimately depend on the learning objectives to be achieved. Given the example here deals with physical education, learning scenario ELS04 (see following section), Gross Motor Imitation, may

be appropriate for utilisation within a teaching session. Therefore, the following lesson plan may be derived in conjunction with the learning scenario outline found ELS04:

*Learning Scenario key: FG – Full group, SG – Small group (including partners), I – Individually

*Cognitive/Behavioural Key: C – Cognitive; B – Behavioural

Example 2 Implementation of Approach

To take another example from the P-Scale curriculum found in the UK, P level 5 for listening describes the student's ability to respond appropriately to questions regarding family or events and experiences. This may have the associated learning outcome of assessing their ability to follow requests and instructions containing at least two key words, signs or symbols. This would map well to the learning areas of problem solving (to identify relevant key concepts and responses) and perhaps also communication. From the learning scenarios listed proposed, ELS03 or ELS05 (see next section) would appear to be well suited to providing a means of working toward this learning outcome. These scenarios' basic structures are of a question and answer session with the option of a number of questions to be asked in a succession, perhaps dealing with a specific theme. To work toward the stated learning objective the robot could be programmed to ask relevant questions in a series regarding a topic that suits the needs of the teaching at the time. This could be translated into the following lesson plan:

<table>
<tr><th colspan="5">Context & Profile</th></tr>
<tr><td>Author:
THR</td><td>Title:
Answer questions regarding learners family or recent events, or have a simple introductory chat</td><td>Timescale:
20 Minutes</td><td>Year group
10-11</td><td>No in group:
One</td></tr>
<tr><td colspan="5">Relevant contextual information on learners:
Multiple and profound disabilities. Aims to successfully elicit appropriate responses from the learner when questions regarding the student's family or recent events are posed.</td></tr>
<tr><td colspan="2">How does this lesson fit into the subject curriculum or the wider curriculum?</td><td colspan="3">Prior learning of learners</td></tr>
<tr><td colspan="2">Main subject area:
Listening
Wider Curriculum:
Addressing and working toward P-Level 5.</td><td colspan="3">Has interacted with the robots before and is familiar with the activity.</td></tr>
<tr><th colspan="5">The Learning</th></tr>
<tr><td>Groups</td><td>Intended progress (Learning Objectives)</td><td colspan="2">How will this progress be demonstrated?</td><td>Assessment of progress by…</td></tr>
<tr><td>N/A</td><td>Successfully answer questions posed by the robot.

Answer a series of questions posed by the robot.</td><td colspan="2">Answer questions appropriately when posed by the robot</td><td>Teacher</td></tr>
<tr><th colspan="5">Organisation</th></tr>
<tr><td colspan="3">Resources:
NAO/EV3 robot
Robot Control Application on Android device
Robotic Interaction: RI 10 – Respond appropriately through speech
Example Learning Scenario: ELS03 – Chatting
Example Learning Scenario: ELS05 – Questions and Answers</td><td colspan="2">Learners:
Individual learner with multiple and profound disabilities.</td></tr>
</table>

Timings	Content		
To start with…		**Cognitive / Behavioural**	**Learning scenario***
5Mins	Robot Set-up and demonstration by teacher	B	ELS03
Main learning			
10Mins	Robotic Activity: robot asks a question from a pre-programmed series of questions. After each questions the robot pauses for a response from the learner. The series may contain from between 5 to 10 questions that deal with asking for generic details regarding the learner's family or recent events. Successfully answering the question will elicit reward behaviour from the robot initiated by the teacher from the tablet application. The application can further be utilised to go to the next question or repeat if a question if it hasn't been understood.	B/C	ELS03
Plenary / extension			
5Mins	End of session: Check learner fatigue. Elicit final reward behaviours prior to concluding session. Initiate appropriate robot behaviour to finish prior to packing up the robot (e.g. wave goodbye).	B/C	ELS03

*Learning Scenario key: FG – Full group, SG – Small group (including partners), I – Individually

*Cognitive/Behavioural Key: C – Cognitive; B – Behavioural

These two examples demonstrate an approach where the UK p-scale criteria a student is working towards, are used as a means of identifying the learning needs of that student. From this, a mapping to the learning areas and example learning scenarios developed as part of the EDUROB project is drawn.

Outside the UK, the P-Scales, as a first step in this method, can be replaced by the specific curriculum attainment criteria applied in the local learning system in which the robot pedagogy is to be implemented. Conversely where there is little guidance or specific criteria for assessing the needs of SEN learners the P-Scale mapping found in this document can be utilised in conjunction with the approach outlined for identifying the most effective means of implementing a robotic pedagogy within the needs of the teaching and associated curriculum.

Robotic Interactions

RI 1 – Make the robot perform an action using speech – (NAO/EV3)

Generic Description

Teacher demonstrates saying target word. Robot responds. Student copies target word. Robot responds with reward.

Process

The teacher/therapist states a target word.

The robot responds appropriately (e.g. with a dance, applause, repeats the word) triggered by 'Wizard of Oz' button press by teacher therapist.

The student must imitate this target word to reproduce the response behaviour from the robot.

The teacher may prompt the student speak the target word.

The reproduction of the target word from the student evokes the reward behaviour from the robot (again by 'Wizard of Oz' button press).

Learning Areas

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

Required robotic subroutines:

- Pre-built response behaviour (appropriate to student's preference).
- Behaviour linked to touchscreen button in app.

RI 2 – Make the robot perform an action using button press – (NAO/EV3)

Generic Description

Teacher demonstrates pressing button. Robot responds. Student copies button press. Robot responds with reward.

Process

The teacher/therapist presses the button (e.g. could be a button on the robot, a jellybean switch, a button on the tablet touchscreen).

The robot responds appropriately (e.g. with a dance, applause, repeats the word) triggered by linkage to the switch.

The teacher/therapist prompts the student to press the switch.

The student must press the switch to reproduce the response behaviour from the robot.

Learning Areas

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

Required robotic subroutines:

- Pre-built response behaviours (appropriate to student's preference).
- Behaviour linked to either:
  - sensor on robot
  - touchscreen button in app
  - suitable accessible switch device

RI 3 – Make the Robot perform a certain action from a range of options (EV3/NAO)

Generic Description

Student prompted to press a particular button from multiple buttons. Student responds with button press. Robot responds dependent on which button pressed.

Process

The teacher/therapist prompts the student to press a particular button.

Buttons on the interface are labelled with symbols, pictures or words.

Student presses a button.

Robot responds with correct response if correct button is pressed (or incorrect button response if incorrect button pressed).

Example layouts:

- A remote control with forward backward left and right buttons.
- A set of motions for NAO (eg sit, stand, lay down, wave)

Learning Areas

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

Required robotic subroutines:

- Set of appropriate robot actions (motions, movements, speech or poses)
- Layout of buttons on Edurob App linked to the desired robot actions.

RI 4 – Recognise Robot Actions (NAO/EV3)

Generic Description

Robot performs an action. Student selects this action card. Robot responds to card selection.

Process

The robot performs an action (eg stand up, sit down, dance, draw a shape, move in a shape display a shape on a screen, display a colour etc). The action is represented on one of a number of cards.

The robot (or teacher/therapist) asks “Which card was that?”

The student tries to pick the card for the action that has been demonstrated.

The robot responds appropriately for student and their given response with a correct, try again or reward behaviour. Correct and try again behaviours may be generic. Reward behaviours can be personalised interactions (e.g. dance to a favourite tune of the student, do something that student finds funny or entertaining).

Learning Areas

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

Required robotic subroutines:

- Text-to-speech (NAO) or pre-loaded robot voice command sounds (EV3) - for robot prompts.
- Pre-built motions for demonstrating the target robot actions.
- Pre-set interactions for ‘Wizard of Oz’ reward.
- Pre-set interactions for ‘correct’ and ‘try again’.

Other items required:

- Set of cards with appropriate pictures

RI 5 – Do as the robot says (Follow verbal instructions) (NAO/EV3)

Generic Description

Robot gives a verbal instruction. Student tries to follow instruction. Robot gives reward behaviour or feedback.

Process

Robot gives verbal instruction.

Student attempts to follow instruction.

Robot gives reward if student follows instruction correctly. Robot gives feedback if student follows instruction wrongly. Detection could be by sensors or by ‘Wizard of Oz’ button press.

Learning Areas

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

Required robotic subroutines:

- Text-to-speech for commands (NAO) or pre-recorded and loaded speech (EV3).
- Preloaded Behaviours and feedback given (dependent on type of instruction given) via either:
    - Robotic sensors detection
    - 'Wizard of Oz' response fired by teacher/therapist.

RI 6 – Do as the robot does (Gross-motor imitation) (NAO/EV3)

Generic Description

The robot produces a movement. The student imitates that movement. The robot produces a reward behaviour.

Process

The robot demonstrates a movement to the student.

The robot or the therapist/teacher encourage the student to copy.

Successful imitation produces reward behaviour.

Learning Areas

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

Required robot interactions:

- List of pre-built robotic movements (e.g open arms, raise both arms, put hands on head, hug, hands together.
- Pre-set interactions for 'Wizard of Oz' reward.

RI 7 – Copy a sequence of robot actions (Gross-Motor Imitation Sequence) (NAO/EV3)

Generic Description

The robot produces sequence of movements. The student repeats the sequence of movements. The robot produces a reward behaviour or feedback behaviour.

Process

The robot says, "Watch me and remember what I do!"

Robot **does** a sequence of actions.

Robot asks the student to copy the sequence.

The student repeats.

If correct: WoO congratulations or reward

If incorrect: Try again responses

Learning Areas

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

Required robotic subroutines:

- Text-to-speech for commands.
- Pre-built actions to mimic.
- Ability to sequence actions together.
- WoO reward behaviour.

RI 8 - Follow a sequence of spoken robot instructions

Generic Description

The robot gives a sequence of verbal instructions. The student carries out the instructional sequence. The robot produces a reward behaviour or feedback behaviour.

Process

The robot says, “Listen to my instructions. I will ask you to do 3 things. When I have told you all 3 you can start.”

Robot **speaks** a sequence of actions.

Robot asks the student to start.

The student tries to follow the sequence.

If correct: WoO congratulations or reward

If incorrect: Try again responses.

Learning Areas

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

Required robotic subroutines:

- Text-to-speech for commands.
- Pre-built actions to mimic.
- Ability to sequence actions together.
- WoO reward behaviour.

RI 9 – Respond appropriately through behaviour (Recognise images/symbols) (NAO/EV3)

Generic Description

Robot asks student for a particular card. Student shows card. Robot responds with appropriate behaviour.

Process

The robot/teacher/therapist asks the student to find a particular card based on some criteria (e.g. find the elephant, find the red object, find the biggest object, a Makaton symbol)

The student shows a card to the robot.

If correct, the robot plays an appropriate behaviour (e.g. the robot plays a sound of trumpeting elephant, the lights on the robot flash red, applause, student's favourite dance) via robot sensors (e.g. camera recognition on NAO) or 'Wizard of Oz' button press.

If not correct robot plays try again routine.

Learning Areas

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

Required robot interactions:

- Text-to-speech for commands (NAO) or pre-recorded requests (EV3)
- Pre-programmed robot behaviours relevant the cards shown/student preferences – responses will depend on cards available and context of the scenario.
- With NAO can use camera automatic card recognition or 'Wizard of Oz'.
- Try again behaviour

Other items required:

- Set of cards with appropriate pictures

RI 10 – Respond appropriately through speech (Question and Answer) (NAO/EV3)

Generic Description

Robot asks a question. Student replies to question. Robot gives appropriate response.

Process

The robot asks a question (fired by teacher/therapist using Wizard of Oz' button press).

The student responds with the answer.

Successful response initiates student specific robotic reward behaviour.

Unsuccessful response elicits robot encouragement behaviour.

Learning Areas

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

Required robot interactions:

- Text-to-speech to build the questions (NAO) / audio files for the questions (EV3)
- Triggering of questions.
- Triggering of reward behaviour.

RI 11 - Can create sequences of input to achieve an objective

Generic Description

Teacher/therapist asks student to program a sequence to move the robot from a to b. Student presses sequence of buttons and go. Robot moves through sequence.

Process

The student has to navigate the robot from A-B to achieve objective by programming a sequence of movement commands and then hitting a go button. This utilises a multi-button interface on the tablet app or the EV3 brick buttons.

Successful end can trigger reward behaviour.

Failure results in missed end-point *or* collision if using barriers.

Learning Areas

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

Required robotic interactions:

- Sequencer for stepwise moves and turns to be triggered when ready.
- Stepwise movement behaviours.
- WoO reward behaviour for completion.

Other items required:

- Navigable course/ mat/ obstacles /targets

RI 12 - Can utilise robotic sensors appropriately (NAO/EV3)

Generic Description

Teacher/therapist asks student to trigger a sensor. Student triggers the sensor. Reward behaviour is performed.

Process

The student is asked to trigger a sensor (e.g. move close to Ultrasonic sensor, hold red to a colour sensor, clap, press a button/touch sensor)

The student tries to trigger the sensor.

Prompts or demonstrations could be given if necessary.

If done correctly a reward is given.

Learning Areas

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

Required robotic interactions:

- Ability to tie sensors to robotic behaviours (or use ‘Wizard of Oz’ button press for reward behaviour).

Example Learning Scenarios

ELS 01 - Geometrical shapes – count and learn shapes with the robot

Scenario Title Geometrical shapes – count and learn shapes with the robot	
Description	The objective of this activity is to improve counting skills from 1 to 10 and to make the student aware of the geometrical shapes square, rectangle, circle and triangle. The complexity of the task is adjustable dependent on the student's learning ability level.
LS Type	Give Commands
Learner Profile	Students with mild or moderate learning difficulties.
Learning Area	**1.** ☐ Imitation – reinforcing behaviour. 2. ☒ Cause and Effect – associating action with behaviour. 3. ☒ Problem solving – through spatial reasoning, coordination. 4. ☒ Communication – improving speaking and listening. 5. ☐ Social Learning – how to act, appropriate behaviour.
National Curriculum Subject Attainment Targets (UK P-Scale) by Learning Area	• Cause and effect o Using and applying mathematics P4 - Pupils are aware of cause and effects in familiar mathematical activities • Problem solving – o Using and applying mathematics P5 - Pupils sort or match objects or pictures by recognising similarities o Using and applying mathematics P7 - Pupils complete a range of classification activities using a given criterion. (specifically shapes space and measures "They pick out described shapes from a collection" o Using and applying mathematics (Number) P6 **-** Pupils demonstrate an understanding of one-to-one correspondence in a range of contexts. Pupils join in rote counting up to five • Communication o English (Speaking) P4 - Pupils repeat, copy and imitate between 10 and 50 single words, signs or phrases or use a repertoire of objects of reference or symbols

Learning Objectives	**Resources**	**Associated Robotic Interactions**
Solve problems involving counting and shape	Edurob Robot Controller **EV3** - files: part 1 – Geometric Shapes	RI 3 Make the Robot perform a certain action from a range of options

recognition	(EV3) EV3_ELS01p1.zip (Download) part 2 – EV3 counting moves app ELS01p2.zip (Download) part 3 – Stepwise Remote Control (EV3) ELS01p3.zip (Download) **NAO** - part 1 – NAO_ELS01_p1.zip (Download) part 2 – NAO_ELS01_p2.zip (Download) part 3 – NAO_ELS01_p3.zip (Download) Student appropriate reward behaviours or NAO_RandomisedFeedback.zip (Download).	RI 11 Can create sequences of input to achieve an objective

Session Outline

Set-up

NAO ensure the robot has the program “Shapes4.crg” installed.

