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Human-Centered-Design Methodology

Creating AR and VR Learning Environments for Learners on the Autism Spectrum

DISCLAIMERS & GENERAL INFORMATION

This document is still a work in progress. Our intention is to offer an overview of the foundation and pillars of the developed methodology. However, please bear in mind that both this document as well as methodology itself will undergo continuous adaptation throughout the duration of the project.

All documents referred to below, which were created during the course of the project, can be accessed via our website https://bitthespectrum.infoproject.eu.

Introduction

This comprehensive guide has been carefully developed to equip you – educators, trainers, and creators of learning environments – with a clear roadmap for designing impactful Augmented Reality (AR) or Virtual Reality (VR) settings. These environments are designed not only to enrich overall methodological teaching and learning perspectives but to cater to the distinctive needs of a specific target audience.

The genesis of this methodology stems from the foundational principles and insights of Human-Centered Design (HCD). As you engage in the creation of digital learning environments with us, we encourage you to acquaint yourself with the HCD philosophy. For your convenience, we recommend immersing yourself in the online course curated within the BitTheSpectrum project. Through this interactive unit, you will gain a profound understanding of the HCD approach, its applicability in educational contexts, and an extensive grasp of the target audience – students with Autism Spectrum Disorder (ASD). Furthermore, you will delve into the modern technologies instrumental in forging these innovative learning environments.

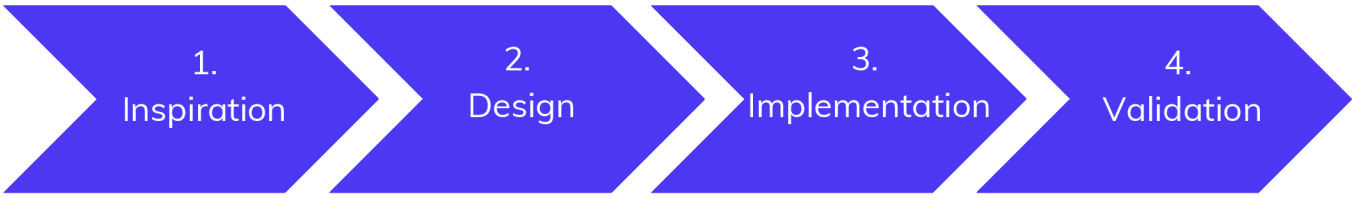
Should you wish to explore the realm of Human-Centered Design even further, we invite you to check out the Desk Research: HCDM.

Methodology

Inspiration	Understand your Audience Locate a Need Choice of Technology
Design	Ideate Develop Prototype Test
Implementation	Augmented Reality Virtual Reality
Validation	Educator Self-Evaluation Student Questionnaire

Methodology

The following steps offer you a holistic guide to create goal oriented immersive learning experiences. This methodology is tailored to be applicable for both Virtual Reality (VR) and Augmented Reality (AR) applications. It consists of four phases, which are clearly structured, and often times consist of multiple steps. Each phase provides you with a guideline on how to develop your learning unit. Within most chapters, you will come across concrete examples that illustrate how this methodology seamlessly integrates with VR and AR technology. We believe in example-based learning, and as such, we have incorporated concrete implementations and applications at relevant points, stemming from the development process of learning applications within the project. These real-life instances are intended to provide you with a clear grasp of how the methodology aligns with the dynamic realms of VR and AR.



Inspiration

The Inspiration phase of the design process corresponds to the stage of unit development where you set the foundation for your learning module. This is where you pinpoint the underlying challenge or concern to be addressed within your unit. Additionally, it involves the identification and understanding of your target demographic, along with the context or setting in which your learning module will be situated. To enhance the clarity of this process, we have identified three fundamental steps:

1. To design an appropriate learning unit, you need to know and **understand your audience.**

2. For the unit to have the intended learning effect, you need to **locate the right need/topic**.

3. Moreover, for the realisation of your idea you have to **choose a beneficial technology.**

You find the description of the 3 fundamental steps on the following pages:

1. Understand your Audience

As you have become acquainted with, human-centered design revolves around the individuals engaged in the process. This includes to comprehend their necessities and prerequisites, as well strength and abilities. It further involves the understanding of their aspirations and potential. Integrating the individuals you are designing and creating for is crucial in this undertaking, necessitating attentive listening to their insights.

