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GENERAL GUIDE FOR PERSONALIZING STEAM FOR STUDENTS WITH IDD

Miguel Á. Conde

Universidad de León

León, Spain

mcong@unileon.es

Abstract

This guide defines the way in which the user model and the repository of resources can be used in real interventions adaptation. This means to be able to characterize a student by using the user model and later look into the repository for resources that could fit with students' needs and learning objectives related to STEAM disciplines.

1. INTRODUCTION

The adaptation of interventions to facilitate STEAM Education for students with IDD requires consideration of several issues: 1) The student IDD and personal needs; 2) The context in which the activity is developed; and 3) The STEAM discipline and learning objective to reach. Depending on these factors we will use the Taxonomy and User Model in different ways. In any case, the foundation for the use of both elements is described below:

- Taxonomy resource: <https://robosteamsen.eu/taxonomy-classification-samples.php> (Figure 1)
- User Model resource: <https://robosteamsen.eu/userModel/public/home> (Figure 2)

The taxonomy and User model are also described in videos to aid understanding of their application. This guide aims to clarify when, why, and how to apply these resources to achieve successful personalization of students' learning.

Taxonomy and classification samples

This **report** aggregates the findings from the WP2.T2 activity, which comprises two distinct segments as outlined in the project proposal the Taxonomy Definition and the classification of 10 sample resources with it:

"On the basis of the analysis defined on WP2.T1 the consortium will define a taxonomy that allows to classify the needs of the students based on their disabilities."

The definition of the taxons will be carried out by the universities and validated by experts from the partnership schools. Some classifications samples will be created to help with future classifications."

The taxonomy is the base for the User Model and for storing the resources so it is necessary to define a clear base that considers all the different possibilities for an IDD student.

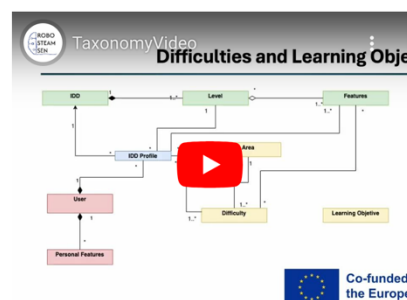
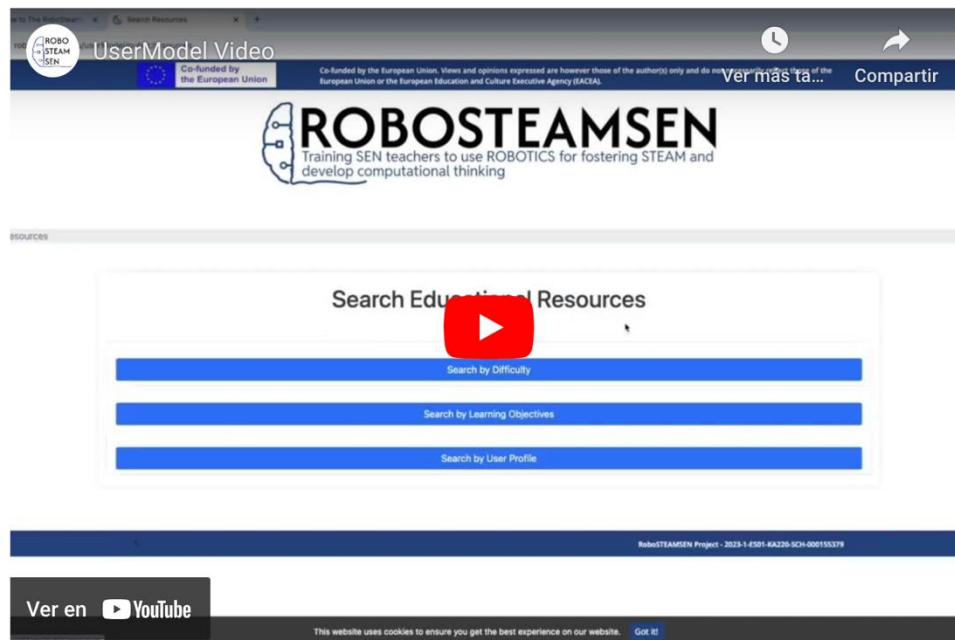


Figure 1. Taxonomy report, manual and video

Watch Our Intro Video



Users Management



Training Plans Management



Educational resources and activities search

Figure 2. – User Model resource and video

The rest of the guide is structured as follows: the next section outlines the main issues to consider before using the resources. This is followed by a description of the key steps for developing the taxonomy and user model. Finally, a simple case scenario is presented to illustrate their application.