EV3 ensure the robot has the program “ShapesGyro.ev3” installed.

The robot uses a set of pre-programmed actions – to demonstrate shapes. This will be:

- For NAO – draw shapes in the air with the hands.
- For EV3 – move on the floor in the shape by a series of movements and turns.

The (EV3) robot can also do stepwise movements with cards (e.g. Move forwards 1 unit, Move forwards 2 units, Rotate 90 degrees to the right, Rotate 120 degrees to the right) to enable students to make their own shapes.

The input can be done by:

- Cards with numbers (colour coded for EV3, Naomarked cards for NAO)
- By spoken triggers (using ‘Wizard of Oz’ teacher control for given answer)
- By speech recognition in NAO (only for clear speakers)

Steps

Part 1 (using RI 3)

The student has to recognise geometrical shapes and to guide the robot to draw the shape by showing appropriate card.

The teacher (or the robot) asks the student to find a particular shape.

The student provides input through the cards or by spoken commands.

The teacher or the robot depending on setup evaluates the student's answer. Reward/feedback is called by either 'Wizard of Oz' button press or by sensor linkup (camera on NAO or colour sensor on EV3).

Reward - Robot draws correct shape and plays rewarding sound/action.

Part 2 (using RI 3)

The student has to recognise different numbers by choosing the card with the number requested and showing to the robot to make it go the appropriate number of steps.

Teacher asks the student to select a number card.

Student selects right card, then the robot moves that number of steps.

Student selects wrong card, then the robot gives try again feedback.

Part 3 (using RI 11)

The student has to navigate the robot to draw requested shape.

The teacher describes to the student a shape to move the robot in. The student shows cards with the appropriate numbers of how many steps to go forward, or how far to turn, in order to make the robot create the shape. The difficulty may be altered by changing the number of card choices and the complexity of shapes.

The result is evaluated by the teacher.

Feedback/reward is provided after student finishes their shape by the teacher using 'Wizard of Oz'.

End-Goal

Correctly choose appropriate number/order of the robot running steps and turns in order to draw correct geometrical shapes.

Robot role	The robot will move at the student's order. The robot acts as: - Illustrator – showing visually how the geometric shapes look - Feedback/reward mechanism – after choosing correct shape will play rewarding sound/action.
Teacher role	Set-up the robot actions – the driving distances appropriate to number, turning angles; driving/drawing full shapes of square,

	rectangle and triangle. 'Wizard of Oz' controls where necessary. Evaluate the student navigated drawing of shapes.
Assessment criteria	Number of correctly chosen cards for appropriate shape (NAO and EV3) Correctly navigating shapes – the square, rectangle and triangle with the robot (EV3).
Feedback method	Feedback is given through the robot via 'Wizard of Oz' button press It uses a student appropriate pre-programmed reward behaviour.
NAO Keys	**Part 1:** ▪ Key: "ShapesSquare" – Robot says "A square is a shape with 4 sides" and draws a square in the air twice. ▪ Key: "ShapesCircle" – Robot says "A circle is round like a ball" and draws a circle in the air twice. ▪ Key: "ShapesTriangle" – Robot says "A triangle has 3 sides" and draws a triangle in the air twice. ▪ Key: "askSquare" – Robot asks "Can you find the Square?" ▪ Key: "askCircle" – Robot asks ""Can you find the Circle?" ▪ Key: "askTriangle" – Robot asks "Can you find the Triangle?" **Part 2:** ▪ Key: "Steps1" – Robot steps a few steps forwards ▪ Key: "Steps2" – Robot steps a few steps forwards, waits and then steps a few more steps forwards. ▪ Key: "Steps3" – Robot does three sets of steps forwards with pauses inbetween. ▪ Key: "Steps4" – Robot does four sets of steps forwards with pauses inbetween. ▪ Key: "Steps5" – Robot does five sets of steps forwards with pauses inbetween. ▪ Key: "Stand" – Robot stands up straight (walking pose is a slight squat) **Part 3:** ▪ Key: "RemoteStepLeft" – Robot steps a few steps to its left ▪ Key: "RemoteStepRight" – Robot steps a few steps to its right ▪ Key: "RemoteForward" – Robot steps a few steps forwards ▪ Key: "RemoteBackward" – Robot steps a few steps backwards ▪ Key: "RemoteTurnRight" – Robot turns 30 degrees to its right ▪ Key: "RemoteTurnLeft" – Robot turns 30 degrees to its left ▪ Key: "Stand" – Robot stands up straight (walking pose is a slight squat)

EV3 Program Paths	**Part 1:** Program path: “ELS01p1/MoveSquare” – Square (moves in a square) Program path: “ELS01p1/MoveTriangle” – Triangle (moves in a triangle) Program path: “ELS01p1/MoveCircle” – Circle (moves in a circle) Program path: “ELS01p1/welldone” – Random well done reward sound Program path: “ELS01p1/tryagain” – Random try again sound Program path: “ELS01p1/SaySquare” – Verbal description of square Program path: “ELS01p1/SayTriangle” – Verbal description of Triangle Program path: “ELS01p1/SayCircle” – Verbal description of Circle Program path: “ELS01p1/AskSquare” – Asks student to find the square Program path: “ELS01p1/AskTriangle” – Asks student to find the Triangle Program path: “ELS01p1/AskCircle” – Asks student to find the Circle **Part 2:** Robot can perform the following separate programs: Program path: “ELS01p2/MoveForward1” – move 1 step forwards Program path: “ELS01p2/MoveForward2” – move 2 steps forwards Program path: “ELS01p2/MoveForward3” – move 3 steps forwards Program path: “ELS01p2/MoveForward4” – move 4 steps forwards Program path: “ELS01p2/MoveForward5” – move 5 steps forwards Program path: “ELS01p2/welldone” – Random well done reward sound Program path: “ELS01p2/tryagain” – Random try again sound **Part 3:** Robot can perform the following separate programs: Program path: “ELS01p3/MoveForward” – move 1 step forwards Program path: “ELS01p3/MoveBackwards” – move 1 step backwards Program path: “ELS01p3/Turn90R” – turn 90 deg right Program path: “ELS01p3/Turn90L” – turn 90 deg left Program path: “ELS01p3/Turn30R” – turn 30 deg right Program path: “ELS01p3/Turn30L” – turn 30 deg left Program path: “ELS01p3/MoveArc” – move through an arc of 90 degrees. Program path: “ELS01p3/welldone” – Random well done reward sound Program path: “ELS01p3/tryagain” – Random try again sound

ELS 02 - Evoking a spontaneous request

Scenario Title Evoking a spontaneous request	
Description	The objective of this activity is to evoke a spontaneous request from the child, which is a fundamental prerequisite for interpersonal interactions
LS Type	Give commands
Learner Profile	ASD; poor communication/intentionality; speaking; 3-6 years; any cognitive level
Learning Area	1. ☒ Imitation – reinforcing behaviour. 2. ☐ Cause and Effect – associating action with behaviour. 3. ☐ Problem solving – through spatial reasoning, coordination. 4. ☒ Communication – improving speaking and listening. 5. ☒ Social Learning – how to act, appropriate behaviour.

National Curriculum Subject Attainment Targets (UK P-Scale) by Learning Area	• Imitation
	  o Languages P4 - Pupils attempt to repeat, copy or imitate some sounds heard in the target language
	• Communication
	  o Speaking P4 - Pupils repeat, copy and imitate between 10 and 50 single words, signs or phrases or use a repertoire of objects of reference or symbols
	  o Languages P5 - Pupils attempt one or two words in the target language in response to cues in a song or familiar phrase
	• Social Learning
	  o PHSE P4 - Pupils express their feelings, needs, likes and dislikes using single elements of communication (words, gestures, signs or symbols)

Learning Objectives	**Resources**	**Associated Robotic Interactions**
Spontaneous request/vocal imitation: the child asks the robot to do something without external prompts.	Reward behaviours: **EV3:** EV3_mp3Dance – a generic dance to which a student specific mp3 may be added. EV3_Encourage and Praise – an app containing a number of programs to call to offer encouragement or praise that	RI 1 Make the robot perform an action using speech

	appears to come from the robot. **NAO:** Dances and Songs – some specific dances and songs Song and Dance – a generic dance to which a student specific mp3 may be added Plane, Monkey, Elephant –the robot does impressions. Correct and Try again behaviours or NAO_RandomisedFeedback.zip (Download).	

Session Outline

Set-up

The child will be stimulated to produce a target word (the request) which in turn will activate the robot. To guarantee an immediate reaction from the robot, the therapist/teacher will use the tablet to initiate the chosen activity once the child has produced the target word (that is, speech-recognition systems will not be used). Variation is also important to differentiate reinforcement, so the same target word may produce different activities on the basis on the child's interests.

Ensure robot has the relevant robot behaviours which engage the particular student and will encourage the spontaneous vocalisation.

Ensure this can be fired from the Edurob Robot Communicator App.

Steps

Here we use the example robot behaviour as 'dance'

1. Training phase

a) The teacher/therapist looks at the robot and produces the target word. The teacher/therapist delivers the command from the tablet: the robot starts to dance
b) The robot dances for 10-15 seconds, then the teacher/therapist stops the robot using the tablet;
c) The teacher/therapist says again the target word, and again activates the robot. The robot starts to dance for 10-15 seconds, then the teacher/therapist stops it.

2. Learning phase

d) The student may react in 2 ways:
    a. Student says (repeats) immediately the target word to activate NAO

b. Student does not say the target word/she is not motivated

Case a: the child says the target word

c. The fact that the child has produced the target word is an example of imitation, We are expecting to evoke a spontaneous request. To do this, after the child has produced the target word for the first time (imitation), the therapist activates NAO for 10-15, then stops it. Once NAO is deactivated, the child is expected to produce spontaneously the target word.
    i. *If the child produces spontaneously the target word*, the therapist activates/deactivates NAO for max 6 times, then the learning activity is over.
    ii. *If the child does not produce spontaneously the target word,* the therapist gives the child a maximum of 2 prompts. If motivated, the child is expected to benefit from such prompts, the task of the therapist is to distinguish between imitation and spontaneous requests. In the latter case, see previous bullet point ("i")

Case b: She does not say the target word

d. The therapist repeats the training phases giving prompts 3 times. If the child does not respond, the activity is over. If the child reacts, see *Case a*.

End-Goal

The child produces spontaneous requests to the robot.

Robot role	Reward. Producing student desired behaviour to encourage interaction.
Teacher role	Control the robot; giving prompts; assessing the achievements
Assessment criteria	The child demonstrates a spontaneous request. The number of prompts and spontaneous requests over the sessions will be recorded. Improvement is indicated by fewer prompts and more spontaneous requests per session.
Feedback method	How is feedback given: Feedback is given through the robot via 'Wizard of Oz' button press It uses a student appropriate pre-programmed reward behaviour. Teacher/therapist will also offer praise/encouragement.
NAO keys	▪ Key: "CorrectAnswer" – Robot does one of a set of 10 praise interactions involving applause, cheering, speech and motions. ▪ Key: "TryAgain" – Robot does one of a set of 6 encouragement interactions, asking the student to try again. ▪ Key: "KeepGoing" – Robot asks the student to keep going. ▪ Key: "DontKnow" – Robot opens his arms and says, "I don't know"
EV3 program paths	▪ Program path: "EncouragePraise/welldone" – Random well done reward sound (verbal encouragement from 6 options)

	▪ Program path: “EncouragePraise/tryagain” – Random try again sound (verbal encouragement from 4 options) ▪ Program path: “EncouragePraise/fanfare” – fanfare sound ▪ Program path: “EncouragePraise/cheer” – Cheering/applause sound

ELS 03 - Chatting

Scenario Title Chatting	
Description	The aim of this scenario is to develop the student’s ability to sustain a very short conversation. The robot starts the conversation and the student provides the appropriate answer.
LS Type	Model behaviour
Learner Profile	ASD; poor communication/intentionality; speaking; 3-6 years; any cognitive level;
Learning Area	**1.** ☐ Imitation – reinforcing behaviour. 2. ☐ Cause and Effect – associating action with behaviour. 3. ☐ Problem solving – through spatial reasoning, coordination. 4. ☒ Communication – improving speaking and listening. 5. ☒ Social Learning – how to act, appropriate behaviour.
National Curriculum Subject Attainment Targets (UK P-Scale) by Learning Area	• Communication o Speaking P3 (ii) Pupils use emerging conventional communication o Speaking P4 - Pupils repeat, copy and imitate between 10 and 50 single words, signs or phrases or use a repertoire of objects of reference or symbols o Speaking P6 - Pupils initiate and maintain short conversations using their preferred medium of communication. They ask simple questions to obtain information [for example, ‘Where’s the cat?’] o Listening P4 - Pupils demonstrate an understanding of at least 50 words, including the names of familiar objects Pupils respond appropriately to simple requests which contain one key word, sign or symbol in familiar situations [for example, ’Get your coat’, ‘Stand up’ or ‘ Clap your hands’] o Languages P5 - Pupils attempt one or two words in the target language in response to cues in a song or familiar phrase o Languages P7 - Pupils introduce themselves by name in response to a question in the target language

	• Social learning o Listening P8 - Pupils take part in role play with confidence

Learning Objectives	Resources	Associated Robotic Interactions
Engaging in a conversation The student answers and asks questions without any prompt.	NAO file with these conversation elements or text to speech with these pre-typed. EV3 mp3 files for each element loaded as programs and triggered from tablet. file: EV3_ELS03.zip (Download)	RI 10 Respond appropriately through speech

Session Outline

Set-up

Requires for EV3, extraction and installation using Mindstorms software of:

- EV3_ELS03.zip
- & optionally EV3_EncouragePraise.zip

Requires for NAO, extraction and installation using Mindstorms software of:

- NAO_ELS03.zip
- & optionally EV3_EncouragePraise.zip

'Wizard of Oz' touchscreen presses by the teacher/therapist will trigger the robot speech.