In the case of learners on the autism spectrum, this responsibility gains heightened significance, given that Autism spectrum disorder (ASD) manifests uniquely in each individual. Several avenues exist to foster a deeper understanding of your learners. Conducting interviews with them, probing their interests and proficiencies, serves as a valuable approach. Insights can also be gleaned from individual medical diagnoses as well as understanding the ability to function. Another means to better apprehend your students is through assessment tools. Our partners at the Luovi Vocational College in Finland have devised the RUORI assessment tool https://luovi.fi/en/luovi-global-education/ruori-assesment-tool/. Specifically tailored for learners with special needs, RUORI evaluates a student's engagement capability. Going beyond expert-assessment tools, RUORI incorporates a self-assessment tool that incorporates the student's perspective in the assessment process.

Regardless of the approach or methodology employed, acquiring insights into your learners and their requirements remains fundamentally pivotal for a successful human-centered design approach and for advancing to the subsequent crucial stage.

2. Locate the Need

Only when you possess an understanding of the learners, you can begin to envision potential content for learning modules. The Human-centered design places considerable emphasis on formulating pertinent queries and addressing root causes instead of surface-level indications. This naturally prompts the inquiry of how one identifies the accurate need or issue. To address this, you must draw upon the amassed information and tools. For instance, you are aware that students on the spectrum frequently encounter challenges with their social skills, resulting in various difficulties in their daily lives. Rather than addressing the consequences (symptoms) of these situations, learning applications guided by the HCD concept should target the specific requirements pertaining to students' social skills. This approach facilitates the attainment of their overarching teaching and learning objectives.

Once more, engaging the learners proves advantageous. What topics or competences do they deem worth exploring? Where do they identify gaps or prospects within their personal lives that a learning module could address? Traditionally, educational institutions, particularly for learners with special needs, tended to dictate these decisions. The human-centered design approach, however, champions the learner's perspective and expertise! Collaborate in brainstorming sessions, foster their self-awareness, and value their perspectives. You can establish focus groups or conduct surveys to capture their insights. When working with students on the spectrum, it becomes especially critical to acknowledge their needs concerning social interaction. This entails adopting a sensitive and accommodating approach to ensure effective communication.

It is important to note that not every notion must be realized. You, as the educational specialist, maintain your role, yet the invaluable insights garnered should inform the entire design process.

3. Choice of Technology (1/3)

If you have reached this juncture while contemplating the adoption of this methodology for prospective educational units, you have already tackled significant choices. The spectrum of technology options has already been narrowed down to two: VR and AR.

To determine the most suitable option for your context, a comprehensive grasp of the merits and drawbacks of both technologies is imperative. Once you are well acquainted with the attributes and constraints of each, it is time to include your audience, as well as the specific need or topic, to aptly select the technology that aligns with the given circumstances.

For an informed decision, consider the following advantages and disadvantages inherent in both technical solutions: Virtual Reality and Augmented Reality.

Based on your students, the subject of the learning experience, and the resources at your disposal, it becomes essential to opt for the suitable technology for your project, considering the pros and cons of both technologies. After choosing your technology, it's time to move on to the next step.

Choice of Technology: VR (2/3)

Pros

Realistic Experience
Opportunity to experiment situations in realistic environments and practice them.

Safety
VR allows safe rehearsal and training of dangerous and rare situations

Creative freedom
Artificial environment allows endless experimentation

Modification
Ability to eliminate disruptive elements of reality (eg. Noises, colours or even complexity)

Immersive experience
The safe possibility to act and interact in an environment with many senses.

Cons

Time-consuming
Elaborate creation and maintenance of the application

Resource-intensive
A lot of VR applications unfold their full effect with special devices such as goggles.

Safety
Interaction in VR environments can be exhausting and stressful. A room setup that takes into account dangers and risks, as well as assistance from pedagogic professionals, is recommended.

Choice of Technology: AR (3/3)

Pros

Simple Usage
Wide range of applications (such as 3DBear App, Zappar, Thinglink, Storyfab or AR Flashcards) make it easy to set-up, maintain and use AR environments. That being said, AR offers a wide range of tools with different levels of complexity.

Real-time
AR environments are embedded in real-time scenarios.

Modification
AR enables the addition to real-life scenarios.

Immersive experience
Applications such as 3DBear AR app run on your phone or laptop and therefor allow usage nearly everywhere and for everyone.

Adaptation
3DBear app allows relatively quick set-ups and adjustments of your environments, which makes it user friendly in situations of differing needs.

Cons

Data Security
Data protection and privacy relevance due to real world embedding.