2. MAIN ISSUES TO CONSIDER BEFORE ANY INTERVENTION

To adapt or develop interventions for facilitating STEAM education, three main issues must be considered:

- 1) **Student Profile:** This refers to the student's disability. It is essential to identify the student's IDD or multiple IDDs, their severity levels, and features based on DSM-5 criteria (Association, 2022). This information helps determine whether the student fits existing data in the taxonomy or if a new disability and its associated data need to be added. A profile can encompass multiple disabilities, enabling consideration of comorbidities. Defining the student profile may require access to medical reports related to the student.
- 2) **Context of the Educational Program:** Clearly define the time allocated for STEAM discipline activities, whether the program is conducted alongside other students with IDD, in regular classes with full or partial integration, or in a Special Educational Needs (SEN) school. This clarification helps understand the activity's development, the type of support teachers can provide, and the resources available in the school. For example, if the goal is to develop computational thinking in a technology class that meets for four hours per week, this sets a time limit for regular class activities. However, if the student with IDD receives extra support classes, the available time may differ. Therefore, it is crucial to have a clear framework of the activity's context.
- 3) **Discipline and learning objective to reach.** Since this guide focuses on adapting STEAM education, it is necessary to define which STEAM discipline will be addressed and the learning objectives to achieve through the activity. Achieving a learning objective may require more than one activity. Schools may cover one or multiple STEAM disciplines, but each discipline must be addressed separately. This information helps teachers define the learning program. Additionally, it is important to know the school's available resources or budget for acquiring equipment.

With these considerations in mind, the Taxonomy and User Model can be utilized effectively.

3. STEPS FOR USING THE TAXONOMY AND THE USER MODEL

To use the Taxonomy and User Model, either a bottom-up or top-down strategy can be followed. This means starting with the definition of the student profile or beginning with the activity to be developed. The authors of this guide recommend starting with the definition of the user profile in the taxonomy, although the other approach is also valid. The following section outlines how to proceed with this process.

3.1 TAXONOMY

The taxonomy allows the classification of the IDD students' needs. It is based on a set of categories and some taxa, later the taxonomy is implemented as the base of the User Model, so to employ the taxonomy it could be necessary to define new taxa or just to classify students' needs using what it is available.

Current taxonomy distribution is shown in Figure 3.

- **IDD:** only three IDDs were considered Autism Spectrum Disorder, Attention Deficit Hyperactivity Disorder (ADHD) and Dyslexia (SLD – Specific Learning Disability).
- **Level:** The level or levels of the disability.
- **Features:** IDD features depending on the level of the IDD. This was done using DSM features (Association, 2022). For instance, for ADHD a feature could be “deficiencies in non-verbal communicative behaviors used in social interaction”.
- **Difficulty:** associated to one or several features related with education, “difficulty to work as a team”.
- **Educational area:** In which it is included the difficulty. For instance: “Collaborative competences” taking into account the classification provided by Polloway (2017) and those included into DSM-5.
- **Learning Objective:** Learning objective linked to possible activity which is focused on a difficulty and an activity.