The therapist uses the tablet to regulate the conversation. The loaded robot behaviours contain 3 scripts:

Script 1 (Speaking P3/P4 level)

1. **ROBOT:** HELLO
2. **Student:** HELLO

Script 2 (Speaking P6 level)

3. **ROBOT:** HELLO
4. **Student:** HELLO
5. **ROBOT:** WHAT'S YOUR NAME?
6. **STUDENT:** #### AND YOU?

7. **ROBOT:** ### (robot's name). HOW ARE YOU?

Script 3 (Speaking P6 level)

8. **ROBOT:** HELLO
9. **Student:** HELLO
10. **ROBOT:** WHAT'S YOUR NAME?
11. **STUDENT:** ####. WHAT'S YOUR NAME?
12. **ROBOT:** ### (robot's name). HOW ARE YOU?
13. **STUDENT:** FINE, AND YOU?
14. **ROBOT:** FINE.

i.e. There are 6 Robot phrases available:

1. **Hello + gesture (at the same time)**
2. Q: **How are you?**
3. Q: **What's your name?**
4. A: **Fine**
5. A: **### (robot's name).**
6. Q+A: **Fine, and you?**

Case a) the student answers properly: Success. Play an appropriate reward behaviour.

Case b) the student does not answer: The therapist gives prompts; the student may imitate the vocal prompts.

End-Goal

The student answers and asks questions without any prompt.

Robot role	Engage the student in conversation.
Teacher role	Control the robot. Prompt the student.
Assessment criteria	Number of prompts required.
Feedback method	Feedback is given through the robot via 'Wizard of Oz' button press It uses a student appropriate pre-programmed reward behaviour.
NAO keys	▪ Conversation (via TTS list) ▪ Key: "CorrectAnswer" – Robot does one of a set of 10 praise interactions involving applause, cheering, speech and motions. ▪ Key: "TryAgain" – Robot does one of a set of 6 encouragement interactions, asking the student to try again.

	▪ Key: “KeepGoing” – Robot asks the student to keep going. Key: “DontKnow” – Robot opens his arms and says, “I don’t know”
EV3 program paths	▪ Program path: “ELS03/hello” – Robot says, “Hello.” ▪ Program path: “ELS03/whatname” – Robot says, “What’s your Name?” ▪ Program path: “ELS03/myname” – Robot says, “My name is Sonny?” ▪ Program path: “ELS03/fine” – Robot says, “Fine?” ▪ Program path: “ELS03/howareyou” – Robot says, “How are you?” ▪ Program path: “ELS03/fineandyou” – Robot says, “Fine, and you?” ▪ Program path: “EncouragePraise/welldone” – Random well done reward sound (verbal encouragement from 6 options) ▪ Program path: “EncouragePraise/tryagain” – Random try again sound (verbal encouragement from 4 options) ▪ Program path: “EncouragePraise/fanfare” – fanfare sound Program path: “EncouragePraise/cheer” – Cheering/applause sound

ELS 04 - Gross-motor imitation

Scenario Title Gross-motor imitation	
Description	The robot does an action and the student has to copy it. For nao it may be more arms and body related. EV3 must use steps and turns.
LS Type	Receive commands
Learner Profile	ASD; poor communication/intentionality; speaking; 3-6 years; any cognitive level;
Learning Area	**1.** ☒ Imitation – reinforcing behaviour. 2. ☐ Cause and Effect – associating action with behaviour. 3. ☐ Problem solving – through spatial reasoning, coordination. 4. ☐ Communication – improving speaking and listening. 5. ☐ Social Learning – how to act, appropriate behaviour.
National Curriculum	• Imitation: o Physical Education P4 Pupils’ movement patterns are

Subject Attainment Targets (UK P-Scale) by Learning Area	established and they perform single actions o Physical Education P8 Pupils move with some control and coordination

Learning Objectives	**Resources**	**Associated Robotic Interactions**
The student is able to imitate a movement	Movements to imitate: file: NAO_ELS04.zip (Download) One/some of the pre-programmed reward behaviours. Stepwise movement EV3 app file: EV3_ELS01p3.zip (Download) Edurob Robot Controller app to fire interactions. or NAO_RandomisedFeedback.zip (Download).	RI 6 Do as the robot does

Session Outline

Set-up

In the training phase, the student sees NAO producing engaging behaviours (e.g., dancing, playing music, etc..) which will be used as reinforce throughout the session.

The therapist controls NAO with the tablet to assure that the behaviour does not saturate the student's interest/attention. The therapist is present for the whole duration of the scenario. NAO is placed in front of a small table upon which there are three objects/pictures. The student and the therapist sit on the opposite side of the table, in front of NAO.

Steps

1. NAO produces a movement (see list of movements below) and says "Can you do this?". Two scenarios may appear:
    a. The student imitates NAO
    b. The student does not imitate NAO

    Case B) The student does not imitate NAO
    c. The therapist produces a physical prompt (max twice) guiding the child in the production of the correct movement
    d. After the correct imitation, NAO produces the reinforcing behaviour
    e. Each movement must be repeated at least twice.

List of movements

1. Open the arms
2. Raise both arms
3. Both hands on the head
4. hug
5. zombie
6. stand (relax)

End-Goal

The student imitates the robot without prompting.

Robot role	Demonstrates the required movements to encourage student to copy.
Teacher role	Controlling the robot by 'Wizard of Oz' app presses; guiding the child with prompts where necessary.
Assessment criteria	Number of prompts provided for each session. The objective is to reduce the number of prompts needed until the student does not require any prompt
Feedback method	How is feedback given: Feedback is given through the robot via 'Wizard of Oz' button press It uses a student appropriate pre-programmed reward behaviour.
NAO Keys	▪ Key: "hug" – Robot puts wraps arms to body, and says "Time for a hug." ▪ Key: "handsonhead" – Robot puts hands on its head and says, "Hands on your head." ▪ Key: "stand" – Robot relaxes in standing pose and says, "and relax" ▪ Key: "armsouttoside" – Robot puts hands out to the sides and says, "Arms out." ▪ Key: "armsup" – Robot puts hands in the air and says, "Put your hands up." ▪ Key: "zombie" – Robot puts hands out forwards and says, "Zombie."
EV3 file paths	Program path: "ELS01p3/MoveForward" – move 1 step forwards Program path: "ELS01p3/MoveBackwards" – move 1 step backwards Program path: "ELS01p3/Turn90R" – turn 90 deg right Program path: "ELS01p3/Turn90L" – turn 90 deg left Program path: "ELS01p3/Turn30R" – turn 30 deg right Program path: "ELS01p3/Turn30L" – turn 30 deg left Program path: "ELS01p3/MoveArc" – move through an arc of 90

	degrees. Program path: “ELS01p3/welldone” – Random well done reward sound Program path: “ELS01p3/tryagain” – Random try again sound

ELS 05 - Robot Question and Answer

Scenario Title Robot Question and Answer Eg How many?, Multiplication tables / arithmetic, or questions about familiar or immediate events or experiences		
Description	The robot will ask the learner a variety of questions about counting, or about familiar or immediate events or experiences. The student must respond either through speech (and the teacher must evaluate the answer) or through the tablet interface (which must be set-up by the teacher).	
LS Type	Question and Answer	
Learner Profile	Suitable for students with mild to moderate learning difficulties or ASD – for multiple choice input method may be dictated by their physical disability.	
Learning Area	**1.** ☐ Imitation – reinforcing behaviour. 2. ☐ Cause and Effect – associating action with behaviour. 3. ☒ Problem solving – through spatial reasoning, coordination. 4. ☒ Communication – improving speaking and listening. 5. ☐ Social Learning – how to act, appropriate behaviour.	
National Curriculum Subject Attainment Targets (UK P-Scale) by Learning Area	• Problem Solving o Number P5 Pupils respond to and join in with familiar number rhymes, stories, songs and games • Communication o Listening P5 - Pupils respond appropriately to questions about familiar or immediate events or experiences o Speaking P4 - Pupils repeat, copy and imitate between 10 and 50 single words, signs or phrases or use a repertoire of objects of reference or symbols	
Learning Objectives	**Resources**	**Associated Robotic Interactions**

• Solve problems involving one of:
  o counting
  o multiplication
  o addition
• or, appropriately answer social interaction questions
	Edurob Robot Controller multiple choice engine.
	Student specific reward behaviours.
	Applause and try again behaviour
	NAO_RandomisedFeedback.zip (Download).
	EV3 file: EV3_ELS07p1.zip (Download)
	EV3 file: EV3_ELS07p2.zip (Download)
	Animal cards: ELS07p1_animals.pdf (Download) Number cards: ELS07p1_NumbersPDFs.zip (Download)
	NAO: file: NAO_ELS05p1.zip (Download)
	file: NAO_ELS05p2.zip (Download)
		RI 9 – Respond appropriately through behaviour
		RI 10 - Respond appropriately through speech.

Session Outline

Set-up

The robot will require a range of pre-built questions for it to read out upon command by the teacher. The interface allows the teacher to input their own questions to be called with text-to-speech and derive the order in which they will be called or define an input button that the teacher can use to call the correct question at the correct time. [NAO only - detail when this functionality is present]

If using tablet input for answering the questions then the interface must be set-up to offer the student potential responses with the correct being tied to appropriate robotic feedback. – [detail when this functionality is present]

Steps

Upon input from the teacher the robot will ask pre-defined questions using text-to-speech.

The student will provide an answer either through speech or through a tablet multiple choice input.

The answer is evaluated by the teacher using 'Wizard of Oz' press, or directly in the case of student tablet interaction.

Feedback/reward is provided through appropriate robotic behaviour.

Part 1: How many things? Maths (Number P5)

There are different numbers of objects around on the table (pens, pencils, toys, coins)

The robot asks, how many x are there? For the different objects.

Best way: “I will choose an object and you have to tell me how many there are…”

Then a list of object buttons.

Part 2: Social interaction questions (Listening P5, Speaking P4)

Suggested possible questions:

- What is your name?
- Do you have any brothers or sisters?
- How many?
- What are their names?
- How old are you?
- Who is your best friend?

Other questions about familiar or immediate events or experiences could be about a recent trip, assembly or lesson, or about a subject/sport/tv show/singer that the student is very keen on.

End-Goal

Correctly answering each question in order to elicit reward behaviour from the robot.

Robot role	The robot will ask the questions.and act as a feedback/reward mechanism upon command by the teacher (e.g. when correct the teacher/therapist presses the input command for clapping)
Teacher role	Set-up the activity by defining what questions will be asked by the robot. If using speech and WoO then the teacher must evaluate each question response and activate appropriate robotic feedback through the interface.
Assessment criteria	Correctly answering each individual question or a full question set. Prompts required.
Feedback method	Feedback is given through the robot via ‘Wizard of Oz’ button press It uses a student appropriate pre-programmed reward behaviour.
NAO Keys	Part 1 ▪ Key: “ELS05p1_introduction” – Robot says ” I will choose an object, and you need to tell me how many of them are here.” ▪ Key: “ELS05p1_object1” – – Robot says, “Pens, How many are there?” ▪ Key: “ELS05p1_object2” – Robot says, “Pencils, How many are there?”

	▪ Key: “ELS05p1_object3” – Robot says, “Toys, How many are there?” ▪ Key: “ELS05p1_object4” – Robot says, “Coins, How many are there?” ▪ Key: “CorrectAnswer” – Robot does one of a set of 10 praise interactions involving applause, cheering, speech and motions. ▪ Key: “TryAgain” – Robot does one of a set of 6 encouragement interactions, asking the student to try again. ▪ Key: “KeepGoing” – Robot asks the student to keep going. ▪ Key: “DontKnow” – Robot opens his arms and says, “I don’t know” Part 2: ▪ Key: “ELS05p2_introduction” – Robot says ” I will ask you some questions.” ▪ Key: “ELS05p2_question1” -Robot asks questions 1-6 ▪ Key: “ELS05p2_question2” ▪ Key: “ELS05p2_question3” ▪ Key: “ELS05p2_question4” ▪ Key: “ELS05p2_question5” ▪ Key: “ELS05p2_question6”
EV3 program paths	Part 1: ▪ ELS05p1/start ▪ ELS05p1/coins ▪ ELS05p1/pens ▪ ELS05p1/pencils ▪ ELS05p1/vehicles ▪ ELS05p1/toys Part 2 ▪ ELS05p2/hello ▪ ELS05p2/yourname ▪ ELS05p2/brothersorsisters ▪ ELS05p2/howmany ▪ ELS05p2/whataretheirnames ▪ ELS05p2/whosyourbestfriend

ELS 06 - Mimic Game (NAO)

Scenario Title Mimic Game (NAO)	
Description	The robot raises an arm (randomised) and the student has to copy the action.
LS Type	From flow diagram middle column
Learner Profile	Describe target students
Learning Area	**1.** ☒ Imitation – reinforcing behaviour. 2. ☒ Cause and Effect – associating action with behaviour. 3. ☐ Problem solving – through spatial reasoning, coordination. 4. ☒ Communication – improving speaking and listening. 5. ☐ Social Learning – how to act, appropriate behaviour.
National Curriculum Subject Attainment Targets (UK P-Scale) by Learning Area	• Imitation o Physical education P4 - Pupils' movement patterns are established and they perform single actions o Physical education - P8 Pupils move with some control and coordination • Communication o Listening P4 - Pupils demonstrate an understanding of at least 50 words, including the names of familiar objects Pupils respond appropriately to simple requests which contain one key word, sign or symbol in familiar situations [for example, 'Get your coat', 'Stand up' or ' Clap your hands']

Learning Objectives	**Resources**	**Associated Robotic Interactions**
Successfully responding to teachers' prompt to elicit reaction.	file: NAO_ELS06.zip (Download) NAO_RandomisedFeedback.zip (Download). Edurob robot controller app	RI 6 - Do as the robot does

Session Outline

Set-up

The NAO robot is pre-loaded with the mimic game scenario.

Steps

A: Physical education towards P4

The teacher says hello to the student and prompts them to say hello to the robot. The student says “Hello, robot!”. At this point, the teacher/trainer presses a button and the robot says “Hello, would you like to play a game?” and raises one of its arms to greet them (e.-g. the right arm). The robot prompts “Raise the same arm as me”.

B: Physical education towards P8

The teacher presses a button and the robot says “Hello” and raises one of its arms (e.-g. the right arm). The student answers Hello Nao, or hello robot!, and raises one arm. Here the position of the student in comparison to the robot is important. Initially, the student is placed beside the robot, then behind the robot, then beside again, and then in front of (facing) the robot. In so doing, the student experiences the spatial world around the robot in comparison to his body. The arm raised by the student should be a non mirror-image to that of the robot (ie the same left or right arm).

At the end of each session (A and B), if the session is successfully concluded, the teacher makes the robot do a reward behaviour (student specific).

End-Goal

Level A – Raising the arm in response to the robot.

Level B – Raising the correct arm in each scenario.