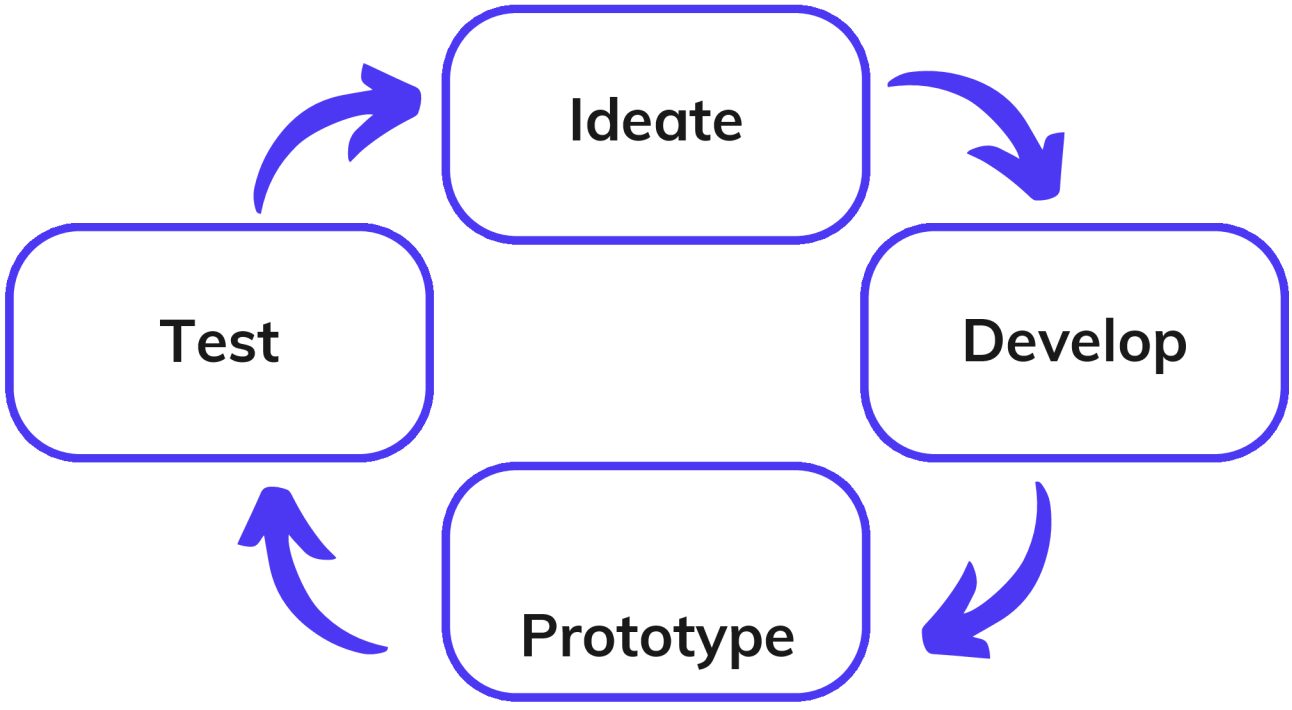
Limited Modification
Real world as a foundation leads to limited adaptability.

Misjudgement of Dangers
The expansion of reality can lead to situations in which dangers are assessed differently or incorrectly.

Design

Now that you have a clear understanding of the factors influencing your learning application, the design phase focuses on detailing the specific content and process. This phase is where creativity and innovation play a significant role. We offer a framework that guides this creative energy toward creating a prototype that you can use to test your learning unit's effectiveness.

Similar to the earlier Inspiration Phase, the design process is broken down into distinct steps that build on each other. It starts with the Ideation, where you generate ideas for your learning unit and then refine the most promising ones for further development. In the next step, Development, you expand these chosen ideas into complete storylines that meet your educational goals. These storylines are then turned into functional Prototypes at a technical level in the third step. Finally, in the fourth step, students will Test these prototypes, providing feedback on how well they work, how easy they are to use, and what their overall impression is.



Ideate

It's time to apply your creativity. The objective is to gather ideas to effectively incorporate the identified learning potential using the chosen technology. This can be a solo endeavor or a collaborative effort with your students. If you opt to involve the learners, bear in mind that brainstorming can be quite challenging for individuals on the autism spectrum. They often seek structure and have well-defined thought patterns, so generating ideas and thoughts in an unstructured manner can pose a significant obstacle. Nonetheless, this challenge isn't insurmountable. Provide a clear framework that still fosters creative thinking and accommodates various ways of expressing these ideas. For example, some students might find it easier to express their thoughts through drawings or visual aids, which can make the task more manageable.