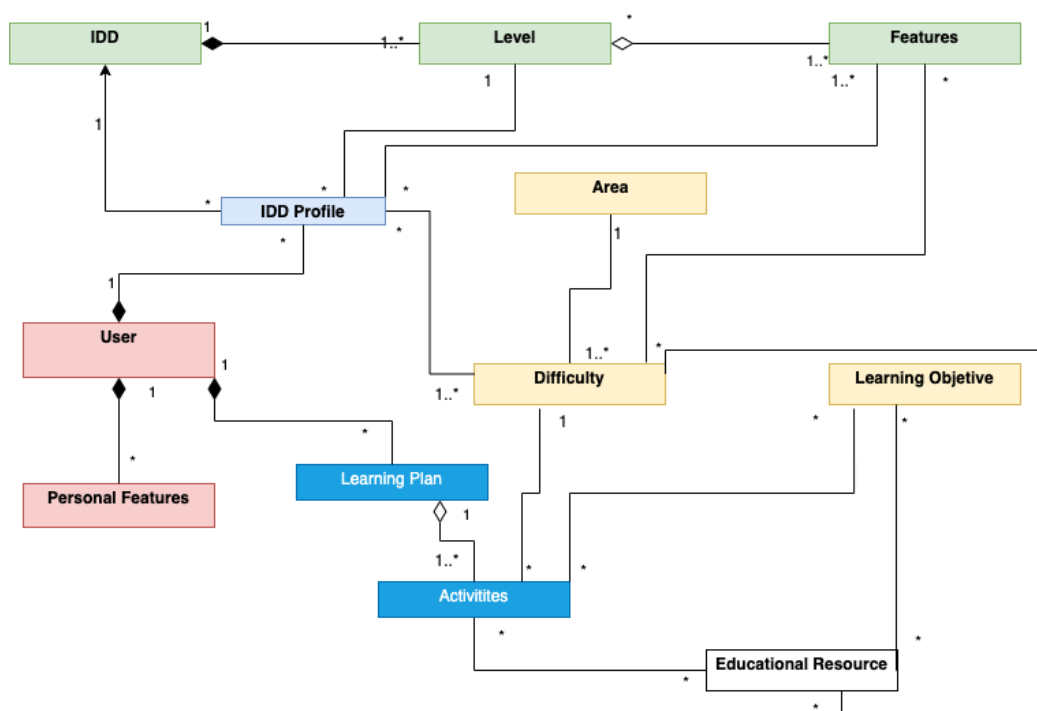


Figure 3. – UML Class Diagram for taxonomy description proposal

The identified IDD's have been mentioned above, but the features already included were compiled using the DSM-5 criteria and are presented in Table 1.

Table 1. – Features based on IDD's

IDD	Main Symptoms	Sub-Symptoms
ASD	Social communication and social interaction	Social-emotional reciprocity
		Nonverbal communicative behaviors used for social interaction
		Developing, maintaining, and understanding relationships
	Restricted, repetitive patterns of behavior, interests, or activities	Stereotyped or repetitive actions
		Insistence on sameness, inflexible adherence to routines, or ritualized patterns or verbal nonverbal behavior
		Highly restricted, fixated interests that are abnormal in intensity or focus
		Hyper- or hyporeactivity to sensory input or unusual interests in sensory aspects of the environment
ADHD	Inattention	Often fails to give close attention to details or makes careless mistakes in schoolwork, at work, or during other activities
		Often has difficulty sustaining attention in tasks or play activities
		Often does not seem to listen when spoken to directly
		Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace
		Often has difficulty organizing tasks and activities
		Often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort
		Often loses things necessary for tasks or activities
		Is often easily distracted by extraneous stimuli (for older adolescents and adults, may include unrelated thoughts).
		Is often forgetful in daily activities
	Hyperactivity and impulsivity	Often fidgets with or taps hands or feet or squirms in seat.
		Often leaves seat in situations when remaining seated is expected
		Often runs about or climbs in situations where it is inappropriate. (Note: In adolescents or adults, may be limited to feeling restless).
		Often unable to play or take part in leisure activities quietly.
		Is often "on the go" acting as if "driven by a motor"
		Often talks excessively.
		Often blurts out an answer before a question has been completed
		Often has trouble waiting his/her turn
		Often interrupts or intrudes on others
SLD	Difficulty reading	
	Difficulty understanding the meaning of what is read.	

Additionally, the taxa related to the identified difficulties are presented in Tables 2, 3, and 4, while the taxa for the learning objectives are shown in Table 5.

Table 2. – Difficulties for the three levels of ASD

Difficulties for ASD
Atypical response to sensory stimuli
Cooperative Interaction
Coordination and/or odd movements pattern
Delayed development or unusual speech patterns

Discomfort sensory-rich environments
Expressing Feelings
Eye contact during conversations
Fixed Interest
Hyper-responsiveness
Hyporesponsiveness
Intense attachment with object or activities
Limited language use
Literal interpretation of language and abstractions
Making/Keeping friends/ interaction with peers
Managing transition and adaption to changes and new situations
Memory and attention to detail
Memory and attention to detail, Intense focus
Mental rigidity,
Misinterpretation of social situations and intentions
Need to follow routines
Non interactive play
Pragmatic language skills
Problems initiating and maintaining conversations. Lack of answer
Repetitive behavior
Repetitive movements
Sensory Information Management
Sensory overload
Sensory-perceptual self-stimulation behaviors
Solitary Activities and Limited Engagement in meetings
Specific sensory preferences
Talks excessively. Impulsivity
Understanding facial expression or body language
Understanding social norms and rules. Inappropriate social behavior
Use of nonverbal cues