Robot role	Give commands and do actions for imitation. Give a student specific reward behaviour.
Teacher role	Control the robot by ‘Wizard of Oz’ interactions. Position the student suitably to perform the interactions.
Assessment criteria	Number of prompts required for the interaction to be successfully completed. Goal is as few prompts as possible.
Feedback method	Feedback is given through the robot via ‘Wizard of Oz’ button press It uses a student appropriate pre-programmed reward behaviour.
NAO keys:	▪ Key: “intro” – Robot says “Hello. Let’s play a copying game.” ▪ Key: “raiseRandomArm” – Robot says “Raise the same arm as me!” and raises a random arm. ▪ Key: “reset” – Robot reset to default standing position. Plus feedback keys

ELS 07 - Card/object recognition

Scenario Title Card/object recognition		
Description	The student must find the card that the teacher/therapist asks for.	
LS Type	Receive commands	
Learner Profile	Students with mild to moderate intellectual disasability.	
Learning Area	**1.** ☐ Imitation – reinforcing behaviour. 2. ☐ Cause and Effect – associating action with behaviour. 3. ☒ Problem solving – through spatial reasoning, coordination. 4. ☒ Communication – improving speaking and listening. 5. ☐ Social Learning – how to act, appropriate behaviour.	
National Curriculum Subject Attainment Targets (UK P-Scale) by Learning Area	• Communication o Listening P4 - Pupils demonstrate an understanding of at least 50 words, including the names of familiar objects Pupils respond appropriately to simple requests which contain one key word, sign or symbol in familiar situations [for example, 'Get your coat', 'Stand up' or ' Clap your hands'] • Problem Solving o Number P7 recognise numerals from one to five o Number P8 recognise numerals from one to nine	
Learning Objectives	**Resources**	**Associated Robotic Interactions**
Student can correctly identify cards or objects requested by voice.	Part 1 Find the Animals/Numbers - Program file: NAO_ELS07p1.zip (Download); Printable animal pictures: NAO_ELS07p1_Animals.pdf (Download). Program file: NAO_ELS07p1_numbers.zip (Download); Printable number pictures: NAO_ELS07p1_NumbersCards.zip (Download) EV3 file: EV3_ELS07p1.zip (Download) EV3 file: EV3_ELS07p2.zip (Download)	RI X with titles for easy ref

	Animal cards: ELS07p1_animals.pdf (Download) Number cards: ELS07p1_NumbersPDFs.zip (Download) Part 2 requires only student specific feedback behaviours and the correct and try again behaviours NAO_RandomisedFeedback.zip (Download).	

Outline of Session

Set-up

The robot is placed on the floor and a set of cards are arranged in front of the student. The trainer runs the ELS07p1 behaviour on the robot using the Edurob robot controller app.

Steps

Part 1 – English (Listening) P4

a) The teacher and the student are looking at some cards with pictures or images symbols or animals. The teacher (or the robot) asks the student to find the card with the specific thing on it (E.g. dog) and show to the robot. The student shows the robot (in this case, NAO) some cards and when the "right" card is shown, the dog, the robot says congratulations. (this may be done by NAOmark (NAO) colour detection (EV3) or by 'Wizard of Oz' interaction.

   In the example behaviour versions given (NAO_ELS07p1 for animals) the robot uses NAOMarked cards to recognise what is shown and responds with applause for a correct answer, and with the statement "No, that is a… Try again" for the wrong answer. TIP: hold the card slightly lower than you would expect to get the robot to see it.

b) Identifying some objects from the classroom, the teacher could ask the student to look and find an object, asking the student: "Find the ruler and show it to NAO", and if the ruler is fetched and shown to the robot; the robot says the name "Ruler" (can be preset or done through Text-to Speech with NAO) or plays a reward behaviour.

Part 2 – Mathematics (Number) P7 and P8

   a) The same as in part 1, but the cards this time have numbers on them (use behaviour NAO_ELS07_numbers or EV3 file: EV3_ELS07p2.zip (Download) For EV3 feedback is via Wizard of Oz

End-Goal

Student can correctly identify cards or objects requested by voice.	
Robot role	Image recognition (unless 'Wizard of Oz') Feedback and reward student.
Teacher role	Ask the student to find some animal card, colours, numbers, objects, and show them to the robot
Assessment criteria	Recognises objects/images/symbols/numbers correctly. Number of prompts required. Fewer prompts is better. More correct answers is better.
Feedback method	Feedback is given through the robot via sensor detection or 'Wizard of Oz' button press It uses a student appropriate pre-programmed reward behaviour.
NAO keys	▪ Key: "ELS07_animals" – Runs the game. ▪ Key: "naocomAbort" – Ends the looping game. This also prevents the program being restarted – need to rerun the file from Choregraphe or reboot the robot tor restart.
EV3 program paths	Use program paths: ▪ ELS07p1/canyoufindthe ▪ ELS07p2/canyoufindthenumber ▪

ELS 08 - Closer to me! (EV3 Only)

Scenario Title Closer to me! (EV3 Only)	
Description	The student explores using the distance sensors on the robot. The student may try estimation of short distances.
LS Type	From flow diagram middle column
Learner Profile	Describe target students
Learning Area	1. ☐ Imitation – reinforcing behaviour. 2. ☒ Cause and Effect – associating action with behaviour. 3. ☒ Problem solving – through spatial reasoning, coordination. 4. ☐ Communication – improving speaking and listening. 5. ☐ Social Learning – how to act, appropriate behaviour.
National	• Cause and effect

Curriculum Subject Attainment Targets (UK P-Scale) by Learning Area	○ Physical education P4 - They show awareness of cause and effect [for example, knocking down skittles]. ○ Using and Applying Mathematics P4 - Pupils are aware of cause and effects in familiar mathematical activities ○ Music P4 - Pupils use single words, gestures, signs, objects, pictures or symbols to communicate about familiar musical activities or name familiar instruments (They are aware of cause and effect in familiar events) • Problem Solving ○ KS1 Y2 National Curriculum - Mathematics Measurement choose and use appropriate standard units to estimate and measure length/height in any direction (m/cm);

Learning Objectives	**Resources**	**Associated Robotic Interactions**
Overall learning objectives	file: EV3_ELS08.zip (Download) using InfraRed or ultrasonic sensor in port 4.	RI 9 - Respond appropriately through behaviour. RI 12 – Can utilise robot sensors

Session Outline

Set-up

Load the Closer to me programs on the robot. Run the appropriate sub program using the Edurob Robot Controller app.

EV3 should be set up with an ultrasound sensor for accuracy, or the IR version can be used which is less accurate.

Steps

Part 1: (Music P4)

Demonstration of proximity sensing.

Program "CloserToMe#/Approximate" is run on the robot that plays a note, which changes as an object gets closer or further from the robot. The student experiments with moving an object closer or further away.

Part 2: (Using and Applying Mathematics P4 - Pupils are aware of cause and effects in familiar mathematical activities)

Demonstration of distance sensing

Program "speakdistance" is run on the robot which speaks the distance from the sensor (rounded to the nearest 10cm). The student experiments with moving things closer and further away. The robot speaks the distance at intervals and displays the distance on its display in numbers.

Part 3: (above UK p-Scale curriculum) Key stage 1 Year 2 Mathematics Measurement

Distance estimation

The Program "CloserToMe#/speak remote" is run on the robot. The teacher asks the student to get close to robot of about 30 centimetres. The robot speaks the distance (on 'Wizard of Oz' press by teacher). The robot speaks the distance estimated. The teacher feeds back with "You are too close/are too far away/got it right".

End-Goal

Working on measure, estimate, and approximation.

Recall a series of actions according to some vocal indication

Robot role	Estimate the distance from its sensor. Demonstrate via feedback speaking, on screen and via musical tone the sensors working.
Teacher role	Prompting the student to interact with the robot. Feeding back to the student on their responses.
Assessment criteria	Level 1: Demonstrates awareness of cause and effect interacting with the robot. Level 2: Investigates the numbers spoke by the robot at different distances. Level 3: Learns to estimate accurately distances between 20cm and 1m.
Feedback method	Feedback is given through the robot via 'Wizard of Oz' button press It uses a student appropriate pre-programmed reward behaviour.
EV3 program paths	▪ Program path for IR sensor: "ELS08IR/Part1" ▪ Program path for US sensor: "ELS08US/Part1" ▪ Program path: "ELS08IR/Part2" ▪ Program path for US sensor: "ELS08US/Part2" ▪ Program path: "ELS08IR/Part3" ▪ Program path for US sensor: "ELS08US/Part3"

ELS 09 - Let's do some exercise!

Scenario Title Let's do some exercise!	
Description	The robot leads a session of exercises with the student.

LS Type	Receive commands
Learner Profile	Students with mild to moderate learning disabilties.
Learning Area	1. ☒ Imitation – reinforcing behaviour. 2. ☐ Cause and Effect – associating action with behaviour. 3. ☐ Problem solving – through spatial reasoning, coordination. 4. ☒ Communication – improving speaking and listening. 5. ☒ Social Learning – how to act, appropriate behaviour.
National Curriculum Subject Attainment Targets (UK P-Scale) by Learning Area	• Imitation o Physical education P4 - Pupils' movement patterns are established and they perform single actions o Physical education P5 - Pupils link two actions in a sequence o Physical Education P7 - Pupils express themselves through repetitive and simple sequences and movement patterns o Physical education - P8 Pupils move with some control and coordination (They follow and imitate sequences and patterns in their movements) • Communication o Listening P4 - Pupils demonstrate an understanding of at least 50 words, including the names of familiar objects Pupils respond appropriately to simple requests which contain one key word, sign or symbol in familiar situations [for example, 'Get your coat', 'Stand up' or ' Clap your hands']

Learning Objectives	**Resources**	**Associated Robotic Interactions**
Imitation Memory Sequencing	Stepwise movement EV3 app file: ELS01p3.zip (Download) NAO: Files containing useful motions file: NAO_ELS09 and NAO_ELS04.zip (Download)	RI 7 - Copy a sequence of robot actions RI 8 - Follow a sequence of spoken robot instructions.

Session Outline

Set-up

Load the appropriate program to the robot and fire it using the Edurob Robot Controller app.

Steps

Spoken

The robot says, “I will list x actions. Listen to what I say and then do it”

The robot gives a sequence of commands (e.g. “Lift up your arms”, “Make a step forward, two steps, five steps” (via ‘Wizard of Oz’ control). The sequence should be of appropriate length for the student’s ability.

The student listens to the sequence and then copies.

If the student does it right the robot plays a student appropriate reward behaviour. If not the robot repeats the prompts up to 3 times.

Imitation

The robot says, “I will do x actions. Watch what I do and then copy me.”

The robot demonstrates a sequence of movements (e.g. “Raises its arms”, “Makes a step forward, two steps, five steps” (via ‘Wizard of Oz’ control). The sequence should be of appropriate length for the student’s ability. For EV3 the movements will be more like steps and turns. For Nao he can demonstrate humanoid movements of various types.

The student watches the sequence and then copies it.

If the student does it right the robot plays a student appropriate reward behaviour. If not the robot repeats the prompts up to 3 times.

End-Goal

Improve student’s skill to recall and fulfil a sequence of actions via observation or listening.

Robot role	To give the instructions for the sequence, or to actively demonstrate the sequence.
Teacher role	To fire the robot instructions or actions via ‘Wizard of Oz’ commands. To judge success of activity. To fire appropriate robot feedback.
Assessment criteria	The teacher has to assess the coherence of the sequence by the student. Number or prompts required may be counted. Number of actions successfully repeated can judge level of success.
Feedback method	Feedback is given through the robot via ‘Wizard of Oz’ button press It uses a student appropriate pre-programmed reward behaviour.
NAO keys	file: NAO_ELS09.zip (Download) ▪ Key: “starjumps” – Robot raises arms above his head and down again. ▪ Key: “ArmsUpDown” – Robot swings arms forward and up above head and back down. ▪ Key: “ArmsOpposites” – Robot swings arms forwards and backwards in a marching style.

	NAO_ELS04.zip (Download) ▪ Key: “hug” – Robot puts wraps arms to body, and says “Time for a hug.” ▪ Key: “handsonhead” – Robot puts hands on its head and says, “Hands on your head.” ▪ Key: “stand” – Robot relaxes in standing pose and says, “and relax” ▪ Key: “armsouttoside” – Robot puts hands out to the sides and says, “Arms out.” ▪ Key: “armsup” – Robot puts hands in the air and says, “Put your hands up.” ▪ Key: “zombie” – Robot puts hands out forwards and says, “Zombie.”
EV3 paths	The EV3 can perform the following separate programs: Program path: “ELS01p3/MoveForward” – move 1 step forwards Program path: “ELS01p3/MoveBackwards” – move 1 step backwards Program path: “ELS01p3/Turn90R” – turn 90 deg right Program path: “ELS01p3/Turn90L” – turn 90 deg left Program path: “ELS01p3/Turn30R” – turn 30 deg right Program path: “ELS01p3/Turn30L” – turn 30 deg left Program path: “ELS01p3/MoveArc” – move through an arc of 90 degrees. Program path: “ELS01p3/welldone” – Random well done reward sound Program path: “ELS01p3/tryagain” – Random try again sound

ELS 10 - Recognise and say the object/animal/colour

Scenario Title Recognise and say the object/animal/colour	
Description	Here the robot performs a series of actions (e.g. NAO says, elephant! And the student has to speak the correct answer.
LS Type	Receive commands
Learner Profile	Describe target students
Learning Area	**1.** ☐ Imitation – reinforcing behaviour. 2. ☐ Cause and Effect – associating action with behaviour. 3. ☐ Problem solving – through spatial reasoning, coordination. 4. ☒ Communication – improving speaking and listening.

	5. ☐ Social Learning – how to act, appropriate behaviour.
National Curriculum Subject Attainment Targets (UK P-Scale) by Learning Area	• Communication o English Speaking P4 - Pupils repeat, copy and imitate between 10 and 50 single words, signs or phrases or use a repertoire of objects of reference or symbols

Learning Objectives	**Resources**	**Associated Robotic Interactions**
Clear spoken communication / recognition of the target colours/objects.	file: NAO_ELS10a.zip (Download) file: NAO_ELS10a.zip (Download) Other preloaded sound/action files if required. Colours file: EV3_ELS10p1.zip (Download) Animal file: EV3_ELS10p2.zip (Download)	RI 4 recognise robot actions

Session Outline

Set-up

Load the robot with appropriate programmed behaviours and load the correct program to fire them on the Edurob Robot Controller.

Steps

The robot performs some actions. These actions could be

a) change the colours of the eye LEDs
b) make a sound (for instance, the trumpeting of the elephant)

The teacher asks the student to tell NAO what colour were the LEDs or what animal makes this sound. The student tells NAO “red, blue, etc” (colour), or “elephant” (sound). The teacher/therapist starts the appropriate robot reward behaviour, or if wrong a try again behaviour.

