Study of security, feasibility of use and usability of IVRAP

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1. INTRODUCTION

Study Objectives

We propose the current study with the aim of verifying that the software created in the IVRAP project in its version, used in Oculus glasses Quest 2 is a safe, viable and usable tool:

Safety: We want to verify that using IVRAP does not generate any adverse effect of greater or lesser impact. To this end, we included a series of precautions (such as not including participants with epilepsy, migraines or vertigo in the sample) and also added a series of checks at the end of each session (a series of systematic records to record any indisposition on the part of the participants during or after the use of IVRAP).

Feasibility: In this first study with the IVRAP prototype, it is important to verify that most of the participants can use it and complete the intervention sessions as proposed, in order to consider that the approach is feasible in order to provide an intervention in which IVRAP is used on a regular basis. This first feasibility study will make it easier to take subsequent steps to carry out more complex studies with more ambitious research objectives.

Usability: In order to introduce new improvements and prepare the IVRAP software for publication and for use by anyone who downloads it, we have found it necessary to carry out a series of tests aimed at measuring and improving the ease of use of each of the elements of the interface and the IVRAP exercises or activities themselves. Usability is a measure that has three components: effectiveness (verifying that the tool serves what it is designed for), efficiency (it allows it to fulfil its function in a time or with optimal resources) and satisfaction (the participants say they have had a good experience after using the tool).

Participants

The participants in this first study with the IVRAP prototype are teachers from the participating centers and students who must meet a series of requirements:

- Have the authorization of the legal guardians to participate in the study (informed consent document included as Annex 9)
- Be between 6 and 18 years old
- Have a diagnosis of Autism Spectrum Disorder and/or Intellectual Disability
- Not present a history of epilepsy, migraines or vertigo (this criterion also applies to teachers).

Study Structure

The IVRAP software implements an individual VR work system based on three components: an "input shelf" where the trays with the tasks to be carried out are located, a "work table/area" where they have to be deposited to be carried out and a "output shelf" where the tasks already completed will be stored.

For the configuration of the sessions, the tutor has an interface that allows:
- Customize some general aspects of operation (such as the level of sensory load, light-guided operation, or whether errors are allowed in performing tasks)
- Configure sessions (composed of a series of activities) taking into account the level of previous progress of the student
- Start the sessions, after which you have to give the glasses to the student
- Adjust the height and orientation of the user with respect to the environment, using the buttons and joystick of the right command/controller, to make it easier for the user to reach the different elements comfortably
- Review the results of the sessions already carried out

In this study we need to take into account both the perspective of the teacher, when handling the interface and devices to prepare, monitor and review the sessions, as well as the perspective of the students when using the system. The study is limited to everything or what happens when the IVRAP application has already been launched and the system is ready for transmission on another screen that allows the teacher to see what the student is doing at all times. The problems and difficulties that may arise in the installation and preparation of the glasses or support screen are outside the scope of this study.

What activities should be tried?

The study does not intend to exhaustively check all the activity tasks (in all their possible configurations) but it is necessary to carry out a sufficient number of tests for each one of the operating modes or conditions that are allowed: (1) Objects with or no automatic movement on release and (2) Allow or disallow errors.

For this reason, we request that in each of the four participating educational centers (Koynos, Trébol, Cambian and Sobe), at least two participants use the system in each of the combinations of these two conditions:

- Allow errors, no automatic movement when dropping objects
- Do not allow errors, no automatic movement when dropping objects
- Allow errors, with automatic movement when dropping objects
- Do not allow errors, with automatic movement when dropping objects

2. USE OF IVRAP AS A TEACHER

The study from the teacher's perspective consists of two parts: (1) free exploration followed by open questions and (2) performance of previously defined tasks.

Free exploration and interview

It is recommended that this exploration be carried out with the participation of two teachers: one of them will take notes while the other uses the system and will conduct the interview at the end. The system should be used in an unstructured way for 10-20 minutes, in order to assess how intuitive the interface is (in the sense that it indicates what can be done without having to read a manual). The teacher who does not use the glasses will take note of the comments or observations that you can make while using IVRAP. You should document what things you do not understand, if there is any information missing that prevents you from continuing to use it (for example, if you do not know how to exit a certain screen or activity), collecting any comments or impressions.

As an interview, the observer should ask these questions at the end of the exploration (we appreciate if you can record the interview on video or audio):

- What did you like the most about the IVRAP tool?
- What did you like the least?
- What functions would you most like to use IVRAP for?
- Do you have any ideas or suggestions for improvement?

In Annex 1 there is a form to collect the answers.

Structured tasks ("task test")

Once again, it is recommended that one person guides this task test, indicating to the teacher wearing the VR glasses the sequence of tasks to be carried out and collecting the difficulties encountered, as well as marking a score for each of them that in relation to the three questions of the After Scenario Questionnaire (ASQ; Lewis 1995) provided as an Annex:

1) In general, I am satisfied with how easy it is to accomplish this task;
2) Overall, I am satisfied with the time spent on this task;
3) In general, I am satisfied with the support information when performing this task.

For each of the 10 tasks listed below, the response score to each of the three questions must be collected on a 7-point scale ranging from 1 point "Totally disagree" to 7 points "Totally agree". agreement".

In addition, the observer must record, also for each task, whether the teacher who has tested it has managed to complete the task or not. A record sheet for the homework test is provided as Annex 2.