Table 3. – Difficulties for ADHD

Difficulties for ADHD
Avoidance behavior or meltdowns
Careless mistakes in schoolwork
Constant changing activity or task
Fixed Interest
Forgetful or losing things
Impulsiveness (waiting turns, interrupts)
Intense attachment with object or activities
Intense focus
Managing transition and adaption to changes and new situations
Memory attention to detail



Organization and planning task and activities
Repetitive behavior
Seeing things from different perspectives
Sharing a common focus
Short attention span
Stand up at the class
Talks excessively
Time management
Unability to follow instructions and rules
Unability to stick to tedious tasks
Unable to play quietly

Table 4. – Difficulties for SLD

Difficulties for SLD
Add, omit or substitute vowels or consonants
Cognitive Abilities
Difficulty connecting letters with the sounds
Difficulty grasping abstract concepts like fractions
Difficulty identifying the correct operation to use
Difficulty in applying steps to solve maths problems
Difficulty understanding place value
Frequently guesses words while reading
Inaccurate or slow and effortful reading
Individualized learning strategies accommodations
Multiple grammatical or punctuation errors
Poor paragraph organization
Reading comprehension (sequence, relationship, inferences or deeper meanings)
Reading, writing or maths challenges
Recognizing words that rhyme;
Sounding out words
Struggles with counting sequences (finger counting) and simple operations
Trouble recalling basic math facts or applying math rules in daily tasks
Trouble understanding math problems
Written expression lacks clarity

Table 5. – Learning Objectives list

Learning Objectives to be addressed by the resources
Cognitive and Behavioral Flexibility
Develop functional writing skills
Developing accuracy in word reading skills
Developing fluency in word reading skills
Distinguishing Meaningful contents

Emphasize self-reliance
Engage in abstract thinking and Symbolic Thought
Enhancing Language Skills
Enhancing Sensory Regulation Strategies
Estrategies for Effective Studying
Executive functions
Facilitating Peer Interaction and Social Interaction Skills
Improve Restricted Interests and Repetitive Behaviors
Improving Attention and focus
Improving knowledge application
Improving metacognition (learning to learn)
Improving reading comprehension
Improving Social Communication Skills
Learning Arts concepts
Learning breathing and relaxation techniques
Learning competences
Learning Engineering concepts
Learning Maths concepts
Learning Science concepts
Learning Technology concepts
Listening competences
Memory improvement
Organization of class structure.
Organization of space
Organization of time
Practical competences
Promote reading comprehension
Promote self-management
Promoting Flexibility and Adaptability
Regulating hyperactivity
Regulating impulsivity

To use the taxonomy effectively, some preparatory steps are required:

- **Step 1:** Gather the student's medical reports and analyze them to define an accurate profile.
- **Step 2:** Identify the student's specific educational difficulties associated with the profile's features.
- **Step 3:** Define the educational activity or activities to be developed, including the learning objectives to be achieved.

Once this information is clear, you can begin using the taxonomy:

- **Step 1:** Check whether the IDD is already included in the taxonomy. If it is, proceed to Step 3.
- **Step 2:** If the IDD is not included, describe it by detailing its different levels, features related to DSM-5 main symptoms, and potential difficulties associated with the disability.
- **Step 3:** Define one profile, ensuring that it corresponds to one and only one IDD level.
- **Step 4:** Associate difficulties and features with the profile.
- **Step 5:** If the student has only one IDD level, proceed to Step 6; otherwise, return to Step 3 and define a new profile.

- **Step 6:** Identify the learning objectives, considering your educational context and the student's needs.
- **Step 7:** Develop a learning plan that includes one or more adapted activities to address the learning objectives based on the student's IDD profile.

3.2 USER MODEL

Once you have classified the student's IDD using the taxonomy and defined a potential learning plan, it is time to implement it in the User Model. This allows you to search for specific resources tailored to the student's profile and find similar activities that can help personalize the learning plan.

A detailed guide on how to use the User Model can be found here: <https://robosteamsen.eu/userModel/public/home>
 The manual for using the tool is available here: XXXXX.

The steps to follow to use the User Model are as follows:

- **Step 1:** If the IDD already exists in the system, proceed to Step 2. If not, send the information about the IDD, including its levels, features, and associated difficulties, to mcong@unileon.es so it can be incorporated into the User Model.
- **Step 2:** Create one or more profiles for the student by completing the following steps in the User Model:
 - Step 2.1: Click on "Users Management" (Figure 4).