NB. In this Atom the room setting is important because colours and sound recognition by NAO

depend on the lightning of the classroom and by the level of noises in it.

End-Goal

Interaction with the robot (the student has to speak clearly and loudly). Clear communication and recognition of the target colours/objects.

Robot role	Performs actions to elicit the spoken responses from the student.
Teacher role	Controls the interactions via 'Wizard of Oz' interactions. Assesses the student response, and fires appropriate reward behaviours.
Assessment criteria	Success is judged by the number of prompts required or the number of correct spoken responses given.
Feedback method	Feedback is given through the robot via 'Wizard of Oz' button press It uses a student appropriate pre-programmed reward behaviour.
Nao Keys	Part 1: EyeColour Part 2 ▪ **elephant** – says, "What goes like this?" and then does elephant movement and sound ▪ **plane** – says, "What goes like this?" and then puts arms out swooping and making a plane sound ▪ **monkey** – says, "What goes like this?" and then does monkey sound and movement ▪ **dog** – says, "What makes this sound?"and then does dog sound ▪ **horse** – says, "What makes this sound?"and then does horse sound ▪ **cat** – says, "What makes this sound?" and then does cat sound ▪ **cockerel** – says, "What makes this sound?" and then does cockerel sound ▪ **bird** – says, "What makes this sound?" and then does bird sound ▪ **sheep** – says, "What makes this sound?" and then does sheep sound ▪ **cow** – says, "What makes this sound?" and then does cow sound ▪ **duck** – says, "What makes this sound?" and then does duck sound
EV3 Paths	The EV3 can perform the following separate programs: Program path: "ELS10p1/lightcolours" Program path: "ELS10p2/animalsound"

ELS 11 - Help me to find the red ball!

<table>
<tr><td colspan="3">Scenario Title

Help me to find the red ball!</td></tr>
<tr><td>Description</td><td colspan="2">In this interaction, the robot asks the student to do some action, and the student has to perform the action, (possibly involving the teacher or, peers in it).</td></tr>
<tr><td>LS Type</td><td colspan="2">Receive Commands</td></tr>
<tr><td>Learner Profile</td><td colspan="2">Describe target students</td></tr>
<tr><td>Learning Area</td><td colspan="2">1. ☐ Imitation – reinforcing behaviour.
2. ☐ Cause and Effect – associating action with behaviour.
3. ☒ Problem solving – through spatial reasoning, coordination.
4. ☒ Communication – improving speaking and listening.
5. ☒ Social Learning – how to act, appropriate behaviour.</td></tr>
<tr><td>National Curriculum Subject Attainment Targets (UK P-Scale) by Learning Area</td><td colspan="2">• Communication -
o English Listening P5 - Pupils respond appropriately to questions about familiar or immediate events or experiences [for example, ‘Where is the ball?’
• Problem Solving -
o Mathematics (Shapes, Space and Measures) P4 - Pupils search for objects that have gone out of sight, hearing or touch, demonstrating the beginning of object permanence
o Mathematics (Shapes, Space and Measures) P6 - Pupils search for objects not found in their usual place, demonstrating their understanding of object permanence
• Social Learning -
o PSHE P5 - Pupils take part in work or play involving two or three others</td></tr>
<tr><td>Learning Objectives</td><td>Resources</td><td>Associated Robotic Interactions</td></tr>
<tr><td>• Understanding statements
• Designing a sequence of action
• Social learning</td><td>NAO: speech only

EV3:
file: EV3_ELS11
(Download)</td><td>RI 5 – Do as the robot says
RI 9 – Respond appropriately through behaviour</td></tr>
<tr><td colspan="3">Session Outline</td></tr>
</table>

Set-up

Robot is set up to ask for the ball by text-to-speech or a pre-programmed interaction. The robot is set up with student's preferred reward scenario.

Steps

NAO asks the student to help it find the red ball. Here we could add some internal scenarios:

1) The ball is visible and accessible: the ball is on the ground, visible and accessible. (Listening P5)
2) The ball is visible but not accessible (for instance, it is on a high shelf or beyond peers who are in the way but can reach it). The student must ask the teacher/ peers for help. (PSHE P5)
3) The ball is not visible but accessible. The teacher shows clearly to the student that he has put the ball in a drawer, or in his pocket. The student must be aware of the presence of the ball when it is out of site. (Mathematics P4, P6 Object permanence)

The student gets the ball, shows it to the robot. The teacher plays a robot reward action via 'Wizard of Oz' interaction.

End-Goal

- Understanding statements
- Designing a sequence of actions
- Social learning

Robot role	Ask the student to perform the search action and giving the feedback about successful fulfilment of the action.
Teacher role	Supporting the student through the sequence of actions. Firing the 'Wizard of Oz' interactions on the robot.
Assessment criteria	Number of tasks and types of tasks successfully achieved.
Feedback method	Feedback is given through the robot via 'Wizard of Oz' button press It uses a student appropriate pre-programmed reward behaviour.
NAO keys	Use TTS
EV3 paths	▪ Program path: "ELS11/canyoufindball" – Robot asks "Can you help me to find the red ball?"

ELS 12 – Navigate the bee to the flower

Scenario Title

Navigate the bee to the flower

Description	Navigate the robot by creating a sequence of instructions to get from one point to another.
LS Type	Navigation
Learner Profile	Students with intellectual disability who need to practice communication, sequencing or spatial awareness tasks.
Learning Area	**1.** ☐ Imitation – reinforcing behaviour. 2. ☐ Cause and Effect – associating action with behaviour. 3. ☒ Problem solving – through spatial reasoning, coordination. 4. ☒ Communication – improving speaking and listening. 5. ☐ Social Learning – how to act, appropriate behaviour.
National Curriculum Subject Attainment Targets (UK P-Scale) by Learning Area	• Problem solving o Mathematics (Shape, Space and measures) P7 - Can create sequences of input to achieve an objective o Mathematics (Shape, Space and measures) - P7 Pupils respond to 'forwards' and 'backwards' [for example, moving forwards and backwards on request, recognising when a vehicle is moving forwards or backwards. • Communication o English (Speaking) P7 Pupils use phrases with up to three key words, signs or symbols to communicate simple ideas, events or stories to others

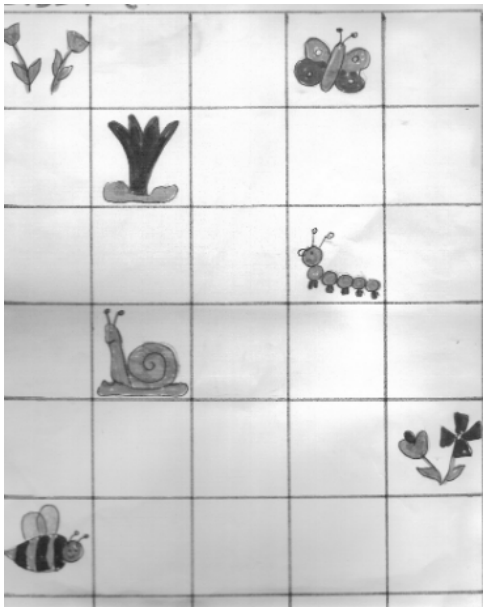
Learning Objectives	**Resources**	**Associated Robotic Interactions**
Understanding the symbols and their purpose, and ultimately being able to create a sequence to reach a goal.	NAO - Stepwise Remote control (EV3) ELS01p3.zip (Download) EV3 Stepwise Remote Control (EV3) ELS01p3.zip (Download) Downloadable cards file: Cards_for_Stepwise_Navigation.docx (Download) A floor map can be created in class - see example below.	RI 3 - Make the Robot perform a certain action from a range of options RI 11 - Can create sequences of input to achieve an objective

Session Outline

Set-up

This Learning Scenario can be employed with many variations.

The Robot runs on the floor where the teacher and/or students have prepared a square or rectangular mat divided by a given number of square tiles (see example below).



The robot, starting from Starting tile 1 (bee) has to go to the end point (a flower). The commands are: Run x steps; turn right x steps; turn left x steps, etc. The robot path has to avoid some obstacles, run some steps, turn right and or left, according to the mat on which it is running. The mat may be very simple with just forward steps required, moving through forward and backward steps, right up to complex maps with obstacles that must be navigated.

Steps

The objective is to send the robot/bee to the flower, avoiding the obstacles.

This scenario implies many concepts: action, sequences, imitation, memory competences, etc. and can be used in many ways to suit many different students at different levels.

a) The student watches the robot and tries to imitate its path;
b) The student tries to give commands to the robot by vocal signals (teacher/therapist controls the robot via 'Wizard of Oz'). This part is useful for the teacher to check the understanding of the path by the student;
c) The student imitates the robot path, walking aside with the robot
d) The student draws on a paper the robot path
e) The student writes on a paper the commands the robot is following

The suggested scenario of use is that the teacher commands the robot on the interface (Wizard of Oz). The student can also *command* the robot, using cards or voice. The cards mirror the same commands/symbols on the interface. The student uses the cards (showing arrows indication

forwards, left, right, and backwards and he/she puts these cards (that may have a Velcro or magnets) on a board. The student can the watch the robot perform their command card sequence. When the operations starts, the teacher replicates the command sequence with the interface. When more able students are better acquainted with the cards symbols, they may use the interface directly.

End-Goal

Understanding the symbols and their purpose, and ultimately being able to create a sequence to reach a goal.

Robot role	Robot plays out the movements that the students place in their sequence. The final position of the robot indicates success or failure. The robot may also be used to perform a reward behaviour after successful tasks.
Teacher role	The teacher must facilitate the putting together of the maps in setup to match the abilities of their students. The teacher then drives the robot based on sequences created.
Assessment criteria	Successfully navigating to the goal. Increasing difficulty of goals. Increasing the number of understood interaction symbols.
Feedback method	Feedback is given through the robot via successfully reaching a goal, and by 'Wizard of Oz' button press It uses a student appropriate pre-programmed reward behaviour.
NAO keys	▪ Key: "RemoteStepLeft" – Robot steps a few steps to its left ▪ Key: "RemoteStepRight" – Robot steps a few steps to its right ▪ Key: "RemoteForward" – Robot steps a few steps forwards ▪ Key: "RemoteBackward" – Robot steps a few steps backwards ▪ Key: "RemoteTurnRight" – Robot turns 30 degrees to its right ▪ Key: "RemoteTurnLeft" – Robot turns 30 degrees to its left ▪ Key: "Stand" – Robot stands up straight (walking pose is a slight squat)
EV3 paths	▪ Program path: "ELS01p3/MoveForward" – move 1 step forwards ▪ Program path: "ELS01p3/MoveBackwards" – move 1 step backwards ▪ Program path: "ELS01p3/Turn90R" – turn 90 deg right ▪ Program path: "ELS01p3/Turn90L" – turn 90 deg left ▪ Program path: "ELS01p3/Turn30R" – turn 30 deg right ▪ Program path: "ELS01p3/Turn30L" – turn 30 deg left ▪ Program path: "ELS01p3/MoveArc" – move through an arc of 90 degrees. ▪ Program path: "ELS01p3/welldone" – Random well done reward sound ▪ Program path: "ELS01p3/tryagain" – Random try again sound

ELS 13 - Classify the objects

Scenario Title **Classify the objects**		
Description	The objective of this activity is to improve abilities to classify the objects and make sets.	
LS Type	Receive Commands	
Learner Profile	Students with mild/moderate intellectual disabilities	
Learning Area	**1.** ☐ Imitation – reinforcing behaviour. 2. ☐ Cause and Effect – associating action with behaviour. 3. ☒ Problem solving – through spatial reasoning, coordination. 4. ☐ Communication – improving speaking and listening. 5. ☐ Social Learning – how to act, appropriate behaviour.	
National Curriculum Subject Attainment Targets (UK P-Scale) by Learning Area	• **Problem Solving** o Mathematics (using and applying Mathematics) P7 Pupils complete a range of classification activities using a given criterion [for example, sorting a pile of coins by size, colour or shape; sorting all the blue Wellington boots; sorting all the size 6 shoes] o Science P5 - They match objects and materials in terms of single features or properties [for example, temperature or colour]	
Learning Objectives	**Resources**	**Associated Robotic Interactions**
Recognise categories of objects, different colours or objects described by 2 adjectives.	NAO: speech only EV3: file: EV3_ELS13.zip (Download) EV3_EncouragePraise.zip (Download) Sets of categorised image cards.	RI 5 – Do as the robot says.
Session Outline **Set-up** The interface must provide a means of commanding the robot through tablet interaction.		

The interface provides must include the ability make the robot speak (by text to speech (NAO) or by pre-recorded sound files (EV3)

Steps

I (object types)

The teacher puts on the desk pictures (drawings) of objects (two, three or more categories could be used, for example: toys, vehicles, clothes). He names main categories.

The robot (or teacher) commands the student to classify objects. The robot says, “Find all the toys”. “Find all the vehicles”, “Find all the clothes”. The result is evaluated by the teacher/therapist and rewards are given by the Robot (via ‘Wizard of Oz’ commands). Correct choices receive applause or a student appropriate reward behaviour.

II (colours)

The teacher shows the student things in different colours: at first red things, than yellow things, and then blue things. The teacher names the colours. The student could help him. The teacher put all things together. Then the robot (or teacher) asks the student to create categories by colour. He commands, “select yellow things”, “select blue things”, “select red things”. Correct choices receive applause or a student appropriate reward behaviour.

III (two adjective object selection)

The teacher sets up a number of objects which can be distinguished by the use of 2 adjectives. The teacher asks the student to show the robot objects. He describes them using two properties, for example: “Show the robot the small, yellow bear”, “Show the robot the big, red ball”, “Show the robot the small, blue flower”. Correct choices receive applause or a student appropriate reward behaviour.

End-Goal

The student classifies the objects by their properties/attributes.

Robot role	Ask the student to find certain classifications of object. Provide a reward behaviour suitable for that student.
Teacher role	Prompt the student to help them to solve the problem. Note prompts given. Note correct choices made.
Assessment criteria	Number of correct choices made. Number of prompts required from the teacher/therapist.
Feedback method	Feedback is given through the robot via ‘Wizard of Oz’ button press It uses a student appropriate pre-programmed reward behaviour.
NAO keys	TTS control
EV3 paths	The EV3 can perform the following separate programs: Program path: “ELS13/allclothes” – Robot says, “Can you find all

	the clothes?" Program path: "ELS13/alltoys" – Robot says, "Can you find all the toys?" Program path: "ELS13/alltransport" – Robot says, "Can you find all the transport?" Program path: "ELS13/redthings" – Robot says, "Can you find all the red things?" Program path: "ELS13/bluethings" – Robot says, "Can you find all the blue things?" Program path: "ELS13/yellowthings" – Robot says, "Can you find all the yellow things?"