Tasks for teachers:
- o Task 1: Register a user by entering their name and date of birth
- o Task 2: Go into the user customization options and "Test the different levels of sensory load", also choose "Do not allow errors" and "Automatic movement when dropping objects"
- o Task 3: Create a new session with 2 training activities and start the session
- o Task 4: Adjust the height and position of the table/shelves using the right controller joystick
- o Task 5: Carry out, as if you were the student, the session created in Task 3
- o Task 6: Create a new session with 4 predefined activities: One for movement, one for classifying, one for matching and one for Half and Half
- o Task 7: Carry out, as the student, the session created in Task 4.
- o Task 8: Save the session data
- o Task 9: Analyze the progress map
- o Task 10: Analyze the last session carried out

At the end of the session, two questionnaires must be administered, one related to security and the other to usability (System Usability Scale , SUS; Brooke, 1996).

Post-session safety questionnaire (adapted from McCleery , et al, 2020):

- o How are you feeling now that the virtual reality session is over?
- o Did you notice during the session or do you now notice any unusual physical side effects, such as dizziness or disorientation?
- o Have you felt bad at some point?
- o Do you have any pain in any part of your body?
- o Did you feel safe during the Virtual Reality experience?
- o Were you comfortable during the Virtual Reality experience?
- o Were the breaks between tasks too short, too long, or just right?
- o Did you like having participated in this Virtual Reality study?
- o Do you have any recommendations on how we could improve the VR platform or experience for you or others?
- o Is there anything else you'd like us to think about as we continue with this particular research study?

Post-session usability questionnaire (1, totally disagree – 5 totally agree):

1. *I think that I would like to use this system frequently.*
2. *I found the system unnecessarily complex.*
3. *I thought the system was easy to use.*
4. *I think that I would need the support of a technical person to be able to use this system.*
5. *I found the various functions in this system were well integrated.*

6. *I thought there was too much inconsistency in this system.*
7. *I would imagine that most people would learn to use this system very quickly.*
8. *I found the system very cumbersome to use.*
9. *I felt very confident using the system.*
10. *I needed to learn a lot of things before I could get going with this system.*

3. USE OF IVRAP AS A STUDENT

For the evaluation of the safety, feasibility and usability of IVRAP by students with ASD/ID from the participating centers, it is necessary that the teacher in charge has previously created the profiles of each one of them within IVRAP and that before delivering the glasses each student has prepared a session with various tasks to be carried out.

In order for the teachers to have been able to accumulate some experience in handling IVRAP, it is necessary that this phase be carried out after the evaluation of usability by the center's teachers.

We ask that two participants from each center participate in each of the following conditions or custom settings:

custom settings	Participants by center
Do not allow errors, with automatic movement when dropping objects	two
Allow errors, with automatic movement when dropping objects	two
Do not allow errors, no automatic movement when dropping objects	two
Allow errors, no automatic movement when dropping objects	two

The table above shows a possible distribution of participants, including first of all the simplest modes of operation (in which the students with the greatest difficulties are suggested to participate), followed by the modes in which the operation is somewhat more complex by allowing errors and any movement of the objects (in which it is suggested that students with the highest level of skill development participate).

Likewise, we request that each student participate in two VR sessions, a first contact session, which incorporates some of the available training activities and, if desired, some basic predefined activity, and a second activity, on a different day, in the one that they carry out several of the predefined activities, choosing these according to the capacities of the student. For example, those with lower skills will be able to perform "move" tasks in which they only have to place the balls in the hole, and those with a higher level of skill development will be able to perform "half and half" tasks that involve moving operations. addition and subtraction and knowledge of numbers.

Teachers should plan in advance what specific activities they will offer each student. It is necessary for teachers to know well the students who are going to participate, especially when they have significant communication difficulties, so that they can help interpret what happened during the sessions and include that information in the corresponding record sheets.

In the case of students, four tests or records are proposed as part of this study: Task test, followed by some questions or record about security, a usability test and some open questions about the session.

Tasks test

Given that it is intended that each student use the predefined activities that best fit their level of skills development, it will be the teacher who must choose which activities to carry out and incorporate them into the session, indicating the choice also in the registration sheets that are provided. This is offered in Annex 5.

The teacher can use either their hands or the Oculus controllers or remotes Quest to create the sessions. Once the teacher gives the glasses to the student, the teacher can use the controller to exit an activity or to adjust the height and orientation in which the images are displayed (using the joystick on the right controller). It is important to remember that while the controller is being used, the student will not be able to see their (virtual) hands in the VR glasses and therefore will not be able to manipulate the environment. However, once the controller is placed on a non-moving surface (on a table) the student will begin to see his hands again if he places them within the field of vision, and the teacher will be able to physically help him manipulate the environment, being able to guide the student's hands with your hands when you consider it necessary.

We ask that between 3 and 5 activities be carried out in each session. In the event that the child shows any indisposition during the session (such as dizziness or signs of feeling ill), the session must be abandoned immediately. In the event that more than 5 activities are desired (up to the 9 allowed by IVRAP), only the details of the first 5 will be recorded on the registration sheets.

For each of the 3-5 included activities, whether or not you have completed it will be recorded and the answer to the next three questions will also be recorded. In the event that the student himself has the necessary understanding and communication skills, he will indicate the answer with a score of 1 to 7 points (varying between 1 "totally disagree" and 7 "totally agree") . Otherwise, it will be the teacher who does it, based on the following estimates:

Ask	Scoring Criteria
In general, I am satisfied with how easy it is to perform this task	1 point if you have not been able to complete the task with help 2 or 3 points if you have done it with physical help 4 or 5 points if you have done it with verbal help 6 or 7 points if you have done it without help
Overall, I am satisfied with the time spent on this task	Set the score based on the time the teacher believes the student would have taken to complete an identical task in a real environment
Overall, I am satisfied with the support information when performing this task	Set the score based on how the teacher believes the visual clarity of the VR task has influenced the student's performance on this particular task.