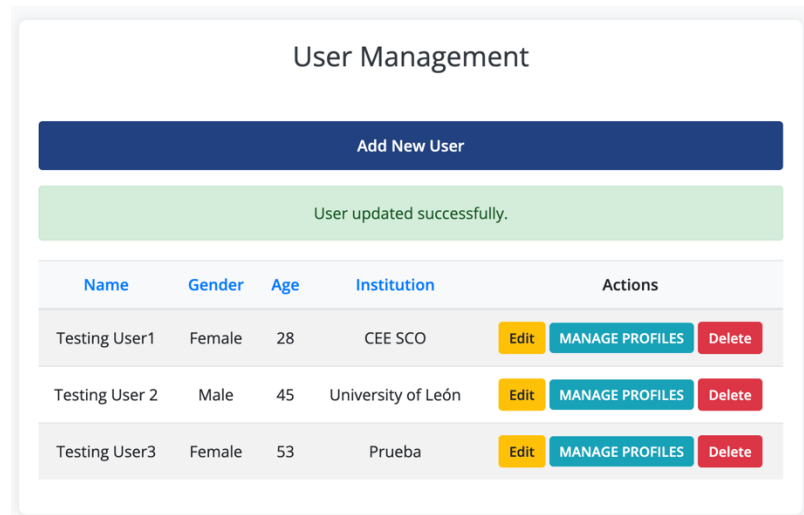
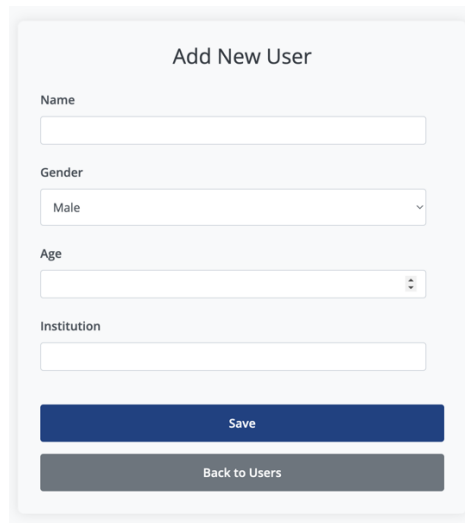


Figure 4. – User management

- Step 2.2. – Click on add a New User.
- Step 2.3. – Introduce the main data of your user, the name can be anonymous, but you need to be able to identify it later (Figure 5).



Add New User

Name

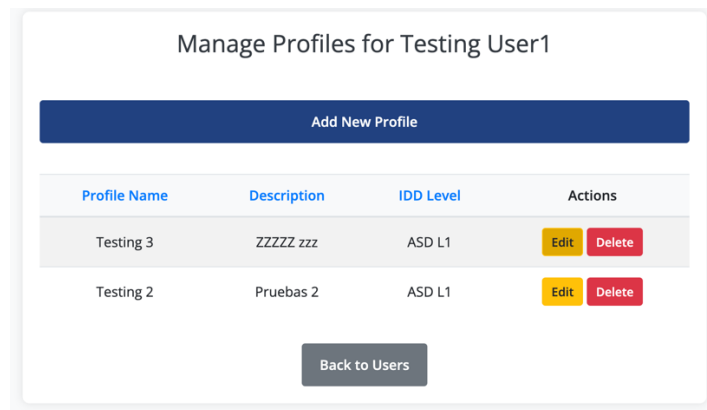
Gender

Age

Institution

Figure 5. New user form

- Step 2.4. – Identify the created user on the list and click on the manage profiles button of this user (Figure 6)



Manage Profiles for Testing User1

Profile Name	Description	IDD Level	Actions
Testing 3	ZZZZZ zzz	ASD L1	Edit Delete
Testing 2	Pruebas 2	ASD L1	Edit Delete

- *Figure 6. – Profile Management for the testing user 1*

- Step 2.5. – Click on Add New Profile.
- Step 2.6. – Fulfill the profile form including idd, level, features and difficulties. After this click on create (Figure 7)

- Figure 7. – Profile form for creation and edition.

