Philippines Disaster Preparedness Simulator

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Project name: Disaster Preparedness Simulator
Project owner: Ania Design Lab
Release date: 2019
Locale: Philippines
URL: https://www.facebook.com/aniadesignlab/
XR medium: VR with smartphone
Hazards: Earthquake, typhoon, flood
Activity: Disaster drills and evacuations
Age group: 12+

Table of Contents

#1
Project Background

The *Disaster Preparedness Simulator* is a virtual reality (VR) integrated disaster preparedness learning experience where users are immersed in disaster scenarios in a controlled environment. It has three experiences of different hazards - earthquake, flood and typhoon - and is specifically targeted at children as an integrated part of their disaster preparedness education in schools. It can also be used as a game to test disaster response knowledge.

The goal of the simulator, built in the Philippines specifically for the local context, is to enhance the disaster preparedness learning curriculum by using innovative learning platforms integrating reasoning and empathy in decision making. A pilot of the project has been rolled out, targeting eight secondary schools in rural communities up to 15 hours drive from Manila's city centre. The simulations were designed using a highly participatory approach involving schools and local government. The design is fully localised to the Philippines context.
The simulator was created by Ania Design Lab, a Filipino startup and learning innovation company that designs, develops, and delivers solutions working towards their vision of an educated Philippines. The project was funded by the Tuklas Innovation Lab, a Philippines startup implemented by a consortium of NGOs and funded by UK Aid, the Start Network, and the CDAC[1] Network. Ania Design Lab is currently looking for further funding to scale up the project, building on the results of the pilot that worked towards understanding how to implement low-cost learning innovation technologies in the classroom.

1 Communicating with Disaster Affected Communities

Typhoon Scenario Environment Prototype, Screenshot

#2
Aims & Rationale

The aim of the experience is to learn decision making skills linked to the most common hazards and to increase knowledge about the hazards.

In their initial research, the Ania team found that the current practices of disaster preparedness education in the Philippines - for example disaster drills - are lacking in certain key features for effective learning in content delivery, including:

- Students do not get to make decisions during a disaster simulations
- Drill scenarios are predetermined when role playing
- Students do not get to experience the full effects of the choices they make because many drills are not realistic
- Simulation drills rarely consider the various potential outcomes of a disaster and how decisions taken in response affect outcomes, as there is no practical way to do so in the current method of content delivery

In addition, when consulting teachers, the Ania team found that the education community was looking for something new that would allow them to employ more creative teaching methods around disaster preparedness and avoid repetitive content delivery. This coincided with a radical change in the Philippines educational system and a new K-to-12[2] curriculum implemented by the Department of Education that has opened up many opportunities for stakeholders involved to improve and innovate. Working together with schools to innovate in the education space was timely and of benefit to students, teachers and the Department of Education.

The above gaps of the current education system and capitalising on the recent changes in the education system led to the development of a virtual reality simulation through which a number of these shortcomings can be addressed. Key to this approach is the simulation of multiple possibilities linked to user decision making.

2 Kindergarten thru 12th grade - based on the US system

#3
Audience

K-12 students are the primary audience. Ania have targeted various age groups, but focus on grades 6 - 12 because at this age the students have disaster preparedness and risk management in their curriculum.

#4
Experience

Key design considerations

The two top simulation design considerations of the Ania Design Lab team were to:

- Use a problem based learning approach, that would add value to the current disaster preparedness practices in schools, normally done by drills or seminars, that do not use problem-based learning to the same extent
- Build in feedback (both in the experience and in the classroom) and discussion (in the classroom) to the approach in order to positively contribute to learning outcomes

Content

The disaster preparedness simulator VR experience is highly focused on helping students' decision making skills in disasters, understanding the consequences of their actions and that different situations require different choices. As such, the three simulations have branching storylines that reflect different choice and decision options.