Safety record

A safety log sheet is provided in Annex 6 to be completed at the end of each session. In the event that the student does not have the necessary comprehension and communication skills, it will be the teacher who knows him well who will complete this sheet based on what he has observed in the session.

Post session usability test

Annex 7 offers a record sheet on usability according to the SUS scale, which must be completed at the end of each session. In the event that the student does not have the necessary comprehension and communication skills, it will be the teacher who knows him well who will complete this sheet based on what he has observed in the session. Alternatively, you can use a system of faces with different levels of satisfaction to collect the user's opinion about each of the questions.

Interview about the session

A record sheet for the interview with open-ended questions on usability is provided in Annex 8, which must also be completed at the end of each session. In the event that the student does not have the necessary comprehension and communication skills, it will be the teacher who knows him well who will complete this sheet based on what he has observed in the session.

As a complementary strategy to be able to carry out this "a posteriori" analysis of the session together with the student, the teacher can record the session (using the "record

video" button within the Oculus app on the tablet or phone where it is recorded).
retransmits the session) and visualize it with the student to collect their reactions.

4. RESULTS

TREBOL and CAMBIAN School sent their results before the moment of writing this report, therefore their results are included. KOYNOS and SOBE have also submitted them and their results will be later included in the open-access paper that is being written by the authors of this study.

A total of 6 teachers and 14 students tested IVRAP (3 teachers and 7 students from CAMBIAN School in the UK and 3 teachers and 7 students from Trebol School in Spain).

Another two students were initially enrolled in the study (included with * in the tables below). In the first of the cases (MM-1 from Trebol School) he rejected using VR Glasses in the first session and couldn't go through the research procedures. In the second case (ID-8 from Cambian School) he participated, but his family retired the authorisation to use his data, so he was removed.

The next section summarizes the results obtained:

Teachers' results

Next table summarizes the answers to the **teachers' free exploration and interview**:

What did you like the most about the IVRAP tool?
- The realism of everything. More specifically, the activities with animals (three teachers from two schools highlighted this)   - It made it very easy to plan the sessions   - The contents are very motivating for users   - It is really flexible and allows customization   - Being more interactive as you can use your hands (much better than with controllers)   - A huge sense of reality.   - Very well structured and organised   - Enthusiastic to use VR for many other competences areas in the Curriculum (- Comfortable, motivating and funny space
What did you like the least?
- I liked all.   - Some kids might have some difficulties using it.   - Having to press the bottoms a few times to work, when setting up the sesssion.

- Being my first time with VR makes that I would need more time to get used to the hand interaction but it was great.
- Difficulties when trying to drop activity trays

What functions would you most like to use IVRAP for?

- For classroom activities where visual support is very important.
- Very useful for students with important learning disabilities
- For training students on logic/mathematics and literacy skills

Do you have any ideas or suggestions for improvement?

- To have new activities on a carpet to develop symbolic play with different elements (cars, cup, etc.)
- Sometimes it was difficult to drop objects from the hand (three teachers reflected this from two different school, it was awkward when you cannot drop it)
- Reduce some lags when interacting with the hands (very occasionally)
- Having an avatar/pet that guides you through the use of the tool (both for teachers and students)
- Creating an early childhood classroom so that younger children can use it, with rounded/collaborative tables and activities.

On the **teachers' tasks tests**, all the teachers did all activities finished all activities and scored 6/7 in all the 10 questions and sub-questions related to the easiness, time efficiency and support information provided by the tool.

On the **post-session safety questionnaire,** three teachers reported some difficulties in the post-session safety test. One of the teachers explained that she felt "a bit disoriented but minimal" after the VR session. A second teacher said she felt dizzy just after finishing. Another teacher reported having a light headache after the session, attributed by the teacher to "inappropriate adjustment of the glasses belt that made the use uncomfortable".

On the **SUS Usability Scale**, the average score of all teachers was 88,83 points. A score over 68 is considered a good result according to that scale (Sauro, 2011)

Complementary, one of the Teachers voluntarily provided a personal testimony about the use of IVRAP that can be found at Annex 11.

Students' Results

This table summarizes the participants from both TREBOL and CAMBIAN School.

ID	AGE	GENDER	Intellectual Disability	COMMENTS
TREBOL				
A-1	8	M	N	Functional language but difficulties in understanding others' language. Low tolerance to frustration
AL-1	8	M	N	High-functioning, fully functional language and very good comprehension, his greatest difficulty is in the social and sensory field.
DF-1	16	M	Y	He is a student with fully functional language and a lot of comprehension, he has a good level, but he is in special education, he is very rigid and you have to explain a lot of things in daily life for him to understand.
HG-1	6	M	Y	Good understanding of language, non-intelligible speech. Low tolerance to frustration.
LA-1	7	F	Y	Simple functional language, limited understanding, echolalia.
*MM-1	8	M	Y	Poor language, better understanding than expression
VL-1	6	M	N	He is a high-functioning student with fully functional language and good comprehension, if there is a difference between his expression and his comprehension, the former being better.
XL-1	8	M	N	Functional language and good understanding, very rigid thinking with behavioural difficulties
CAMBIAN				
ID-1	15	M	NO	Asperger's; Pathological Demand Avoidance (PDA); ADHD; Anxiety Sensory processing difficulties; OCD
ID-2	15	M	NO	ASD; Anxiety disorder; Behavioural issues; Sleep difficulties; Colitis; Auditory processing disorder; Mild dyspraxia; Irlen syndrome; Severe