Our partners at Luovi Vocational College have devised different methods and approaches for the collection of ideas, tailored to the learners' characteristics and strengths.

To bolster ideation, creating a safe environment is crucial. The student's understanding of their surroundings, who's present, whether there are remote participants, and the assurance of support if needed or the option to leave the space, all enhance discussions and ideation.
Once the ideas are gathered, the next step is selecting some for further development. Human-centered design promotes learner involvement in this process. You can make a preliminary selection based on pedagogical aspects of your unit. Subsequently, you can inquire about the students' favorite ideas. We recommend choosing 3-5 ideas for AR environment implementation. For VR environments, due to the additional workload, it's advisable to pick one to a maximum of 2 ideas for prototyping.

Ideation Methods

Guided Discussion	Initiating ideation is supported by informing students about the topics and questions beforehand. The teacher introduces the theme and provides examples. The discussion is expanded through clarifying questions. Direct questions might be challenging, so a bit of initial guidance and time for reflection can be helpful.
Visualization	Ideation through written and illustrated means. Students are given time to think and can then put their thoughts on paper, which makes sharing their views easier. The teacher lists different answer options related to the theme in writing or with pictures on paper. The student selects an answer. New written or illustrated answers and discussion options revolve around the chosen answer, fostering deeper topic exploration.
Bilateral Conversation	Converse with the student using YES - NO responses. Responses can be indicated using left and right hands or slips of paper. Concrete options facilitate choosing an answer.
Talking Mats	Tools like Talking Mats can be employed for ideation. Images related to the theme are grouped on a platform, encouraging precise or diversified discussions on the topic. There yre digital and analog versions of the tool. Electronic communication programs like Boardmaker can serve a similar purpose.
Functional Methods	Themes for ideation and discussion are laid out on the floor. The student positions themselves in relation to the topic they wish to advocate for.

Develop (1/4)

The ideas have been gathered and explored, yet the creative journey continues. Moving from the initial concepts formed during the Ideation step, the current task is to craft comprehensive learning modules tailored for VR or AR technologies. As the composition of individual steps within these learning modules hinges on pedagogically defined objectives, and to ensure a cohesive narrative, we advise that this phase be primarily undertaken by the pedagogical team.

Similar to the Development phase, various approaches to transforming rough ideas into complete narratives exist. Once more, we'd like to introduce methods that have proven effective in shaping storylines for AR/VR environments. To offer you a clearer grasp of these methods, we've included examples showcasing the creation of learning modules within the BitTheSpectrum project as well.

Method 1:
Flowchart (VR)