ELS 14 - Recognise patterns

Scenario Title **Recognise patterns**		
Description	The objective of this activity is to improve ability to recognise patterns	
LS Type	Receive Commands	
Learner Profile	Students with mild to moderate intellectual disabilities	
Learning Area	1. ☐ Imitation – reinforcing behaviour. 2. ☐ Cause and Effect – associating action with behaviour. 3. ☒ Problem solving – through spatial reasoning, coordination. 4. ☒ Communication – improving speaking and listening. 5. ☐ Social Learning – how to act, appropriate behaviour.	
National Curriculum Subject Attainment Targets (UK P-Scale) by Learning Area	• Problem solving o Using and applying mathematics P8 - Pupils talk about, recognise and copy simple repeating patterns and sequences o Using and applying mathematics P6 - Pupils sort objects and materials according to a given criteria (They copy simple patterns or sequences) • **Communication -** o English Listening P5 - Pupils respond appropriately to questions about familiar or immediate events or experiences	
Learning Objectives	**Resources**	**Associated Robotic Interactions**

The student demonstrates recognition of patterns.	NAO:~all speech EV3: file: EV3_ELS14.zip (Download) Use with file: EV3_EncouragePraise.zip (Download) Sequencing cards	RI 5 - Do as the robot says RI 9 – Respond appropriately through behaviour

Session Outline

Set-up

The interface provides a means of commanding the robot through tablet interaction.

The interface provides the ability make the robot speak (pre-recorded EV3 sound files, text-to-speech on NAO)

Steps (select from the scenarios below based on ability of the student)

Part 1 - What is next in the pattern

The teacher makes sequences of three pictures (e.g. cat dog mouse cat dog mouse). The robot asks the student to name the objects and continue the sequence. “What comes next?”

A correct answer elicits a reward from the robot (by ‘Wizard of Oz’ command).

Part 2 – Copy the pattern

The teacher shows the student three pictures of objects and makes a sequence. The teacher names the objects, for example: a cat, a dog, a mouse and gives the student the same pictures. Then robot asks the student to copy the sequence. The robot says: “Put the pictures in order”.
A correct answer elicits a reward from the robot (by ‘Wizard of Oz’ command).

Part 3 – Find the missing item in a pattern

The teacher makes sequences of pictures**,** for example: a circle, a triangle, a square, a circle, ..., a square. The robot asks: “Can you fill in the missing figure”.

A correct answer elicits a reward from the robot (by ‘Wizard of Oz’ command).

End-Goal

The student demonstrates recognition of patterns.

Robot role	The robot will give the commands/ask the questions. The robot will act as the reward mechanism.

Teacher role	Set-up the robot actions, Assessing the session, help student with prompts, if necessary. Evaluate the student activities and trigger robot feedback.
Assessment criteria	Number of successful responses. Number of prompts required to assist in successful responses. Increasing difficulty of scenario.
Feedback method	Feedback is given through the robot via 'Wizard of Oz' button press It uses a student appropriate pre-programmed reward behaviour.
NAO keys	Use TTS
EV3 paths	The EV3 can perform the following separate programs: Program path: "ELS13/putinorder" – Robot says, "Can you put the pictures in order?" Program path: "ELS13/whatcomesnext" – Robot says, "What comes next?" Program path: "ELS13/whatismissing" – Robot says, "What is missing from the sequence?"

ELS 15 – Comparative sizes

Scenario Title **Arrange objects by size**	
Description	The objective of this activity is to improve the ability to arrange the objects by size and to help students to understand the relationship between numbers
LS Type	Receive commands
Learner Profile	Students with mild to moderate intellectual disabilities
Learning Area	**1.** ☐ Imitation – reinforcing behaviour. 2. ☐ Cause and Effect – associating action with behaviour. 3. ☒ Problem solving – through spatial reasoning, coordination. 4. ☐ Communication – improving speaking and listening. 5. ☐ Social Learning – how to act, appropriate behaviour.
National Curriculum	• Problem solving o Mathematics (Shapes, space and measures) P5 They

<table>
<tr><td>Subject Attainment Targets (UK P-Scale) by Learning Area</td><td colspan="2">compare the overall size of one object with that of another where there is a marked difference [for example, they indicate which of two shoes is the bigger, compare objects – big boxes and small boxes]
o Using and applying mathematics P6 - They compare the overall size of one object with that of another where the difference is not great [for example, identifying the bigger of two Russian dolls or nesting cubes]
o Using and applying mathematics P7 - Pupils complete a range of classification activities using a given criterion [for example, sorting a pile of coins by size]
o Using and applying Mathematics P8 - Pupils talk about, recognise and copy simple repeating patterns and sequences (They use ordinal numbers (first, second, third) when describing the position of objects, people or events)</td></tr>
<tr><td>Learning Objectives</td><td>Resources</td><td>Associated Robotic Interactions</td></tr>
<tr><td>Overall learning objectives</td><td>EV3:
file: EV3_ELS15p1.zip (Download)
file: EV3_ELS15p2.zip (Download)
Use with file: EV3_EncouragePraise.zip (Download)

NAO: Speech only – use TTS and pre loaded rewards and try again behaviours</td><td>RI 5 - Do as the robot says
RI 9 – Respond appropriately through behaviour</td></tr>
<tr><td colspan="3">Outline of Session

Set-up

The appropriate programs are loaded on the robot.

The robot is controlled through tablet interaction.

Steps

I – find big or small objects (P5)

The teacher puts on the desk small and big objects

The robot says, “Find all the big objects and put them into the big box”.

The robot says, “Find all small objects and put them into the small box”.</td></tr>
</table>

II. - make pairs of big and small objects (P5)

The robot (or the teacher) asks, “Make pairs – (e.g. big block and small block, big ball and small ball).

III - recognise big, small and medium-sized (P6, P7)

The teacher gives the student three things in different sizes. The robot asks, “Which thing is the biggest?”, “Which thing is the smallest?”, or “Which is the medium-sized one?”

Finally, the robot asks, “Arrange #the things# in order from the smallest to the biggest.”

IV – Ordinal numbers (P8)

The teacher gives the students three toy animals in different sizes. The teacher says listen the robot and do what the robot says. The robot says: The elephant is the biggest. The elephant is the first. The cow is medium. The cow is the second. And the rabbit is small. The rabbit is ..... Which one is the rabbit?

End-Goal

The student arranges objects by size and can describe and recognise sizes. (P5,6,7)

The student can use ordinal numbers (P8)

Robot role	The robot will give the commands/ask the questions. The robot will act as the reward mechanism.
Teacher role	Set-up the robot actions, Assessing the session, help student with prompts, if necessary. Evaluate the student activities and trigger robot feedback.
Assessment criteria	Number of successful responses. Number of prompts required to assist in successful responses. Increasing difficulty of scenario.
Feedback method	Feedback is given through the robot via ‘Wizard of Oz’ button press It uses a student appropriate pre-programmed reward behaviour.
NAO Keys	Uses TTS
EV3 Paths	**Part 1** – The EV3 can perform the following separate programs (ELS15p1): ▪ Program path: “ELS15p1/biginbig” – Robot says, “Find the big objects and put them into the big box?” ▪ Program path: “ELS15p1/smallinsmall” – Robot says, “Find the small objects and put them into the small box?” ▪ Program path: “ELS15p1/makepairs” – Robot says, “Can you make pairs by putting the big ones with the small

	ones?" ▪ Program path: "ELS15p1/putinorder" – Robot says, "Can you arrange them in order from the smallest to the biggest?" ▪ Program path: "ELS15p1/smallest" – Robot says, "Which thing is the biggest?" ▪ Program path: "ELS15p1/biggest" – Robot says, "Which thing is the smallest?" ▪ Program path: "ELS15p1/medium" – Robot says, "Which is the medium-sized one?" **Part 2** – The EV3 can perform the following separate programs (ELS15p2): ▪ Program path: "ELS15p2/ordinals" – Robot says, "The elephant is the biggest. The elephant is the first. The cow is medium. The cow is the second. And the rabbit is small. The rabbit is ..... Which one is the rabbit?" ▪ Program path: "ELS15p2/rabbitisthird" – Robot says, "The rabbit is third."

ELS 16 - Mimic sequences of sounds and actions

Scenario Title Mimic sequences of sounds and actions	
Description	desc
LS Type	Receive commands
Learner Profile	Describe target students
Learning Area	**1.** ☒ Imitation – reinforcing behaviour. 2. ☐ Cause and Effect – associating action with behaviour. 3. ☐ Problem solving – through spatial reasoning, coordination. 4. ☐ Communication – improving speaking and listening. 5. ☐ Social Learning – how to act, appropriate behaviour.
National Curriculum Subject Attainment Targets (UK P-Scale) by Learning Area	• Imitation o Physical education P4 - Pupils' movement patterns are established and they perform single actions o Physical education P5 - Pupils link two actions in a sequence o Physical Education P7 - Pupils express themselves through repetitive and simple sequences and movement patterns

	o Physical education - P8 Pupils move with some control and coordination (They follow and imitate sequences and patterns in their movements) • Communication o Listening P4 - Pupils demonstrate an understanding of at least 50 words, including the names of familiar objects Pupils respond appropriately to simple requests which contain one key word, sign or symbol in familiar situations [for example, 'Get your coat', 'Stand up' or ' Clap your hands']

Learning Objectives	**Resources**	**Associated Robotic Interactions**
Correct repetition of sequences of robot sounds and actions.	Action files NAO: Files containing useful motions: NAO_ELS09.zip (Download) and NAO_ELS04.zip (Download) Files containing useful sounds: NAO_ELS16.zip (Download) EV3: Motions: Stepwise movement EV3 app file: ELS01p3.zip (Download) file: EV3_ELS16.zip (Download)	RI 7 - Copy a sequence of robot actions

Session Outline

Set-up

Load required behaviour files on robot, and the app interface for ELS16.

Steps

The robot produces a sequence of two or more actions, using alternately sounds and movement (gestures) appropriate to the student.

The teacher or robot asks the student to copy it…

1. as soon as robot has finished.

2. at the same time.

The action is repeated 2 or 3 times.

<table>
<tr><td colspan="2">Robot rewards correct answer with student specific reward behaviour.

End-Goal

Correct repetition of sequences of robot sounds and actions.</td></tr>
<tr><td>Robot role</td><td>The robot will be giving commands

The robot will be acting as reward mechanism.</td></tr>
<tr><td>Teacher role</td><td>Set-up the robot actions

Assess the session, help/prompt student, if it is necessary

Evaluate the student activities</td></tr>
<tr><td>Assessment criteria</td><td>Correctly done tasks. Teacher interactions/prompts required.</td></tr>
<tr><td>Feedback method</td><td>Feedback is given through the robot via ‘Wizard of Oz’ button press
It uses a student appropriate pre-programmed reward behaviour.</td></tr>
<tr><td>NAO keys</td><td>It uses the following keys to fire the sounds:

▪ ELS16_elephant – plays elephant sound
▪ ELS16_plane – puts arms out swooping and making a plane sound
▪ ELS16_monkey – does monkey sound and movement
▪ ELS16_dog – plays dog sound
▪ ELS16_horse – plays horse sound
▪ ELS16_cat – plays cat sound
▪ ELS16_cockerel – plays cockerel sound
▪ ELS16_bird – plays bird sound
▪ ELS16_sheep – plays sheep sound
▪ ELS16_cow – plays cow sound
▪ ELS16_duck – plays duck sound
file: NAO_ELS09.zip (Download)
▪ Key: “starjumps” – Robot raises arms above his head and down again.
▪ Key: “ArmsUpDown” – Robot swings arms forward and up above head and back down.
▪ Key: “ArmsOpposites” – Robot swings arms forwards and backwards in a marching style.
NAO_ELS04.zip (Download)
▪ Key: “hug” – Robot puts wraps arms to body, and says “Time for a hug.”
▪ Key: “handsonhead” – Robot puts hands on its head and says, “Hands on your head.”
▪ Key: “stand” – Robot relaxes in standing pose and says, “and relax”
▪ Key: “armsouttoside” – Robot puts hands out to the sides and says, “Arms out.”
▪ Key: “armsup” – Robot puts hands in the air and says, “Put your</td></tr>
</table>

	hands up." ▪ Key: "zombie" – Robot puts hands out forwards and says, "Zombie."
EV3 Paths	The EV3 can perform the following separate programs for movements (EV3_ELS01p3): Program path: "ELS01p3/MoveForward" – move 1 step forwards Program path: "ELS01p3/MoveBackwards" – move 1 step backwards Program path: "ELS01p3/Turn90R" – turn 90 deg right Program path: "ELS01p3/Turn90L" – turn 90 deg left Program path: "ELS01p3/Turn30R" – turn 30 deg right Program path: "ELS01p3/Turn30L" – turn 30 deg left Program path: "ELS01p3/MoveArc" – move through an arc of 90 degrees. Program path: "ELS01p3/welldone" – Random well done reward sound Program path: "ELS01p3/tryagain" – Random try again sound The EV3 can perform the following separate programs for animal sounds (EV3_ELS16): Program path: "ELS16/randomanimal" – random animal sound from the following list or use the followimg paths for specifics. Program path: "ELS16/cat" Program path: "ELS16/cow" Program path: "ELS16/cockerel" Program path: "ELS16/dog" Program path: "ELS16/elephant" Program path: "ELS16/monkey" Program path: "ELS16/bird" Program path: "ELS16/duck" Program path: "ELS16/cow" Program path: "ELS16/horse" Program path: "ELS16/sheep"

ELS 17 - Recognise actions

Scenario Title Recognise the verbs	
Description	The objective of this activity is to improve the ability to communicate, and answer simple question, using verbs

LS Type	Receive commands, Question and answer.
Learner Profile	Students with mild/moderate learning disabilities.
Learning Area	**1.** ☐ Imitation – reinforcing behaviour. 2. ☐ Cause and Effect – associating action with behaviour. 3. ☐ Problem solving – through spatial reasoning, coordination. 4. ☒ Communication – improving speaking and listening. 5. ☐ Social Learning – how to act, appropriate behaviour.
National Curriculum Subject Attainment Targets (UK P-Scale) by Learning Area	• Communication o English (Speaking) P4 - Pupils repeat, copy and imitate between 10 and 50 single words, signs or phrases or use a repertoire of objects of reference or symbols o Physical education P4 - Pupils' movement patterns are established and they perform single actions [for example, rolling, running, jumping or splashing]

Learning Objectives	**Resources**	**Associated Robotic Interactions**
Overall learning objectives	NAO files: NAO_ELS17.zip (Download) Action cards download file: ELS17_Cards_for_ActionsNAO.pdf (Download) Can be used with a feedback file such as file: NAO_RandomisedFeedback.zip (Download) Can also be used with other reward behaviours such as songs or dances. EV3 robot interaction file: EV3_ELS17.zip (Download) Action cards download file: ELS17_Cards_for_Actions.pdf (Download) Use with file: EV3_EncouragePraise.zip (Download)	RI 4 – Recognise robot actions.