				social language impairment; Working memory impairment; Elevated anxiety and depression
ID-3	14	M	NO	ASD; Cognitive behaviours; PDA
ID-4	17	M	NO	ASD/ ADHD
ID-5	14	M	NO	ASC, ADHD, Anxiety/Low Confidence, Emotional regulation difficulties.
ID-6	13	M	NO	ASD; Dyspraxia; Low muscle tone; Complex social communication difficulties; Delayed expressive and receptive language Skills; Difficulties with cognitive and learning Skills; social interaction; emotional regulation and self-help Skills; Complex sensory needs.
ID-7	14	M	NO	ASD, ADHD
*ID-8	-	-	-	-

Answers to the interview:

What did you like the most about the IVRAP tool?
- Vegetables activity (A1)
- I liked the experience of VR (DF-1)
- Dinosaurs activities and physics of elements (DF-1)
- The simplicity of the tasks (HG-1)
- To play (HG-1, XL-1)
- Balls disappear when dropped into the floor, and then they reappear (LA-1)
- Associating animals in the ground, water or sky (VL-1, XL-1)
- Variety of tasks (ID-2)
- When picking the objects (ID-3)
- If the lightning is ok – hand tracking seems pretty good (ID-4)
- Move balls to the right task (ID-4)
- Handtrack (ID-5)
- It is amazing the fact that you can use hand tracking in VR (ID-6)
- The dynamism of the control of the space (ID-7)

What did you like the least?

- Shapes (A1)
- Picking up and dropping shelves (DF-1)
- Nobody else in the classroom (HG-1)
- Tennis balls (LA-1)

- Difficulties grabbing objects (VL-1, XL-1)
- Hand tracking is a bit inaccurate (ID-1)
- Some animals such as bugs or birds are too small to pick up (ID-1)
- Hand tracking, feels strange (ID-2)
- Shelves & trays (ID-3)
- Half and half task was annoying (ID-3)
- Half and half animals – tedious (ID-4)
- I would rather to not to stand up to do the activity (ID-5)
- Graphics (ID-6)
- Trays – at first (ID-6)
- Not challenging – must tend to get bored (ID-7)

What functions would you most like to use IVRAP for?

- Subjects like Maths – adding and substraction (ID-1)
- Associate tasks (ID-2)
- Maybe for subjects like Maths or English (ID-3)
- I guess for improving Skills (ID-5)
- Forces you to use hand movements to prepare you for the real world (ID-6)
- Categorising vehicles (ID-6)
- In a basic level I guess most of the tasks are useful (ID-7)
- Foods (DF-1)
- To play with toys (LA-1)
- To discover new things (XL-1)

Do you have any ideas or suggestions for improvement?

- Making it easier (A1)
- Allowing me to see my school in the distance (A1)
- Make holes a bit smaller in the first activities (DF-1)
- Better lens focusing (DF-1)
- To have other environments, like a house (HG-1)
- To see more people in the classroom (HG-1)
- Substitute the shapes tasks (LA-1)
- Using VR to make a party (LA-1)
- To improve how easy is to take objects (VL-1)
- Having ninjas to fight with (VL-1)
- A bit of lag when picking the object (ID-1)
- Light levels might not be good enough for accurate tracking (ID-1)
- Some animals such as bugs or birds are too small to pick up (ID-1)
- Textures might be not to stretched in the boxes when a task is completed with a tick (ID-1)
- Half and half tasks – might be a possibility to snap the model (ID-1)
- For interface and hand tracking, I would rather use controllers (ID-2)
- Explore the possibility of using other headsets (ID-1)

On the students **Tasks tests**:

- All the 14 students completed all the tasks they were offered (a total of 127 tasks, 9 tasks per participant on average).
- All students from Trébol School enrolled in two sessions. In Cambian school, as participants were high functioning, they preferred to concentrate all the tasks in just one session (with the exception of one of the students).
- Every task was scored on a 1-7 scale about their easiness, the necessary time and the visual support provided. The results of performance on the tasks tests were 5-7 in most of the cases. In the Annex 10, the details of all the tasks performance are included.

On **Safety evaluation**, only one of the 14 participants (HG-1, 6 years old) felt a bit dizziness after session 1 and felt uncomfortable in hands and eyes, only in one of the two sessions

On the **SUS Usability Scale**, the students' average score of all teachers was 83,21 points. A score over 68 is considered a good result according to that scale (Sauro, 2011)

5. DISCUSSION AND IMPLICATIONS FOR IVRAP IMPROVEMENT

The fact that all students completed all the planned tasks is a clear indicator of the feasibility of IVRAP Toolkit as an intervention tool for autistic students.

A small percentage of participants reported having some difficulties or sense of dizziness after using IVRAP. This should be properly reflected in manuals and training courses about IVRAP so that all potential beneficiaries are aware of this possible side-effects in order to prevent them and be attentive to its possible appearance.

Both teachers and students found IVRAP highly usable, according to their scores on SUS scale. In the interviews, most of them shown to be very enthusiastic about the possible use of this tool in their classrooom.

The answers provided in the interview, together with the task results provided on ANNEX 10 will serve as a guide to make minor improvements in the final version of IVRAP Toolkit.