There are three virtual reality scenarios:

1. **Earthquake in a school**
2. **Flooding in a house**
3. **Typhoon in a barangay**[3]

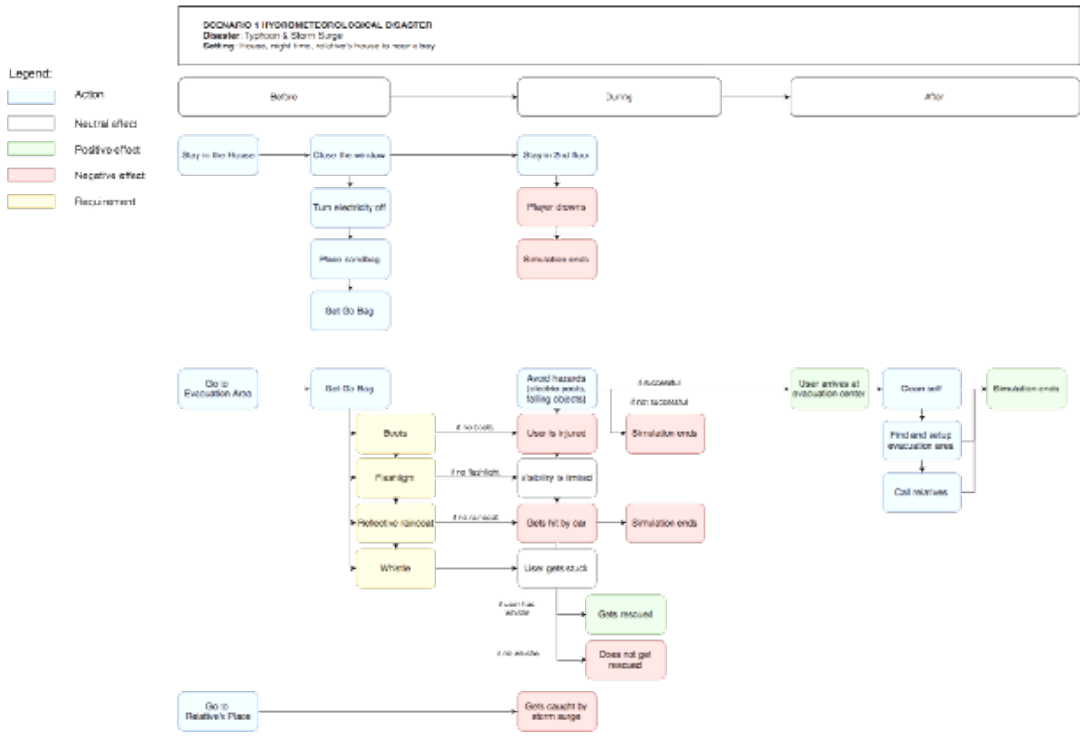
These disaster scenarios were selected based on the most common hazards in the Philippines. The design of the school for the earthquake simulation used actual school floor plans from a typical school. The house was built on a list of common themes identified in the co-design process and was redesigned during the pilot following user feedback in order to be more realistic.

The two hydrometeorological scenarios are divided into three parts - before, during, and after the disaster. Each part contains different precautionary measures taken from the Philippines' National Disaster Readiness and Risk Management (DRRM) manual and curriculum under K-to-12 program of the Department of Education. The earthquake simulation contains two parts - during and after - and is also aligned with national response protocol. The aim when playing is for the user to survive the disaster through the decisions they make along the way.

Detailed storyboards and decision pathways were designed for the simulations, that show how each precautionary measure taken in the simulation leads to a specific consequence and level of risk. For example, if the user in the typhoon simulation chooses to leave their home and go to a relative's house, they get caught by the storm surge and the game ends.

3 A barangay is the smallest administrative division in the Philippines and is the native Filipino term for a village, district or ward

Example scenario and decision matrix for typhoon and storm surge at home:



Example storyboard for earthquake scenario in a school:

Setup: The scenario is a school area. The starting point is inside the classroom on the second floor of the building.