Session Outline

Set-up

Install the behaviours on the robot and start the ELS 17 learning app. Place the cards in front of the student face down (dependent on the scenario).

Steps

I. The teacher shows the students the verb-card (stand, walk, drink, eat, play, etc.) and asks the question, “What is he/she/it doing?” The robot rewards correct answers with a student appropriate reward behaviour.

II. Three verb cards are face down on the table (dance, walk, sing). The robot commands, “take a card. Then he asks, “What is he/she/it doing?” If the student gives the correct answer, the robot will perform the action (NAO) or play an appropriate sound (EV3).

III. The verbs cards are in the box. The robot says: “Take a card. What is he doing?” If the student gives correct answer, the teacher will ask the student to perform the action. The robot rewards actions with a student appropriate reward behaviour.

End-Goal

Interaction between student and robot. Student recognises verbs.

Robot role	The robot will be giving commands The robot will act as reward mechanism. The robot will be able to demonstrate the actions.
Teacher role	Set-up and trigger the robot actions Assessing the session, help/prompt student, if it is necessary Evaluate the student activities.
Assessment criteria	By correctly identified actions, and number of prompts required.
Feedback method	Feedback is given through the robot via ‘Wizard of Oz’ button press It uses a student appropriate pre-programmed reward behaviour.
NAO keys	The NAO can perform the following separate actions: Program key: “whataction” – Says, “What action are they doing?” Program key: “pickone” – Says, “Pick one of the cards.” Program key: “walk” Program key: “sit” Program key: “wave” Program key: “sing” Program key: “dance” Program key: “eat” Program key: “drink”
EV3 paths	Program path: “ELS17/randomanimal” – random animal sound from the following list or use the followimg paths for specifics.

	Program path: “ELS17/whataction – Says, “What action are they doing?” Program path: “ELS17/pickone – Says, “Pick one of the cards.” And sound effect files can be played with: Program path: “ELS17/walk” Program path: “ELS17/run” Program path: “ELS17/skip” Program path: “ELS17/play” Program path: “ELS17/sing” Program path: “ELS17/dance” Program path: “ELS17/eat” Program path: “ELS17/drink”

ELS 18 - Tell me a story

Scenario Title **Tell me a story**		
Description	The objective of this activity is to improve the ability to communicate,	
LS Type	Receive commands	
Learner Profile	Students with mild/moderate intellectual disabilities	
Learning Area	**1.** ☐ Imitation – reinforcing behaviour. 2. ☐ Cause and Effect – associating action with behaviour. 3. ☒ Problem solving – through spatial reasoning, coordination. 4. ☒ Communication – improving speaking and listening. 5. ☐ Social Learning – how to act, appropriate behaviour.	
National Curriculum Subject Attainment Targets (UK P-Scale) by Learning Area	• Communication o English (Speaking) P7 - Pupils use phrases with up to three key words, signs or symbols to communicate simple ideas, events or stories to others • Problem Solving o Science P8 - Pupils show that they have observed patterns or regular changes in features of objects, living things and events [for example, chrysalis/butterfly day/night]	
Learning Objectives	**Resources**	**Associated Robotic Interactions**

Arrange a series of picture cards into the logical order to create a story.	file: EV3_ELS18.zip (Download) Use with file: EV3_EncouragePraise.zip (Download) NAO: TTS speech only Need story sequencing cards. Need sequencing cards about a robot.	RI 5 - Do as the robot says

Session Outline

Set-up

The interface provides a means of commanding the robot speech through tablet interaction.

Steps

I. The teacher presents in order two sequencing cards and tells the story . Then he gives the student another two cards. One of them belongs to series. Robot command, “Which card fits with the others? Try to finish this story.”

II. The teacher presents the students story sequencing cards (three) in random order. He asks the student to show the robot each card. Teacher describes each card and asks student to help him (he could ask students some prompt questions; What is it? What is he doing? etc). After describing all 3, the robot says, “It is a story. Arrange the pictures into order from the beginning to the end.”

III. The teacher gives the students sequencing cards about the robot in random pile.

Robot asks says: “Choose some cards” , “Who is on the card?” “Tell me a story about the robot.”

Robot rewards student activities.

End-Goal

Arrange a series of picture cards into the logical order to create the story.

Robot role	The robot will be giving commands and asking questions. The robot will act as reward mechanism.
Teacher role	Set-up and trigger the robot actions and appropriate reward behaviours. Assessing the session, help/prompt student, if it is necessary Evaluate the student activities.
Assessment criteria	By correctly identified sequences, and number of prompts required.
Feedback method	Feedback is given through the robot via ‘Wizard of Oz’ button press It uses a student appropriate pre-programmed reward behaviour.

NAO keys	Uses TTS
EV3 paths	▪ Program path: "ELS18/choosesomecards" – Robot says, "Choose some cards." ▪ Program path: "ELS18/arrangepictures" – Robot says, "It is a story. Arrange the pictures into order from the beginning to the end." ▪ Program path: "ELS18/tellmeastory" – Robot says, "Tell me a story about the robot." ▪ Program path: "ELS18/whoisonthecard" – Robot asks, "Who is on the card?" ▪ Program path: "ELS18/finishthestory" – Robot asks, "Which card fits with the others? try and find the one to finish the story."

ELS 19 - Understanding and communication of directions

Scenario Title Understanding and communication of directions	
Description	A set of interactions where students follow directions to move a robot, and name directions of movement from their own and the robot's point of view.
LS Type	Navigation
Learner Profile	Students with mild learning disabilities.
Learning Area	**1.** ☐ Imitation – reinforcing behaviour. 2. ☐ Cause and Effect – associating action with behaviour. 3. ☒ Problem solving – through spatial reasoning, coordination. 4. ☒ Communication – improving speaking and listening. 5. ☐ Social Learning – how to act, appropriate behaviour.
National Curriculum Subject Attainment Targets (UK P-Scale) by Learning Area	• Problem solving o Mathematics (Shape, Space and measures) P7 - Can create sequences of input to achieve an objective o Mathematics (Shape, Space and measures) - P7 Pupils respond to 'forwards' and 'backwards' [for example, moving forwards and backwards on request, recognising when a vehicle is moving forwards or backwards. • Communication o English (Speaking) P7 Pupils use phrases with up to three key words, signs or symbols to communicate simple ideas,

	events or stories to others

Learning Objectives	Resources	Associated Robotic Interactions
To understand and communicate directions.	Remote control application on Edurob Robot Controller app. If the EV3 has IR sensor and remote control use: file: RemoteControl.zip (Download) Or stepwise remote control app: file: EV3_ELS01p3.zip (Download) For NAO, use file: NAORemoteControl.zip (Download) A maze to navigate for part 2 can be created in class.	RI 3 - Make the Robot perform a certain action from a range of options (Part 1 & 3) RI 10 – Respond appropriately through speech (Part 2)

Session Outline

Set-up

Load the remote control app and link to robots.

Steps

Part 1:

The Student is instructed to verbally or using arrows, move the robots

in a particular direction using the remote control or the tablet.

Part 2:

The Student is asked to move the robot around a maze and asked to name the direction of movement at various turns in the maze.

Part 3:

The Student is asked to move the robot in a particular direction, either from her own point of view or from the robots' point of view.

End-Goal To understand and communicate directions.	
Robot role	Acts as an actor in the scenarios being driven around.
Teacher role	The teacher must: Part 1: The teacher must issue the instructions for where the robot is going. Part 2: The teacher must ask the student which direction the robot is going, and assess the response, feeding back by 'Wizard of Oz' or verbally. Part 3: The teacher must ask the student to move the robot from a particular point of view – and assess the responses, firing feedback via the robot – or giving it verbally.
Assessment criteria	Part 1: successfully managing to move the robot in the right direction counts as an achievement. Part 2: correctly naming the direction the robot is taking, counts as an achievement. Part 3: successfully moving the robot in the correct direction and from the relevant point of view asked, is counted as achievement.
Feedback method	How is feedback given: Feedback is given through the robot via 'Wizard of Oz' button press It uses a student simple correct or wrong statements. The teacher/therapist can also give feedback.
NAO keys	▪ Key: "RemoteStepLeft" – Robot steps a few steps to its left ▪ Key: "RemoteStepRight" – Robot steps a few steps to its right ▪ Key: "RemoteForward" – Robot steps a few steps forwards ▪ Key: "RemoteBackward" – Robot steps a few steps backwards ▪ Key: "RemoteTurnRight" – Robot turns 30 degrees to its right ▪ Key: "RemoteTurnLeft" – Robot turns 30 degrees to its left ▪ Key: "Stand" – Robot stands up straight (walking pose is a slight squat)
EV3 Paths	▪ Program path: "ELS01p3/MoveForward" – move 1 step forwards ▪ Program path: "ELS01p3/MoveBackwards" – move 1 step backwards

	▪ Program path: “ELS01p3/Turn90R” – turn 90 deg right ▪ Program path: “ELS01p3/Turn90L” – turn 90 deg left ▪ Program path: “ELS01p3/Turn30R” – turn 30 deg right ▪ Program path: “ELS01p3/Turn30L” – turn 30 deg left ▪ Program path: “ELS01p3/MoveArc” – move through an arc of 90 degrees. ▪ Program path: “ELS01p3/welldone” – Random well done reward sound ▪ Program path: “ELS01p3/tryagain” – Random try again sound

ELS 20 – Move the robot using verbal instructions

Scenario Title Move the robot using verbal instructions		
Description	The student is encouraged to speak by means of a number of interactions where the student has to direct the robot to move.	
LS Type	Give commands	
Learner Profile	Student with intellectual difficulties and in particular inhibition to speak.	
Learning Area	**1.** ☐ Imitation – reinforcing behaviour. 2. ☐ Cause and Effect – associating action with behaviour. 3. ☐ Problem solving – through spatial reasoning, coordination. 4. ☒ Communication – improving speaking and listening. 5. ☐ Social Learning – how to act, appropriate behaviour.	
National Curriculum Subject Attainment Targets (UK P-Scale) by Learning Area	• Communication o English (Speaking) P4 Pupils repeat, copy and imitate between 10 and 50 single words, signs or phrases or use a repertoire of objects of reference or symbols [They use single words, signs and symbols for familiar objects [for example, cup, biscuit], and to communicate about events and feelings [for example, likes and dislikes]]	
Learning Objectives	**Resources**	**Associated Robotic Interactions**
To improve English speaking skills.	Nao remote control movements file: NAORemoteControl.zip (Download)	RI 1 – Make the robot perform an action using speech

	EV3 remote app (for use with IR sensor only) file: RemoteControl.zip (Download) or stepwise remote app file: EV3_ELS01p3.zip (Download)	

Session Outline

Set-up

Load the remote control app and link to robots.

Steps

Part 1: The student is asked to move the robot using verbal instructions towards a particular object (The robot is moved remotely by the teacher/therapist).

Part 2: The student is asked to move the robot around the room by giving verbal instructions. (The robot is moved remotely by the teacher/therapist).

Part 3: The student is asked to take the robot around a trail using verbal instructions.

End-Goal

Improved English speaking.

Robot role	To move appropriately to the scenario and encourage speech in the student.
Teacher role	To introduce the scenario, and to prompt the student to give commands. To use 'Wizard of Oz' commands to move the robot. To offer praise and trigger robot praise when speech is heard.
Assessment criteria	If student gives a verbal instruction to the robot, it counts as achievement regardless of whether the verbal instruction is right or wrong as the task is to get the student to speak.
Feedback method	How is feedback given: Feedback is given through the robot via 'Wizard of Oz' button press It uses remote control movements of the robot. Teacher/therapist also offers praise for verbal instructions.
NAO keys	▪ Key: "RemoteStepLeft" – Robot steps a few steps to its left ▪ Key: "RemoteStepRight" – Robot steps a few steps to its right ▪ Key: "RemoteForward" – Robot steps a few steps forwards ▪ Key: "RemoteBackward" – Robot steps a few steps backwards

	▪ Key: “RemoteTurnRight” – Robot turns 30 degrees to its right ▪ Key: “RemoteTurnLeft” – Robot turns 30 degrees to its left Key: “Stand” – Robot stands up straight (walking pose is a slight squat)
EV3 Paths	▪ Program path: “ELS01p3/MoveForward” – move 1 step forwards ▪ Program path: “ELS01p3/MoveBackwards” – move 1 step backwards ▪ Program path: “ELS01p3/Turn90R” – turn 90 deg right ▪ Program path: “ELS01p3/Turn90L” – turn 90 deg left ▪ Program path: “ELS01p3/Turn30R” – turn 30 deg right ▪ Program path: “ELS01p3/Turn30L” – turn 30 deg left ▪ Program path: “ELS01p3/MoveArc” – move through an arc of 90 degrees. ▪ Program path: “ELS01p3/welldone” – Random well done reward sound ▪ Program path: “ELS01p3/tryagain” – Random try again sound

ELS 21 - Improve Listening Skills by robot navigation

Scenario Title Improve Listening Skills by robot navigation	
Description	This uses a selection of robot navigation activities to encourage listening skills.
LS Type	Receive commands
Learner Profile	Learner with learning difficulties who needs to work on listening skills
Learning Area	**1.** ☐ Imitation – reinforcing behaviour. 2. ☐ Cause and Effect – associating action with behaviour. 3. ☐ Problem solving – through spatial reasoning, coordination. 4. ☒ Communication – improving speaking and listening. 5. ☐ Social Learning – how to act, appropriate behaviour.
National Curriculum Subject Attainment	• Communication o English (Listening) P7 Pupils listen, attend to and follow stories for short stretches of time (They follow requests and instructions with four key words, signs or symbols)

Targets (UK P-Scale) by Learning Area	

Learning Objectives	Resources	Associated Robotic Interactions
Overall learning objectives	Nao remote control movements file: NAORemoteControl.zip (Download) EV3 remote app (for use with IR sensor only) file: RemoteControl.zip (Download) or stepwise remote app file: EV3_ELS01p3.zip (Download) Objects placed strategically to allow landmarks for navigation.	RI 8 - Follow a sequence of spoken robot instructions RI 9 – Respond appropriately through behaviour

Session Outline

Set-up

Load remote control app for selected robot.

Steps

Part 1 -To be able to move the robot when asked in a sequence of one two or three movements

Part 2 -To be able to move the robot around a maze and bring the robot to a stop when asked and answer a simple question for example name the colour of the crayon.

Part 3 -To be able to take the robot from one object to another and stop at the second object and wait for instructions for the next movement

End-Goal

Improve listening skills.