ANNEX 1: TEACHER. FREE EXPLORATION AND INTERVIEW

School:	
Date:	
Teacher Name/Identifier:	
Notes on free observation:	
What did you like the most about the IVRAP tool?	
What did you like the least?	
What functions would you most like to use IVRAP for?	
Do you have any ideas or suggestions for improvement?	

ANNEX 2: TEACHER. TASKS' TEST

School:	
Date:	
Teacher Name/Identifier:	

#	Task	In general, I am satisfied with how easy it is to perform this task (1 – 7 points)*	Overall, I am satisfied with the time spent on this task (1 – 7 points)*	Overall, I am satisfied with the support information when performing this task (1 – 7 points)*	Task completed (YES / NO)
1	Register a user by entering their name and date of birth				
two	Go into the user customization options and "Try different levels of sensory load", also choose "Do not allow errors" and "Automatic movement when dropping objects"				
3	Create a new session with 2 training activities and start the session				
4	Adjust the height and position of the table/shelves using the right controller joystick				
5	Carry out, as if you were the student, the session created in Task 3				
6	Create a new session with 4 predefined activities: One for movement, one for classifying, one for associating and one for Half and Half				

7	Carry out, as if you were the student, the session created in Task 4.				
8	Save session data				
9	Analyze the progress map				
10	Analyze the last session				

*From 1 point "Totally disagree" to 7 points "Totally agree".

ANNEX 3. TEACHER. POST-SESSION SAFETY QUESTIONNAIRE

School:	
Date:	
Teacher Name/Identifier:	

Ask	Answers
How are you feeling now that the virtual reality session is over?	
Did you notice during the session or do you now notice any unusual physical side effects, such as dizziness or disorientation?	
Have you felt bad at some point?	
Do you have any pain in any part of your body?	
Did you feel safe during the Virtual Reality experience?	
Were you comfortable during the Virtual Reality experience?	
Were the breaks between tasks too short, too long, or just right?	
Did you like having participated in this Virtual Reality study?	
Do you have any recommendations on how we could improve the VR platform or experience for you or others?	
Is there anything else you'd like us to think about as we continue with this particular research study?	

ANNEX 4. TEACHER. POST-SESSION USABILITY QUESTIONNAIRE

School:	
Date:	
Teacher Name/Identifier:	

#	Ask	Punctuation*				
		1	2	3	4	5
1	I think I would like to use IVRAP frequently					
2	I found IVRAP unnecessarily complex					
3	I thought IVRAP would be easy to use					
4	I think I would need the support of a technician to be able to use this system					
5	I found the various functions of this system to be well integrated					
6	I think there is too much inconsistency in IVRAP					
7	I imagine that most people will learn to use IVRAP very quickly					
8	I found IVRAP very complicated to use					
9	I felt very safe using IVRAP					
10	I would need to learn many things before starting with IVRAP					

* From 1 "totally disagree" to 5 "totally agree"

ANNEX 5. STUDENT. TASKS' TEST

School:	
Date:	
Student Name/Identifier:	
Age:	
Sex:	
Teacher Name/Identifier:	
Personalization settings in the session:	Objects not automatically moving when dropped Allow mistakes
Description of the student's profile (fill in only once):	

Task	In general, I am satisfied with how easy it is to perform this task (1 – 7 points)*	Overall, I am satisfied with the time spent on this task (1 – 7 points)*	Overall, I am satisfied with the support information when performing this task (1 – 7 points)*	Task completed (YES / NO)
Take the activity trays from the shelf and bring them to the table				
Take the trays already made and take them to the "finished" shelf				
Completion of the task (indicate name):				
Completion of the task (indicate name):				
Completion of the task (indicate name):				
Completion of the task (indicate name):				

					25
Completion of the task (indicate name):					

* The student should be asked and, when this is not possible, the scoring criteria contained in this guide should be used.

ANNEX 6. STUDENT. SECURITY REGISTRATION

School:	
Date:	
Student Name/Identifier:	
Teacher Name/Identifier:	

Ask	**Answers**
How are you feeling now that the virtual reality session is over?	
Did you notice during the session or do you now notice any unusual physical side effects, such as dizziness or disorientation?	
Have you felt bad at some point?	
Do you have any pain in any part of your body?	
Did you feel safe during the Virtual Reality experience?	
Were you comfortable during the Virtual Reality experience?	
Were the breaks between tasks too short, too long, or just right?	
Did you like having participated in this Virtual Reality study?	
Do you have any recommendations on how we could improve the VR platform or experience for you or others?	
Is there anything else you'd like us to think about as we continue with this particular research study?	

ANNEX 7. STUDENT. USABILITY TESTING

School:	
Date:	
Student Name/Identifier:	

#	Ask	Punctuation*				
		1	2	3	4	5
1	I think I would like to use IVRAP frequently					
2	I found it difficult and I think it could have been easier					
3	I thought it would be easier to use					
4	I think I would need more help from my teacher to be able to use it					
5	activities worked well					
6	In each activity you had to manipulate the elements in a different way					
7	I imagine that most people will learn to use IVRAP very quickly					
8	I found cumbersome handling IVRAP					
9	I felt very safe using IVRAP					
10	I would need to learn many things before starting with IVRAP					

* From 1 "totally disagree" to 5 "totally agree"

ANNEX 8. STUDENT. INTERVIEW

School:	
Date:	
Student Name/Identifier:	
Teacher Name/Identifier:	
General notes about the session:	
What did you like the most about the IVRAP tool?	
What did you like the least?	
What functions would you most like to use IVRAP for?	
Do you have any ideas or suggestions for improvement?	