Action	Narrative / Context	Outcome
BEFORE: Inside the classroom before the earthquake. AUDIO FILE. PROLOGUE: "Magandang umaga mga mag-aaral. Ngayong umaga para sa ating DRRM Class, ay ating pag-uusapan ang paghahanda para sa lindol. Sa panimula, maari nating tidnan ang mga "hazards" na makita natin sa ating silid-aralan at paligid ng ating paaralan".		
Check surroundings	Ceiling fan	1. User will see that some are not working 2. User will see that some are not in stable/good condition
	Tables and chairs	User will see that some tables and chairs are damaged
	Cabinets	Users will see the books, hardhats, whistle, go bag
DURING: Shaking starts. AUDIO FILE. Add music and earthquake intermittent sound alarm.		
Stay in the classroom	User chooses to not go outside the room	AUDIO FILE
Put book on top of head	User finds a book and clicks Use Book button	Book disappears from player view and is placed on top of the user AUDIO FILE
Wear hard hat	User finds a book and clicks Use Hard Hat button	Hard hat disappears from player view and is placed on top of the user AUDIO FILE
Stay under Student's Table	User chooses a table and clicks Go Under button	Animation of the player under the student's table and walking is disabled AUDIO FILE
Stay under Teacher's Table	User chooses the teacher's table and clicks Go Under button	Animation of the player under the teacher's table and walking is disabled AUDIO FILE
Get go bag	User finds and clicks Get Go Bag button	Go Bag disappears from player view AUDIO FILE

Action	Narrative / Context	Outcome
Go to another room	User chooses to leave the room and enter another room	Some falling debris hits user
Put book on top of head	User finds a book and clicks Use Book button	Book disappears from player view and is placed on top of the user
Wear hard hat	User finds a book and clicks Use Hard Hat button	Hard hat disappears from player view and is placed on top of the user
Stay under Student's Table	User chooses a table and clicks Go Under button	Animation of the player under the student's table and walking is disabled
Stay under Teacher's Table	User chooses the teacher's table and clicks Go Under button	Animation of the player under the teacher's table and walking is disabled
Get go bag	User finds and clicks Get Go Bag button	Go Bag disappears from player view
Go down to open area	User chooses to leave the room and go down the stairs	Some falling debris hits user
AFTERSHOCK: Shaking stops for a few seconds and aftershock occurs		
Objects falling	If user avoids falling objects	
	If user gets hit by falling objects	User gets injured
Gets trapped	This applies only if the user goes to another room during the earthquake	Gets stuck inside the classroom
Use whistle	This will only be available to the user if he gets the go bag. User clicks Use whistle button	Whistle sound
AFTER: Shaking stops AUDIO FILE. "okay class pumila kayo"		
Go to open area	User walks and goes down to the open area	AUDIO FILE."Kailangan ko nang pumunta sa safe area"
Go to another room	User walks and enters another room	Hit by falling debris inside the room
Gets trapped	This applies only if the user goes to another room after the earthquake	Gets stuck inside the classroom
Use whistle	This will only be available to the user if he gets the go bag. User clicks Use whistle button	Whistle sound

Integration into school disaster training curriculum

Ania Design Lab aims to make the Disaster Preparedness Simulator a complete learning experience and not a standalone tool. Therefore the virtual reality simulations are designed to supplement the Disaster Readiness and Risk Management modules of the Philippine basic education curriculum.

The learning package consists of three stages:

4. **Briefing**
5. **Simulation**
6. **Debriefing and feedback**

The briefing stage introduces the Disaster Preparedness Simulator learning experience to the users and tells them what to expect during the simulation process, instructs them on how to use the system, and explains the health and safety hazards involved with system use. Users go through a screening process for any health and safety issues and anyone categorised as unfit to use the simulation are identified and given an explanation.

The simulation stage involves allowing users to use the simulator individually. Instructors monitor users closely to avoid potential harm. The average duration is five minutes per user per scenario. The Ania Design Lab team recommends that one teacher supervise up to four users simultaneously. After the simulation module, users are assessed for any mental or physical impacts, such as motion sickness or negative psychological impacts from the scenarios.