- Step 2.7.- Go to step 2.5 to create as many profiles for this student as you need.
- Step 2.8. – Click on Home link to finish or on Users link if you want to go to Step 2.1. again and create new users (Figure 8)



Figure 8. – Breadcrumb with the description of the current user situation into the system

- **Step 3:** Once defined the user it is necessary to create a new learning plan for the user, to do so click on “Training Plans Management” link. Once in this section the steps to follow are:
 - Step 3.1. – Click on “Create New Learning Plan” (Figure 9)

Learning Plans			
Create New Learning Plan			
Name	User	Actions	
Testing LP	Testing User 2	Edit	Clone MANAGE ACTIVITIES Delete
Testing LP (Copy)	Testing User1	Edit	Clone MANAGE ACTIVITIES Delete
Plan 1	Testing User1	Edit	Clone MANAGE ACTIVITIES Delete
Plan2	Testing User1	Edit	Clone MANAGE ACTIVITIES Delete

Figure 9. – List of existing Learning Plans

- Step 3.2. – Create a plan for a user (Figure 10).

Create New Learning Plan

Plan Name

Completa este campo

Assign to User

Select a User

[Create Plan](#)

[Cancel](#)

Figure 10. – Form to create a new Learning Plan

- Step 3.3.- Click on Manage Activities button for the chosen learning plan (Figure 11).

Activities for Learning Plan: Testing LP		
Add New Activity		
Name	Description	Actions
Act1	AAAA	Edit MANAGE RESOURCES Delete

Figure 11. – Activities management view

- Step 3.4.- Click on Add New Activity for the specific plan, including a description, the difficulty to deal with (only one) and the learning objectives you aim to address (Figure 12)

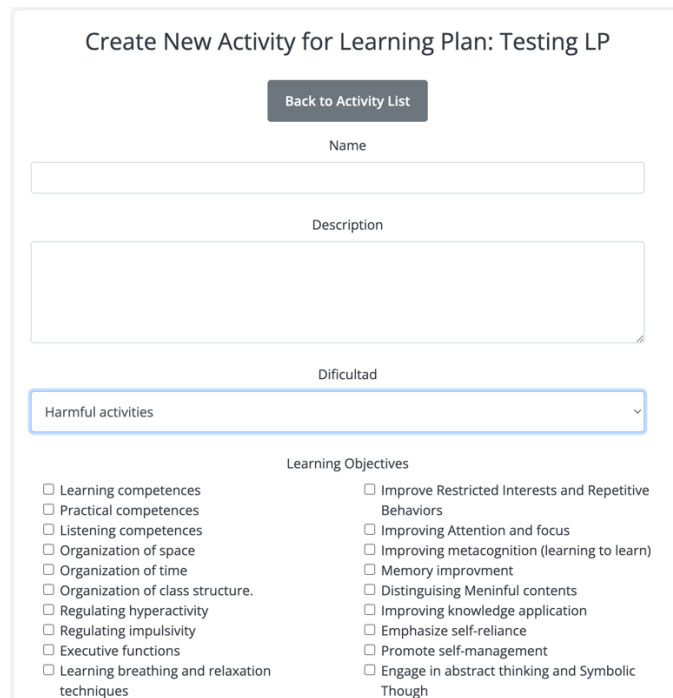


Figure 12. Create/Edit Activity form

- Step 3.5.- Per each activity it is possible to manage resources including one of several of the existing ones (Figure 13).

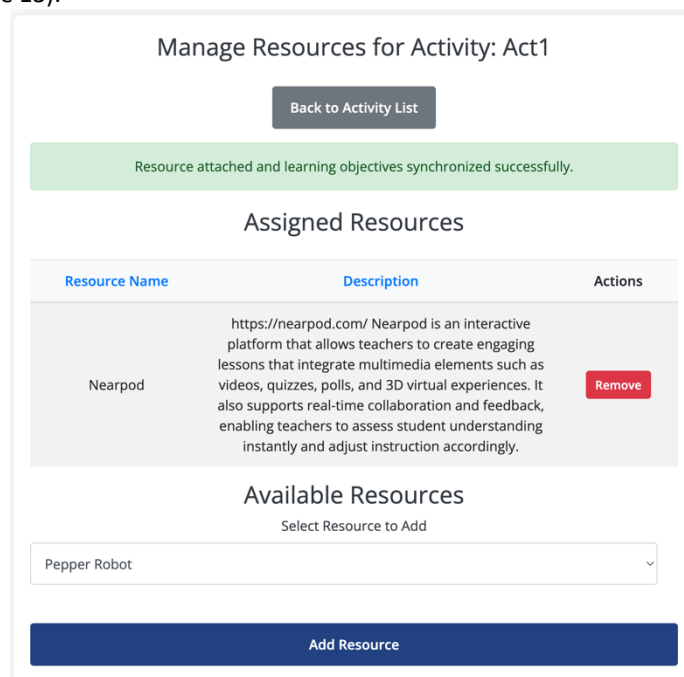


Figure 13. – Resources view for Act1

- Step 3.6.- Add as many resources as necessary going to Step 3.5.
- Step 3.7.- Add as many activities as needed to the learning plan, going to Step 3.3.