ANNEX 9. INFORMED CONSENT AND CONFIDENTIALITY COMMITMENT

1.-   INFORMATION TO THE RESEARCH PARTICIPANT

The research project for which we ask your participation is entitled :
"IVRAP: Immersive Virtual Reality as a Tool for Autistic Pupils and Teachers (Erasmus+ 2019-1-ES01- KA201-065156)" .

In order for you to participate in this study, it is necessary to have your consent, and that you know the basic information necessary for said consent to be considered truly informed. Therefore, please read the following information carefully. If you have any doubts, express them, before signing this document, to the coordinator of this research, either personally, by phone or by email. The details of the research coordinator also appear in this document.

The basic information you need to know is as follows:

a)   *Objective of the study* :

Within the framework of the IVRAP project, a prototype of an individualized work system supported by virtual reality technologies has been developed that aims to help children with autism learn to perform tasks autonomously and effectively.

The objective of the research in which we request your collaboration is to validate the viability, safety and usability of said technological tools developed in the project. To do this, it has the collaboration of the ▮▮▮▮▮▮▮▮▮▮ center , from where a group of children with autism/intellectual disability and professionals who work with them will participate.

b)   *Methodology to be used for the study, type of collaboration expected from you and duration of said collaboration* :

The research design that is intended to be followed is that of a study of security, feasibility and usability. Participants will have to test the system in short sessions and their reactions and responses will be recorded.

c)   *Possible discomfort and Risks of your participation in the study* : To avoid possible problems derived from the use of computer systems, children who present epileptic seizures, especially those of photosensitive origin, as well as children who have a history of migraines or vertigo, will not participate. If your child has any of these conditions, we do not ask for your cooperation in this pilot study. No other possible risks of participating in the study are known.

d) *Measures to respond to adverse events* : Due to the type of participation requested (use of materials analogous to those used at school and use of a non-invasive virtual reality system), no adverse events are expected, although as part The study collects possible adverse effects derived from the type of technology used.

e) *Measures to ensure adequate compensation in the event that you suffer any damage* : the educational center participating in the project has the corresponding civil liability insurance for all its actions in the school environment, as is the case in this study.

f) *Benefits that are expected to be obtained with the research* : with the completion of this study, the aim is to obtain a reliable and proven tool to favor personal autonomy and precision in the performance of tasks by students with autism.

g) *Consequences of non-participation* : if you prefer not to participate, this will not affect your right to health care or to receive any type of service, and the relationship with the people who offered you to participate will be just as cordial and dedicated with those who refuse to participate than with those who do participate.

h) *Possibility of withdrawal at any time and consequences* : You can withdraw from the project at any time by signing the revocation of consent that is included at the end of the document. Your withdrawal will not have any negative consequences for you, and will be accepted without problems by the research team.

i) *Who financed the study?* : European Union, Erasmus+ Program

j) *What institution performs it?* : It is carried out by the IRTIC of the University of Valencia in collaboration with the ▒▒▒▒▒▒▒▒▒▒▒ Center .

k) *Gratuity for participation* : Study participants will not receive any financial compensation for participating in this study.

l) *Forecast of subsequent use of the results* : the results will be used for the purpose of teaching, research and scientific publication, as well as the improvement of technological tools for people with autism and/or intellectual disabilities. These results will be published completely anonymously as detailed in the section called '2. Confidentiality commitment'-

m) *Photographs and video* recording: In order to verify that the procedures are applied in an identical and reliable manner in the different participating centers, it will be necessary to make video recordings when the different tools of the project are used.

By signing this consent, you accept that these recordings are made both in your educational center and later viewed by the research team of this study. Said consent or authorization does not include the use of said videos in research forums such as congresses or other scientific meetings. If you want to use these videos for this purpose, the research team will contact you again to request a new authorization.

n)   *UV research team* : Gerardo Herrera Gutiérrez, Lucía Vera Mahiqués and Patricia Pérez Fuster.

Teachers participating in the center ▬▬▬▬▬

o)   *Contact details of the coordinator of this research study for clarifications or queries* : Gerardo Herrera Gutiérrez. Postal address: IRTIC - University of Valencia. C/ Professor José Beltrán, 2. 46980 Paterna (Valencia); Electronic address: Gerardo.Herrera@uv.es ; Telephone: 616 02 92 33

p)   The project will be carried out following the international ethical criteria contained in the Declaration of Helsinki.

2.-   CONFIDENTIALITY COMMITMENT.

a)   *Measures to ensure respect for private life and the confidentiality of personal data* : The appropriate measures have been adopted to guarantee the complete confidentiality of the personal data of the research participants who participate in this study, in accordance with the Personal Data Protection Law (LOPD) 15/1999, of December 13.

b)   *Measures to access the relevant information for you arising from the investigation or the total results* : Know that you have the right to access the information generated about you and the person you represent in the study. These data include the initial data collection, the results of the use of the technology and the tracking records of technology use throughout the project.

c)   *Measures taken as it is an anonymized study* : An effective anonymization system has been established that does not allow subsequent identification of the participant. In no case will the consents granted, where the participant is identified, be combined with the information collection questionnaires used in the study. In the use made of the results of the study, for teaching, research and publication purposes, the due anonymization of personal data will always be respected, so that the research participants will not be identified or identifiable. These measures include the anonymous treatment of the information through numerical aliases within the computer files where the results of the IVRAP project are stored.