The debriefing stage has two aims. Firstly, to disseminate further information on hazards and disaster preparedness, including IEC materials. Secondly, to assess, discuss and provide feedback to users on their performance in the simulation and issues that arose. Instructors are encouraged to allow users to interact and discuss with each other, sharing insights and experiences from the simulation with their peers. This allows the instructor to gather data via observation of the discussion.

#5
Technology

Development and requirements

The VR simulation has been developed in Unity for Android phones and uses the phone's gyroscope sensors to detect the orientation of the phone. It can be experienced in virtual reality with Google cardboard v2 and headphones. Buttons on the Google cardboard are used to select and make decisions in the simulation.

Android Smartphone Requirements:

- Headphone jack (wired) or Bluetooth (wireless): for the audio features of the system
- Android Operating System latest version (8.1 Oreo as of November 2018), with the minimum not lower than version 5.1 Lollipop.
- Gyroscope sensor

The minimum cost for this specification of phone in the Philippines is 100USD. The cost of a Google Cardboard v2 headset is 15USD.

Delivery

To date, the experience has been delivered by Ania Design Lab directly while visiting the schools. No schools have used the technology on their own, although they have donated the cardboard headsets to the schools. Most of the schools visited can not afford the technology needed, despite it being at the lowest end of the cost spectrum for virtual reality. The budget did not extend to providing phones to the schools.

#6
Production & Distribution

The production process contained a high level of community engagement and participation. The simulation took eight months to produce and six months of this time was spent in a robust "co-design process" developing the scenarios, storyboards and decision pathways together with representatives from local government, schools (teachers and students) and community partners. Data was also gathered from resources from the National Disaster Risk Reduction and Management Council and in-house research on VR user experiences. Following the co-design process, it took one month to develop the scenarios and one month to roll it out to eight schools. After each test in the eight schools[4], the Ania team adjusted and updated the simulations based on user feedback. Patrick Naui, Ania Design Lab CEA says, *"We were constantly redesigning the Disaster Preparedness Simulator every time we visited a new school... to make sure that we were designing the best experience for our users." For example, "We redesigned the household setting to fit the Philippine context when our users said that the houses we built didn't look anything like the houses we had here in the Philippines."*

Challenges identified in the production process included:

- The intensively participatory approach was time consuming (75% of the overall process)
- Co-designing with communities that had very different perspectives from one another
- Limited time to do quality assurance as part of the development process

The major challenge facing the developers today is the lack of funding to scale up and roll out the project.

4 *Potrero Elementary School (in Malabon), Saint Mary's College Quezon City, the Center for Disaster Preparedness, the Far Eastern University, CENTEX School (in Bauan, Batangas), Siruma National High School, Governor Mariano Villafuerte Community College, and Sibaguan Agro-industrial High Schools.*

#7
Outcomes and Future Planning

Impact to date

Ania received good feedback from teachers and students on the simulation. The students were happy to try something new with the "wow" factor, and teachers liked having a more innovative way of showing their students about disaster preparedness and response in an interactive and realistic format. Local administrators had positive feedback, though some were concerned about scale up due to the cost of the phones. Feedback was gathered from students and teachers at the time of testing the simulations, but no formal evaluation has been carried out. The development of evaluation tools will come on the next cycle of the project if funding is secured.

1 Million PHP	8	405+	3	8
Initial Funding from TUKLAS Innovation Labs	Communities Visited	Activity Participants	Fully-developed Disaster Scenarios	Months

Future planning

Ania received the one-off grant from Tuklas labs and this pilot has now come to an end and therefore Ania Design Lab are currently looking for donors to be able to scale up the distribution of the simulations to more schools in the Philippines. They are working to identify how to sustain the project that they feel has the potential to support disaster education in the Philippines at a larger scale. Ania Design Lab's CEO Patrick Naui says, "*What we have in place has value and is driven by local information, given the long co-design process we went through*". Their aim is to build on this tried and tested model:

"Looking forward, we are looking into developing more scenarios, building partnerships with new communities and more users that can provide insights on how we can improve the system even further."