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Optional. Search for specific resources for student profile or for the educational difficulties or learning objectives in the option “Educational resources and activities search” (Figure 14).

Search Educational Resources

Select a search type:

Search by Difficulty

Search by Learning Objectives

Search by User Profile

Figure 14. – Possible searching options.

4. CASE SCENARIO SAMPLE

This section illustrates the use of the taxonomy and User Model for a simulated student. In this case, Claire has ASD Level 1, with features related to “Social communication and social interaction” and “Restricted, repetitive patterns of behavior, interests, or activities.” Her difficulties include “Problems Expressing Feelings,” “Mental Rigidity,” and “Literal Interpretation of Language and Abstractions.” The learning objective is to improve computational thinking in technology classes.

Steps to Follow Before Using the Taxonomy and User Model

- **Step 1:** Gather medical reports about the student and study them to define an accurate profile. The information described above was obtained through this process.
- **Step 2:** Analyze the student’s specific educational difficulties associated with their profile features. These have been described above.
- **Step 3:** Define the educational activity or activities to be developed, including the learning objectives. In this case, the goal is to improve computational thinking in technology classes through robotics, considering the student’s specific features. Activities will involve programming with robots, focusing on computations, conditionals, and repetitive sentences.

Using the Taxonomy

- **Step 1:** Check if the IDD is already included in the taxonomy. If it is, proceed to Step 3. In this case, it is already included.
- **Step 3:** Define a profile, ensuring it is associated with only one IDD level. Based on the medical reports, Claire’s profile was defined.
- **Step 4:** Associate difficulties and features with the profile. Claire’s profile includes “Social communication and social interaction” and “Restricted, repetitive patterns of behavior, interests, or activities” as features, and “Problems Expressing Feelings,” “Mental Rigidity,” and “Literal Interpretation of Language and Abstractions” as difficulties.
- **Step 5:** If the student has only one IDD level, proceed to Step 6. Otherwise, return to Step 3 to define a new profile. Claire has only one level of disability.
- **Step 6:** Identify the learning objectives based on the educational context and the student’s needs. For Claire, the objective is to develop computational thinking in technology classes.
- **Step 7:** Build a learning plan with one or more adapted activities to address the learning objectives. Considering Claire’s communication difficulties and mental rigidity, the learning plan should involve tasks that help her address communication challenges through interaction with a robot or computer. Tasks should be simple, with clear solutions to mitigate rigidity. The learning plan includes four activities:
 - Introduction to programming and communicating with a robot.
 - Navigating with a simple robot.
 - Solving a maze problem.
 - Addressing a repetition problem.
 Suggestions for these activities include providing clear instructions, illustrating content, offering problems with single solutions, and ensuring Claire feels comfortable with the robot.

Implementing the Solution Using the User Model

- **Step 1:** If the IDD is already included, proceed to Step 2. This is the case here.
- **Step 2:** Create one or more profiles for the student in the User Model. Use the “Users Management” feature to add a new user, then manage profiles to include ASD Level 1, its features, and associated difficulties.
- **Step 3:** Create a new learning plan for the student using the “Training Plans Management” feature. Four activities, as defined in the taxonomy, were included in Claire’s plan. The first and last activities focus on communication issues, while the other two address mental rigidity.

To identify the best resources for each activity, use the “Educational Resources and Activities Search” feature. Search for resources and activities tailored to Claire’s profile to meet her specific needs. After selecting resources aligned with the learning objective, return to Claire’s learning plan, manage activities, and associate the chosen resources with each activity. For example, Bee Bot was selected for the maze problem, and Pepper Robot for the repetition problem. These choices were based on the school’s available equipment and context.

4. REFERENCES

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Polloway, E. A., Bouck, E. C., Patton, J. R., & Lubin, J. (2017). Intellectual and developmental disabilities. In *Handbook of special education* (pp. 265-285). Routledge.