3.- CONSENT.

In the event that the research participant is a minor:
Mr/Mrs

_____
_____,
of legal age, holder of the ID: _____,
□ father, □ mother, □ legal guardian
of

_____
_____,
I hereby declare that:

I have been informed of the characteristics of the Research Project entitled: **«IVRAP: Immersive Virtual Reality as a Tool for autism Pupils and Teachers (Erasmus+ 2019-1-ES01-KA201-065156) »** .

I have read both section 1 of this document entitled "information to the research participant", and section 2 entitled "confidentiality commitment", and I have been able to formulate any doubts that have arisen in this regard. I believe that I have understood this information.

I am informed of the possibility of withdrawing from the study at any time.

Under these conditions, I consent to participate in this study.

And in proof of conformity, I sign this document in the place and on the date indicated below.

_____, _____ of _____ , 2022.

Name and surname of the child :	*Name and surnames of the father, mother or guardian* :	*Name and surname of the researcher* :
Signature:	Signature:	Signature:

If the study participant is an intellectually and emotionally capable adolescent between 12 and 16 years of age, their opinion must be heard and their participation in the study authorized by also signing this consent. In the case of minors who are not incapable or incapacitated, but who are emancipated or have reached the age of 16, it is not possible to give consent by proxy and it will be the study participant who will sign the consent (Law 41/2002).

REVOCATION OF CONSENT

I revoke the consent given on date _ _____ to participate in the project entitled **«IVRAP: Immersive Virtual Reality as a Tool for autism Pupils and Teachers (Erasmus+ 2019-1-ES01-KA201-065156)»** and, for the record, I sign this revocation.

On _____, on _____ of _____ , 20___.

Name and surname of the child : Signature:	*Name and surnames of the father, mother or guardian* : Signature:	*Name and surname of the researcher* : Signature:

If the study participant is an intellectually and emotionally capable adolescent between 12 and 16 years of age, their opinion must be heard and their participation in the study authorized by also signing this consent. In the case of minors who are not incapable or incapacitated, but who are emancipated or have reached the age of 16, it is not possible to give consent by proxy and it will be the study participant who will sign the consent (Law 41/2002).

ANNEX 10. RESULTS OF STUDENTS TASKS' TEST

TRAY HANDLING

Taking and dropping trays from/to the shelves					
Student	Take Tray-Easy	Take Tray-Time	Take Tray-Info	Drop Tray-Easy	Drop Tray-Time	Drop Tray-Info
A1-1	2	1	1	5	6	2
A1-2	7	6	6	7	7	7
AL-1-1	7	7	5	7	7	4
AL-2-2	7	7	7	7	7	7
DF-1-1	7	7	7	7	7	7
DF-1-2	3	1	1	3	3	7
HG1-1	7	7	7	7	6	7
HG2-2	7	7	7	7	7	7
LA-1-1	6	5	7	7	7	7
LA-1-2	7	5	7	7	5	7
VL-1-1	7	5	7	7	5	7
VL-1-2	7	6	7	7	6	7
XL-1-1	6	4	6	7	7	7
XL-1-2	7	7	7	7	7	7
ID-1	5	5	7	5	4	6
ID-2	5	7	7	5	7	7
ID-3	4	5	7	4	5	7
ID-4	4	5	7	4	5	7
ID-5	5	7	7	7	7	7
ID-6-1	7	7	7	7	7	7
ID-6-2	7	7	7	7	7	7
ID-7	6	6	6	6	6	6
Average	**5,91**	**5,64**	**6,23**	**6,23**	**6,14**	**6,55**

MOVING BALLS

Task name:	Move 2 balls down		
Student	X task-Easy	X task-Time	X task-Info
A1-2	7	7	7
Average	**7**	**7**	**7**

Task name:	Move 3 balls down		
Student	X task-Easy	X task-Time	X task-Info
A1-1	7	7	7
ID-2	7	7	7
ID-6-2	7	7	7
LA-1	5	5	7
VL-1	7	4	6
Average	**6,60**	**6,00**	**6,80**

Task name:	Move to right 2 balls		
Student	X task-Easy	X task-Time	X task-Info
A1-1	7	7	7
VL-1-2	7	7	7
Average	**7,00**	**7,00**	**7,00**

Task name:	Move to right 3 balls		
Student	X task-Easy	X task-Time	X task-Info
A1-1	7	7	7
AL-1	7	6	7
ID-1	6	6	7
ID-3	7	7	7
ID-4	6	7	7
ID-5	6	7	7
ID-6-1	7	7	7
ID-7	7	7	6
DF-1-2	7	7	7
HG-1-1	7	7	7
LA-1-2	7	4	7
Average	**6,73**	**6,55**	**6,91**

SORTING

Task name:	Sort by 3 sizes with colours		
Student	X task-Easy	X task-Time	X task-Info
ID-3	7	7	7
Average	**7**	**7**	**7**

Task name:	Sort by 3 widths with colours		
Student	X task-Easy	X task-Time	X task-Info
ID-3	7	7	7
XL-1-1	6	4	4
Average	**6,50**	**5,50**	**5,50**

Task name:	Sort by 2 positions		
Student	X task-Easy	X task-Time	X task-Info
XL-1-2	7	7	7
Average	**7**	**7**	**7**

Task name:	Sort by 3 positions		
Student	X task-Easy	X task-Time	X task-Info
ID-4	6	6	7
ID-5	5	7	7
ID-6-2	7	7	7
Average	**6,00**	**6,67**	**7,00**