Robot role	The robot moves when the student successfully hits sensors and remote buttons, offering encouragement to interact.
Teacher role	The teacher provides prompts to the student and can provide demonstrations of what will happen if necessary. The teacher must also track achievement counting successful interactions as well as

	number of prompts required.
Assessment criteria	Part 1: If student correctly moves the robot in the right direction and right sequence, it counts as an achievement. Part 2: If student successfully brings the robot to a stop when asked, it counts as achievement, answering the question correctly does not matter. Part 3: If student brings the robot to a stop when he reaches the object and then moves it in the correct direction when asked to, it counts as achievement, both things have to be done to achieve the score.
Feedback method	How is feedback given: Feedback is given through the robot via 'Wizard of Oz' button press It uses a student appropriate pre-programmed reward behaviour.
NAO keys	▪ Key: "RemoteStepLeft" – Robot steps a few steps to its left ▪ Key: "RemoteStepRight" – Robot steps a few steps to its right ▪ Key: "RemoteForward" – Robot steps a few steps forwards ▪ Key: "RemoteBackward" – Robot steps a few steps backwards ▪ Key: "RemoteTurnRight" – Robot turns 30 degrees to its right ▪ Key: "RemoteTurnLeft" – Robot turns 30 degrees to its left Key: "Stand" – Robot stands up straight (walking pose is a slight squat)
EV3 Paths	▪ Program path: "ELS01p3/MoveForward" – move 1 step forwards ▪ Program path: "ELS01p3/MoveBackwards" – move 1 step backwards ▪ Program path: "ELS01p3/Turn90R" – turn 90 deg right ▪ Program path: "ELS01p3/Turn90L" – turn 90 deg left ▪ Program path: "ELS01p3/Turn30R" – turn 30 deg right ▪ Program path: "ELS01p3/Turn30L" – turn 30 deg left ▪ Program path: "ELS01p3/MoveArc" – move through an arc of 90 degrees. ▪ Program path: "ELS01p3/welldone" – Random well done reward sound Program path: "ELS01p3/tryagain" – Random try again sound

ELS 22 - Interact with the robot and make choices

<table>
<tr><td colspan="3">Scenario Title

Interact with the robot and make choices</td></tr>
<tr><td>Description</td><td colspan="2">Interact with the robot using sensors, and remote control.</td></tr>
<tr><td>LS Type</td><td colspan="2">Give commands</td></tr>
<tr><td>Learner Profile</td><td colspan="2">Students with severe/profound intellectual disability. Students working towards cause and effect goals.</td></tr>
<tr><td>Learning Area</td><td colspan="2">6. ☐ Imitation – reinforcing behaviour.
7. ☒ Cause and Effect – associating action with behaviour.
8. ☐ Problem solving – through spatial reasoning, coordination.
9. ☐ Communication – improving speaking and listening.
10. ☐ Social Learning – how to act, appropriate behaviour.</td></tr>
<tr><td>National Curriculum Subject Attainment Targets (UK P-Scale) by Learning Area</td><td colspan="2">• Cause and Effect
o Computing AND Physical Education P2 (ii) - Pupils begin to be proactive in their interactions (They perform actions, often by trial and improvement, and they remember learned responses over short periods of time)
o Computing AND Physical Education P3 (i) Pupils begin to communicate intentionally (They remember learned responses over more extended periods)</td></tr>
<tr><td>Learning Objectives</td><td>Resources</td><td>Associated Robotic Interactions</td></tr>
<tr><td>To interact with the robot and make choices.</td><td>Also link to any printable cards etc needed.
For part 1 on EV3 use file: GangnamOnly.zip (Download)
EV3_mp3Dance – a generic dance to which a student specific mp3 may be added. Comes with a short section of Gangnam Style by default. Instructions to add your own mp3 are located in the Mindstorms file.
Part 2 and 3 on EV3: Remote control using IR sensor remote use file:</td><td>RI 2 – Make the robot perform an action using button press
RI 3 – Make the Robot perform a certain action from a range of options
RI 12 - Can utilise robotic sensors appropriately</td></tr>
</table>

	RemoteControl.zip (Download) Stepwise EV3 remote (EV3_ELS01p3.zip (Download)) For part 1 on NAO use: NAO touch foot bumper to make him dance NAO_ELS22_foottodance.zip (Download) NAO parts 2 and 3 use: Stepwise motions on NAO, file: NAORemoteControl.zip (Download)	

Session Outline

Set-up

Load the required behaviours to the robots, and the appropriate control app.

Steps

Part 1: (RI 12)

The student is asked to press the robots' 'foot'. When the button is touched the robot dances and plays music.

Part 2: (RI 2)

The student is asked to press buttons on the remote control or the tablet screen to make the robot move in different directions around the room.

Part 3: (RI 3)

The student is asked to make the robot move towards different objects by remote control or tablet interface.

End-Goal

Ultimate learning goal

Robot role	The robot moves when the student successfully hits sensors and remote buttons, offering encouragement to interact.
Teacher role	The teacher provides prompts to the student and can provide demonstrations of what will happen if necessary. The teacher must also track achievement counting successful interactions as well as

	number of prompts required.
Assessment criteria	Part 1: Attempting to press the button to play music, is counted as achievement. Part 1: Touching the tablet or remote control, regardless of whether it makes the robots move, counts as achievement. Part 3: Any attempt to press the buttons on the remote control or tablet gives a score of achievement.
Feedback method	Feedback is given through the robot moving when the student hits the sensor or remote. Part 1 uses a student appropriate pre-programmed reward behaviour.
NAO keys	foottodance
EV3 path	Program: “ELS22.ev3/Gangnam”

Appendix 1 – Lesson Plan Template

Context & Profile				
Author:	**Title:**	**Timescale:**	**Year group/age:**	**No in group:**
Relevant contextual information on learners:				
How does this lesson fit into the subject curriculum or the wider curriculum?	Prior learning of learners			
Main subject area: **Wider Curriculum:**				
The Learning				
Groups	Intended progress (Learning Objectives)	How will this progress be demonstrated?	Assessment of progress by…	
Organisation				

Timings	**Content**		
To start with…		**Cognitive / Behavioural**	**Learning scenario***
Main learning			
Plenary / extension			

*Learning Scenario key: FG – Full group, SG – Small group (including partners), I – Individually

*Cognitive/Behavioural Key: C – Cognitive; B – Behavioural

Appendix 2 – P-Scale Mapping per Learning Area – Example from the UK

The initial mapping for **Imitation** would be:

Curriculum Area	Performance Descriptor	Types of Attainment (as flexible and scalable LOs)	Example Robotic Mediated Tasks
Physical Education	P4 Pupils' movement patterns are established and they perform single actions	They respond to simple commands	The robot can provide commands, or demonstrate movements to the student which they have to follow ("stand-up, sit-down etc")
	P5 Pupils link two actions in a sequence	They recognise and collect, on request, familiar pieces of equipment	The robot issues instructions to gather several pieces of equipment – such as a hoop and basketball
	P8 Pupils move with some control and coordination	They follow and imitate sequences and patterns in their movements	The robot increases the complexity of the movements to be imitated (e.g., stand up, turn around, and sit down).

Using and applying Mathematics	P6 Pupils sort objects and materials according to a given criteria	They copy simple patterns or sequences	The robot performs a simple pattern of repeated movements; and the student copies these movements.
Music	P5 Pupils take part in simple musical performances	They listen to, and imitate, distinctive sounds played on a particular instrument	The robot plays a series of distinctive sounds that the students have to imitate.
Languages	P4 Pupils attempt to repeat, copy or imitate some sounds heard in the target language	They listen and may respond to familiar rhymes and songs in a foreign language.	The robot plays familiar rhymes and songs and the students repeat, copy and imitate these sounds. Robot voice recognition could be used to check accuracy.

The initial mapping for **Cause and effect** would be:

Curriculum Area	Performance Descriptor	Types of Attainment (as flexible and scalable LOs)	Example Robotic Mediated Tasks
Computing	P4 Pupils make selections to communicate meanings	Pupils make selections to generate familiar/preferred sounds or images. They know that certain actions produce predictable results	Pupils use a switch to activate their favourite piece of music or dance performed by the robot
Using and applying mathematics	P4 Pupils are aware of cause and effects in familiar mathematical activities	They anticipate, follow and join in familiar activities when given a contextual clue	The robot sings a song or a rhyme. Students are challenged to anticipate the next chorus or action in these songs and rhymes.
Music	P4 Pupils use single words, gestures, signs, objects, pictures or symbols to communicate about familiar musical activities or name familiar instruments	They are aware of cause and effect in familiar events	The robot performs a song and dance. The student recognises that this can be started and stopped through their action – such as clapping their hands, stamping their feet, or using a switch.

The initial mapping for **Problem Solving** would be:

Curriculum Area	Performance Descriptor	Types of Attainment (as flexible and scalable LOs)	Example Robotic Mediated Tasks
Listening	P5 Pupils respond appropriately to questions about familiar or immediate events or experiences	They follow requests and instructions containing at least two key words, signs or symbols	The robot asks a series of questions and student responds via speech
	P6 Pupils respond to others in group situations	They follow requests and instructions with three key words, signs or symbols	Robot asks a series of questions and student responds via speech (could also be used in Social Learning)
	P8 Pupils take part in role play with confidence	Pupils listen attentively. They respond appropriately to questions about why or how	Robot asks a series of questions and student responds via speech (could also be used in Social Learning)
Geography	P5 Pupils consolidate a sense of place and direction	Pupils can follow set routes around familiar places	Pupils direct the robot around a maze to demonstrate their understanding of sense of place and direction
History	P5 Pupils know they took part in past events and they listen and respond to familiar stories about their own past	With some prompting or support, they answer simple questions about historical artefacts and buildings	The robot asks questions related to historical artefacts - for example, identifying a bowl as being made out of wood.
	P7 Pupils begin to recognise some distinctions between the	They listen to and follow stories about people and	The robot tells a series of historical stories. It then prompts them to sort real objects into new and old categories for example, old toys and new toys.

	past and present in other people's lives as well as their own and communicate about these in simple phrases and statements	events in the past as well as events in their own lives. They sort objects to given criteria	
Using and Applying Mathematics	P5 Pupils sort or match objects or pictures by recognising similarities	They make sets that have the same small number of objects in each	The robot challenges the students to distribute sweets into containers so that there is one or two in each. The students sort objects into red or blue categories, and then challenge the robot to kick the red ones (using object recognition system) to gain feedback on correct selection.
	P7 Pupils complete a range of classification activities using a given criterion	They respond appropriately to key vocabulary and questions	The robot poses questions such as, 'How many blue balls'? And student responds. Robot uses object recognition to check answer.
Number	P5 Pupils respond to and join in with familiar number rhymes, stories, songs and games	Pupils can indicate one or two	Robot sings a familiar song or rhyme. Students are challenged to say (robot voice recognition), or sign (robot object recognition – e.g., for Makaton Symbol) to indicate at least one of the numbers in the song or rhyme. Other means by which the robot could recognise the answer may be through number of eye blinks, eye pointing or gesture (robot vision system).
	P6 Pupils demonstrate an understanding of one-to-one correspondence in a range of contexts. Pupils join in rote counting up to five	They count reliably to three, make sets of up to three objects and use numbers to three in familiar activities and games	Students touching one, two, three items as the robot counts.

	P8 Pupils join in with rote counting to beyond 10	They continue to rote count onwards from a given small number	Students continue to say, sign or indicate the count aloud when the robot begins counting the first two numbers
Space, Shape and Measures	P5 Pupils search intentionally for objects in their usual place	They compare the overall size of one object with that of another where there is a marked difference	Robot challenges the student to indicate which of two shoes is the bigger, compare objects – big boxes and small boxes.
	P7 Pupils respond to 'forwards' and 'backwards'		Robot asks to be moved forwards or backwards and students uses the interface to select the correct action.
Science	P4 Pupils explore objects and materials provided, changing some materials by physical means and observing the outcomes	Pupils communicate their awareness of changes in light, sound or movement.	Students make a sound or clap when the robot begins to move or makes a sound.
	P5 Pupils take part in activities focused on the anticipation of and enquiry into specific environments	They respond to simple scientific questions	The robot poses simple scientific questions – such as show me the flower from the range of objects in front of them. The robot's object recognition system could be used to check the answer.

The initial mapping for **Communication** would be:

Curriculum Area	Performance Descriptor	Types of Attainment (as flexible and scalable LOs)	Example Robotic Mediated Tasks
Speaking	P4 Pupils repeat, copy and imitate between 10 and 50 single words, signs or phrases or use a repertoire of objects of reference or symbols	They use single words, signs and symbols for familiar objects	The robot speaks the word and the student responds verbally to an agreed tolerance
	P5 Pupils combine two key ideas or concepts	They combine single words, signs or symbols to communicate meaning to a range of listeners	They present two signs to the robot in a logical sequence (e.g., stand up, walk)
	P7 Pupils use phrases with up to three key words, signs or symbols to communicate simple ideas, events or stories to others		They present two (three, four,...as a flexible, scalable LO) signs to the robot in a logical sequence (e.g., stand up, walk)
Geography	P5 Pupils consolidate a sense of place and direction	They can answer simple questions about places and people	Robot asks questions such as 'Who can help us?' Student must point to correct person
Languages	P5 Pupils attempt one or two words in the target language in response to cues in a song or familiar		Robot says a familiar phrase and challenges the student to speak one of the words in the target language (using robot speech recognition system, within a range of tolerances)

	phrase		
	P7 Pupils introduce themselves by name in response to a question in the target language	They listen, attend to and follow familiar interactions in the target language.	The robot asks them to introduce themselves in a foreign language and listens for response (using robot speech recognition system, within a range of tolerances).
	P8 Pupils listen attentively and know that the target language conveys meaning	They respond briefly using single words, signs or symbols	The robot asks a question in a foreign language and the students is challenged to respond using single words (also could be used in problem solving)

The initial mapping for **Social Learning** would be:

Curriculum Area	Performance Descriptor	Types of Attainment (as flexible and scalable LOs)	Example Robotic Mediated Tasks
Listening	P8 Pupils take part in role play with confidence	Pupils listen attentively. They respond appropriately to questions about why or how	Robot initiates conversation and instructions and pupils take turns to answer
Physical Education	P7 Pupils express themselves through repetitive and simple sequences and movement patterns. Their control and coordination skills are developing	They share and wait their turn	The robot performs simple series of activities and challenges students in a group situation to copy these. Students must wait their turn (also applies to Imitation).
PHSE	P4 Pupils express their feelings, needs, likes and dislikes using single elements of communication (words, gestures, signs or symbols)	They show an understanding of 'yes' and 'no', and recognise and respond to animated praise or criticism.	The robot praises the students in animated ways, and encourages students to respond appropriately.
	P6 Pupils respond to others in group situations, playing or working in a small group cooperatively	They may show concern for others	The robot displays a range of emotions and the students are encouraged to respond appropriately to distress.