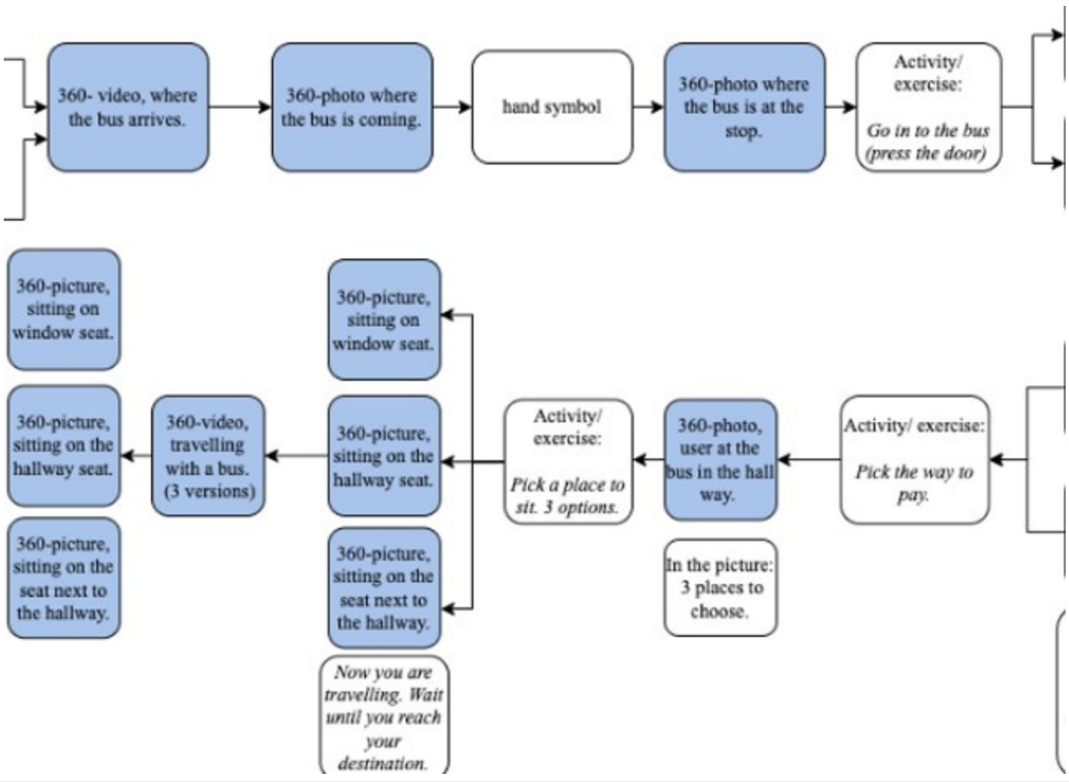
NAME OF THE EXERCISE	DESCRIPTION OF THE EXERCISE n. 1
Name and number of the exercise	Title "Associate animal to emotion and identify it"
Goal of the exercise	The goal of the exercise is to identify different emotions while associating them with animals →animal of the student's choice regarding PERSONAL experiences- associations (**there is no right or wrong**) Suggestions: -Give a list of emotions (students can choose the animals from collections) -Try to tell a story-personal experience
Difficulty of the exercise	2 (medium) it depends on the user's capability and familiarity to talking\identifying a different set of emotions
Activity in the exercise	The exercise consists of framing a blank background\, space and inserting an animal between the ones available on the 3DBear app. After that, the student will select 'text' and write it down an emotion that he\she believes can be Correlated to the selected animal (or to how the animal is depicted in the app)
SEN approached, description	Recognition and understanding of different emotions, correlation of emotion to how the student perceives it, Recognition of certain gestures that can be linked to a specific emotion
Learning potentials addressed	Specify the learning disorder the exercise refers to and described above. i.e. -Increase self-esteem and self-awareness -Communicating with other people -Reading and Writing skills -Communicating and identifying emotions
AR description	On 3DBear App frame an empty space. From the add button select the animal you prefer from the 'animal section' then Select from 'letters and numbers' the text option and add the emotion you associate with the selected animal
Category System	2: Emotional skills
How to use the exercise	The exercise can be developed by the students alone or with the support of a teacher\, tutor if necessary. While Developing the exercise, the student will think about his\her own emotions and how to make others understand his\her Needs and feelings. The exercise can be important to express feelings in a creative way
Any videos, images, or texts needed for the exercise	Images to be inserted: animals \, text to be inserted: the word expressing a specific feeling-emotion
Technical information	Decision on color and elements will be personal (to allow self-expression)
Instructions for the user	The goal of the exercise is to allow the student to both express a feeling that he\she knows and to write it down. In this Way the student will show the teachers-tutors the emotions-feelings that he\she knows best and it will be done in a A more creative way is by collocating that emotion to a specific animal. An explanation of the decision made will Follow to allow a better understanding of the knowledge of the feeling and also of some personal background. Ex. if the Animal chosen is a dog correlated to the emotion 'fear' it will be possible to understand and maybe talk about an Episode of the past that generated this fear and how to deal with this emotion

Method 2:
Lesson plan template (AR)

Develop - Flowchart (2/4)

An intricately detailed flowchart serves as the roadmap for the creation of a concrete VR environment. This flowchart outlines the precise learning journey that students will undertake. It encompasses the depiction of scenes, interactive exercises, tasks, and elements such as text, symbols, and voiceovers. Additionally, it outlines the sequential progression through the path, delineating conditions like requiring a correct answer to advance or an incorrect answer leading to an alternate route.

As the Development phase commences, a critical step involves reviewing examples of existing VR environments. This process widens the perception of possibilities, including diverse exercises, alternate paths, navigation mechanisms, visual elements, and gamification elements. This preparatory step is vital to ensure fresh and inspired ideas before embarking on building the flowchart.
The process of constructing the flowchart begins with the inception of the VR environment or pathway being developed. To illustrate, in the creation of the bus-traveling VR environment within the BitTheSpectrum project, the flowchart construction initiated by outlining the initial steps required when a person arrives at the bus stop. This sequential approach underscores the importance of having a clear overarching theme for the VR environment before delving into the flowchart creation.



Develop - Lesson plan (3/4)

As the Development phase kicks off, the initial step involves the examination of exemplar AR environments and correlated lesson plans (if possible). This review process significantly broadens the comprehension of exercise possibilities within the AR context.