Task name:	Sort by quantity		
Student	X task-Easy	X task-Time	X task-Info
AL-1	6	7	7
ID-5	5	5	6
DF-1	5	7	7
XL-1-1	7	7	7
Average	**5,75**	**6,50**	**6,75**

Task name:	Sort by 4 quantities		
Student	X task-Easy	X task-Time	X task-Info
ID-7	7	7	6
Average	**7**	**7**	**6**

Task name:	Sort by 3 volumes with colours		
Student	X task-Easy	X task-Time	X task-Info
DF-1	6	7	4
LA-1-2	7	5	7
XL-1-2	5	7	7
Average	**6,00**	**6,33**	**6,00**

Task name:	Classify 3 shapes by colour		
Student	X task-Easy	X task-Time	X task-Info
A1-1	2	2	2
Average	**2**	**2**	**2**

Task name:	Sort by 3 textures		
Student	X task-Easy	X task-Time	X task-Info
AL-1	7	7	7
ID-1	6	7	7
ID-6-2	7	7	7
HG-1-2	7	6	7
Average	**6,75**	**6,75**	**7,00**

Task name:	Sort by 2 colours		
Student	X task-Easy	X task-Time	X task-Info
AL-1	4	4	7
HG-1-1	7	7	7
VL-1-2	7	7	7
Average	**6,00**	**6,00**	**7,00**

Task name:	Sort by 3 colours		
Student	X task-Easy	X task-Time	X task-Info
ID-6-1	7	7	7
Average	**7**	**7**	**7**

Task name:	Sort by shapes		
Student	X task-Easy	X task-Time	X task-Info
ID-2	7	7	7
LA-1	5	6	6
Average	**6,00**	**6,50**	**6,50**

ASSOCIATION

Task name:	Associate vegetables		
Student	X task-Easy	X task-Time	X task-Info
A1-1	5	5	5
HG-1-2-	7	6	7
XL-1-1	6	6	7
Average	**6,00**	**5,67**	**6,33**

Task name:	Associate animals with animations		
Student	X task-Easy	X task-Time	X task-Info
AL-1	7	7	7
ID-2	6	6	7
ID-4	6	7	7
ID-5	6	4	7
ID-6-2	7	7	7
DF-1	6	7	7
HG-1-1	7	5	7
LA-1-2	7	4	7
VL-1	7	4	7
XL-1-2	7	6	7
Average	**6,60**	**5,70**	**7,00**

Task name:	Associate vehicles		
Student	X task-Easy	X task-Time	X task-Info
AL-1-1	7	6	7
ID-2	6	7	7
ID-3	7	7	7
ID-6-1	7	7	7
ID-7	7	7	6
DF-1-2	5	7	7
HG-1-2	7	6	7
LA-1	7	3	6
VL-2	7	7	7
XL-1-1	7	6	7
Average	**6,70**	**6,30**	**6,80**

HALF AND HALF

Task name:	Half and half - Dinosaurs		
Student	X task-Easy	X task-Time	X task-Info
ID-5	6	4	6
ID-6-2	7	7	7
DF-1	7	7	7
HG-1-1	7	6	7
VL-1	7	5	6
Average	**6,80**	**5,80**	**6,60**

Task name:	Half and half additions		
Student	X task-Easy	X task-Time	X task-Info
XL-1-1	7	5	7
Average	**7**	**5**	**7**

Task name:	Half and half subtract		
Student	X task-Easy	X task-Time	X task-Info
ID-1	6	7	6
ID-4	6	7	7
ID-6-1	7	7	7
Average	**6,33**	**7,00**	**6,67**

Task name:	Half and half creatures		
Student	X task-Easy	X task-Time	X task-Info
AL-1	5	6	5
ID-1	5	5	6
ID-2	7	6	6
ID-3	7	7	7
ID-7	7	7	6
HG-1-2	7	6	7
Average	**6,33**	**6,17**	**6,17**

ANNEX 11. FEEDBACK FROM A TEACHER FROM TREBOL SCHOOL

The next text is a testimony from one of the Teachers of Trebol School.

After having participated as a teacher in the sessions of the IVRAP project and after carrying out 16 sessions, 2 for each of the 8 participating students, I have been able to create my own perception of the experience and the truth is that I have been very surprised by what I have left finding. We have done it with students of different ages and levels, and also with different types of language, both expressive and comprehensive, which has made it a very varied experience and from which I have drawn various perceptions.

In the first place, to highlight how technology can be so motivating, in some of the selected cases I had serious doubts that they could really carry out the sessions and if I was going to find a way to explain how it works and that's how it has been, I just in 1 of the 8 cases it was not possible to carry it out, although I personally believe that by doing a desensitization with the glasses we could have carried it out, since we did not manage to hold the glasses for more than 5 seconds in several attempts.

Secondly, I have to say that motivation has made learning faster, since in all cases from the first to the second session there have been great changes both in use and in the time used to carry it out, even With those of us who have had to carry out the sessions on the same day and within the same hour, I mean by this having managed to carry out a session, even having to resort to total modeling to understand the use or giving constant instructions to be able to finish, that the next session a few minutes later, be totally independent.

Also note that the use of IVRAP is still work, they sit at a table and perform tasks as they would in any other session, but after a 'classic' session I have never seen my students run out to tell their parents excited about what they have done and how they have done it, instead of these virtual reality sessions that is how it has been, which brings us back to the motivation it generates. Although I must also say that this motivation means that in some cases they get distracted by what they can do virtually and we have to ask them to continue working.