A deeper understanding of AR's technical capabilities allows for more detailed planning of exercises. During this phase, straightforward tools (like Flinga) can be harnessed to gather ideas for exercises. At this point, a basic assignment can be transformed while also considering the technical potential. For instance, an initial assignment could be as straightforward as "Create an AR scenario that captures your happiest moment." Subsequently, decisions about the technical execution of the exercise must be made. For example, you might choose to initiate the AR exercise with or without pre-existing models visible. Furthermore, you could contemplate constraining the utilization of AR models or conversely, granting students the liberty to utilize any models available.

In this planning stage, a lesson plan template serves as a valuable tool. This template is designed for teachers who will subsequently convey the AR exercise or task to the students. Once the initial planning is complete, the process of populating the lesson plan template commences. The lesson plan template covers key aspects: 1) articulation of the exercise's learning outcomes, 2) delineation of students' tasks within the exercise, and 3) specification of the exercise's target audience. The lesson plan methodically outlines each step of the activity or exercise that students will undertake, supplemented with an illustrative image or video displaying the anticipated results. Furthermore, the lesson plan can include an assessment component for evaluating the exercise's efficiency.

NAME OF THE EXERCISE	DESCRIPTION OF THE EXERCISE n. 13
Name and number of the exercise	Title: "What makes a person good-natured or bad-tempered"
Goal of the exercise	The main goal of the exercise is to identify and enable discussion about different emotional states. Strengthening social skills in interaction. Support for interaction, emotional expression and verbalization of emotional states.
Difficulty of the exercise	3: more challenging exercise, that requires collaboration with a partner
Activity in the exercise	The exercise requires continuous collaboration between the student and another person (i.e another student, a teacher, A parent, an educator). The goal is to make the user comprehend and empathize with the other's emotions, understand and differentiate between 'positive' and 'negative' behaviors and understand what actions and words increase a

Develop (4/4)

While we recommend employing these methods, it's important to mention that these are just two approaches for creating learning applications with AR/VR technologies. It's entirely possible to utilize or even develop alternative methods and concepts for crafting these learning environments.

Constantly bear in mind the students you are designing for. Through the course of the BitTheSpectrum project, we engaged with students with ASD to gather insights on their expectations from VR/AR learning environments. One of their expressed desires was to infuse a sense of excitement into topics or tasks that might otherwise be perceived as boring. Notably, both VR and AR offer a potent tool for achieving this through gamification. Gamification involves integrating playful elements within non-game contexts. In educational settings, this approach effectively elevates learners' engagement and curiosity, particularly in areas that might have been considered lame or uninteresting.

Another pertinent consideration was the ease of user interaction. Students underlined that an excessive number of buttons and functions could potentially disrupt their experience rather than enhance it. While the requirements of your students might naturally vary, the crucial point is to contemplate and engage them consistently throughout the entire process.

Upon reaching the end of this process, you will have crafted a practical blueprint for your learning module. You'll be well-versed in the placement of various story elements throughout your session and will have pinpointed potential decision points and interactive segments for learners. Reassess your narrative, ensuring it aligns with learners' needs and maintains narrative cohesion. Once this phase is concluded, you're poised to advance to the prototyping stage.

Prototype

As indicated by the title of this phase, it's the opportune moment to bring your developed narrative to life from a technical perspective. Since this guide centers on the methodological facets of unit creation, it won't delve into intricate technical instructions or explanations.

Nevertheless, if you intend to utilize the 3DBear app, which we recommend for AR environment creation, you can access comprehensive instructions on its usage HERE. This resource furnishes detailed guidance on navigating the app.

If you are lacking the experience and want to create VR environments using the WondaVR software, we recommend contacting 3Dbear (or an organisation of your choice if you want to use another tool) for detailed advice and support. The multitude of possibilities and the technical complexity require some practice or expert assistance. However, this should not deter you; the advantages of the VR environments are worth the effort. If you decide to create VR content on your own, be aware that a well-planned and implemented prototype is crucial. If you are working with 360° recordings, keep in mind that it is difficult to reproduce these as the environment, people, etc., change. A well-thought-out video shoot is therefore highly recommended.
Other technology providers for VR are for example Matterport.

Whether you opt for independent implementation or enlist expert assistance, the culmination of this phase should yield a functional prototype of your learning application. While not every intricate detail of your narrative requires integration, it's important to include enough elements to render the environment usable and cohesive. This will enable students to effectively test both the technical execution and the narrative.

If you are confident that these criteria are met, you are ready to move on to the next step.

Test (1/2)

Regardless of the extent of preparation, development, and integration carried out prior, the testing phase emerges as a paramount stage within the overall methodology. This juncture unravels the practical efficacy of the theoretical contemplations, idea generation, story development, and technical realization. While this phase might elicit moments of frustration, potentially highlighting areas necessitating improvement in prior stages, it's imperative to view it as an opportunity. An opportunity to enhance your understanding of the target audience and precisely tailor your learning unit to align with their needs and preferences.

For this phase, we suggest conducting a trial run of the prototype with 2-4 students, selected based on their specific needs. The duration of the testing phase shouldn't exceed an hour, considering the complexity of the learning unit. Enlisting additional staff or colleagues to assist during the testing stage could prove advantageous.

The primary objective of the testing phase is, naturally, to garner feedback from the learners pertaining to the execution of the unit. Feedback can be collected through various methods, contingent on the students' requirements and the available resources. During the testing phase, you can begin gathering information through observation alone. If your technology permits, you can also incorporate tools like eye tracking or field of view applications to amass supplementary data. Moreover, consulting the students is advisable. Depending on their needs, you might conduct interviews, surveys, or group discussions.

The ensuing criteria hold particular significance:

- Usability: How do the learners feel about using the unit? Are they able to carry out the unit as intended? Is the interface intuitive or difficult to understand?

- Enjoyment: Do the learners enjoy interacting in the environment? Are tasks challenging in a beneficial manner or frustrating? How do the students feel about the duration of the unit? Is it possible to reach the objective/finish or is the unit too difficult?

- Well-being: Do the students feel sick or have other complaints (motion sickness, nausea, dizziness)?

Test (2/2)

As before we provide you with a standardized survey already tested and used in the BitTheSpectrum project. The survey can be found here: https://bitthespectrum.infoproject.eu/ .

The gathering and refinement of feedback data constitutes the final stride of the testing phase. Equipped with the amassed data, you initiate the design cycle anew, commencing with Ideation. That does not mean that necessarily you have to start from zero, most times you fine-tune your original concepts and developments, aligning them with the insights gleaned from the preceding testing phase. If the results of student feedback indicate that, for instance, Ideation wasn't a part of the problem (due to a technical error, for example), then there's no need to make changes at this stage. However, it's important to note that modifications and adjustments in one step can result in necessary changes in subsequent steps. Thus, skipping individual stages within the design cycle is discouraged to ensure a cohesive progression.

Subsequently, you proceed to re-test your revised prototypes. This iterative process typically spans about 2-4 cycles of the design phase. Once you've garnered consistent and affirmative feedback concerning both your narrative and the technical execution, you are able to transit to the Implementation phase.

Implementation

The implementation phase represents the translation of outcomes from prototyping into the real-world application environment. While it might seem that the major work has been accomplished, implementation is an equally significant and exacting stride in materializing your learning application.

The creativity that previously commanded the spotlight, along with its resultant output, now requires harmonization with the context of the learning environment and its potentialities. The transition from prototype to an authentic learning experience for your students necessitates the convergence of technical resources and the expertise to deploy them effectively. Creating a seamless experience for your students may involve modifying the arrangement of the space. Moreover, integrating your learning application into the broader curriculum necessitates additional planning and coordination.

Here, we aim to outline some pivotal facets and crucial considerations for executing your learning application. Irrespective of the chosen technical platform, implementation is split into two phases: the System Setup and the Test Run. However, recognizing the variances contingent upon the technology, distinct guidelines are delineated for each phase. This approach ensures alignment with the concepts and background discussed earlier in this document.

AR

System Setup

Hardware	If you're utilizing the 3DBear Application, your learning environments can be implemented on iOS or Android mobile devices, such as phones and tablets. Depending on the number of students expected to use the learning application simultaneously, you should ensure ample equipment and support to ensure safe and accurate usage. If you intend to employ users' devices, take into account potential restrictions beforehand.
Hardware	The 3DBear mobile app provides a freely available version and enables sharing your learning environment with colleagues or peers. It can be easily installed on iOS and Android devices. 3DBear offers support for transferring environments to different devices. The app's simplicity ensures user-friendly utilization.
Hardware	Given that augmented reality applications augment the real world, caution must be exercised regarding what is observed within the real environment. AR holds the potential for distorting perceptions of hazards and risks. Particular attention is vital, especially when working with individuals on the autism spectrum, who may already have compromised danger perception. It is advised to inspect the application environment for potentially hazardous objects and areas, in harmony with the presented concepts and background. Furthermore, it should be ensured that privacy rights concerning audio and visual recordings of participants or third parties are taken into account. This is particularly relevant for applications intended to be uploaded onto the internet.

AR

Test Run

The primary objective of the test run is to validate the implementation. As uncertainties persist regarding the seamless functioning of the application, enlisting support from colleagues is highly recommended. On one hand, colleagues can assist in identifying or preventing potential adverse situations. On the other hand, having additional staff allows for a more comprehensive initial assessment of the test run.

If the 3DBear app is employed, the presence of a technician is not strictly obligatory, thanks to its user-friendly nature. The test run also serves to assess the technical functionality of the application. Does the technical integration unfold as intended? Do students encounter difficulties while using it? Are there any unintended side effects for the students that did not show during the inital prototype testing? Does the use of the application clash with your learning environment setup? Are you able to perceive and address your students' needs during the use of the new exercise?

VR

System Setup

Hardware

If you decide to use the tool WondaVR, which we used in the creation of the learning environments for the BitTheSpectrum project, you are able to realise your project on all available VR headsets. WondaVR furthermore allows the implementation of your created environments on your notebooks or Desktop PC through a browser application. While this use does not enable the complete immersion that VR glasses are able to facilitate, it might be a solution easier to realise. Whether you're utilizing VR headsets or desktop PCs & Notebooks as well as tablets, ensure that the hardware you're using meets the minimum requirements of the employed software.

Software

For the development of the BitTheSpectrum learning environments, the tool WondaVR was used. It allows the creation of one VR environment free of charge. The setup and implementation of the learning environment at the technical level require expertise and time. While smaller and technically simpler solutions can be attempted independently, more complex applications necessitate professional assistance. For the WondaVR application, this support can be provided by our project partner 3DBear. Since application areas and options heavily depend on the learning concept and external circumstances, we do not provide a universal recommendation for a technical solution. We encourage you to gather information about possible applications and their suitability for your institution and learning unit.

Environment

Insofar as VR glasses are used for the implementation, the learners are almost completely cut off sensory from the outside world. Accordingly, it is important to create sufficient freedom of movement in the application area and to eliminate potential hazards. The area of application should be discussed with the learners beforehand in order to point out the limitations. Be aware that implementing VR learning units with VR glasses requires more attention from you compared to implementing them through a browser. Users are not only visually but also partially acoustically isolated from the real world, necessitating guidance and support. Additionally, VR experiences can cause motion sickness, nausea and dizziness (while also being very unlikely for young students). Therefore, this application is particularly recommended for use in small groups or in collaboration with a colleague.

VR

Test Run

Just as in the Test Run for AR applications, we strongly recommend the presence of additional staff for the initial trials. Colleagues can assist in identifying or preventing potential adverse situations and contribute to a more comprehensive initial assessment of the test run. Given the technical intricacies of VR environments, it is advisable to have a technician participate in the first trials to address potential issues.
The primary purpose of the test run remains to ensure the smooth operation of the learning application. Is the technical integration functioning as intended? Are students encountering difficulties in using it? Are there any unintended side effects for the students? Are you able to perceive and address your students' needs during the use of the new exercise? How is the rest of the class/students that are not engaging in the VR application reacting to the situation?
Refine the environment to address potential issues until a pedagogically safe and valuable scenario has been created.

Validation

If you have reached this juncture, you have undertaken all necessary steps to successfully implement your learning unit. From an idea, a functional application has emerged, which has been integrated into a real-life learning environment ready for use. The final crucial step involves assessing the extent to which your learning application has achieved “success”. In this context, success is understood in terms of whether effective learning outcomes have been achieved. But not only this information is important. The satisfaction of the learners, their interest, and enjoyment with the application, as well as their deeper understanding of the learning content are equally crucial. The Human-Centered Design approach underscores that your impressions encompass valuable information warranting consideration as well.

To gather and evaluate this information, we have developed questionnaires that you can use for this purpose. One questionnaire focuses on the learners' perceptions, while the other is intended for your own self-evaluation of your impressions. Likewise, it is advisable to align the questionnaire responses with the needs and abilities of the learners, to the extent feasible. Accordingly, we have provided a response scale for numerous questions, followed by an opportunity to answer specific questions in one's own words.

When the evaluation of your learning application should take place cannot be precisely determined. This timing depends on the scope of the unit, its intensity, and its learning goals, as well as the frequency of its usage. For analyzing the learners' responses, we have created an evaluation matrix that will help you draw the right conclusions from the insights.

Bit the Spectrum

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Enjoy creating!

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