#8
Internal Evaluation and Learnings

Process

The Ania team adopted a strongly participatory approach to develop the disaster preparedness simulator, that took into account both government expertise and messaging on hazards, and community perspectives and realities. The bulk to the development time was focussed on this "co-design" and although it took time, resulted in a product that was approved by the local government and able to be taken by teachers and integrated into their traditional disaster preparedness education.

Patrick Naui, Ania CEO comments on the co-design process:

"The intensive co-design process is worth it. It takes a lot of time to co-design, but this allowed the developers to fully understand what kind of scenario they should be developing."

The technical development was done in house by the Ania team, who are university graduates and have other jobs as well as running the Lab. Production costs were low as it was all done in house, and the project kept within their grant budget of 20k. It was a resource efficient process overall. The roll out incorporated a strong feedback element, and after testing in each school substantial changes were made to the simulation based on user feedback. The simulation has been tested by over 400 people to date, as part of a pilot phase of the project. The result of the co-design and the user feedback and adaptation based on this feedback has resulted in a product that is well suited to the local context, based on government approved hazard messaging and has the ability to be integrated into the Philippines curriculum.

Product and features

A major strength of the simulator is how users can make decisions based on real disaster scenarios that impact on the outcome of the serious game. This was a key feature of the design process and aim behind the tool and is reflected in the "branching scenarios" for each of the simulations. The simulator gives feedback to the user by displaying if they made a right or a wrong decision in the simulation. The game doesn't start over if a wrong decision is made, instead the users are shown the consequences of their decisions.

There is no system in place for behavioural analysis or to suggest what they could have done better, but this is factored in to the debriefing and feedback section of the experience. In the current version this is left to the students to discuss among themselves and for the teachers to encourage the discussion. How this feedback is then taken by teachers to adjust how they teach disaster preparedness to students is not clear, because due to the time constraints of the project the Ania team were not able to look at this. More specific direction could be given to the teachers to facilitate a discussion on how to improve decision making more formally, as feedback and behavioural analysis is often overlooked in any kind of simulation.

The simulation is totally localised and customised to the Philippines, with Philipines school plans as the basis of the design and the local language used in the simulation as well as targeting the most relevant hazards and locations. This localisation allows for users to identify more strongly with the content and experience.

The Ania Design Lab team cited very low levels of motion sickness when in the simulation. However lower quality graphics and headset (cardboard) have limitations to how long users can remain in the simulation without experiencing motion sickness.

Content

Because of funding challenges, the disaster preparedness simulator is not yet available to the public and has only been tested in eight schools. However, the detailed storyboards and scripts show the level of detail of the content, particularly that went into the decision flow of the simulations, with the aim of getting students to think carefully about the decisions they would make in a disaster and the impacts those would have, allowing them to try different approaches in an immersive but safe space. The quality of the content is therefore high in terms of relevance and appropriateness, even if the graphics and delivery method are at the basic end of the virtual reality spectrum.

The developers of the disaster preparedness simulator state that the experience can be used by anyone from kindergarten to 12th grade, but that it is more used from 6th grade and up as this is the point when disaster preparedness is integrated into the curriculum. The official age recommendation for immersive virtual reality is over 13, particularly when realistic disaster simulation content is used. In the next iteration of the project it is recommended that this age restriction be made clear. There was one report of emotional disturbance after using the simulation, suggesting that the measures in place to identify participants not fit for the simulation could be improved.

Scalability

The Ania Design Lab team chose a low tech form of virtual reality using Google cardboard and smartphones, with the aim of being more scalable in a low income context. As a result the Disaster Preparedness Simulator is highly scalable across the Philippines. Despite complaints from local authorities of the expense, for a VR experience the costs are as low as is possible. At the time of writing the phone and cardboard package in the Philippines would cost approximately 120 USD total. Despite donations of the headsets, due to not always having the appropriate phones at the schools, the simulation is not currently being run by the schools independently.

Smartphone ownership in the Philippines is rising faster than in most countries in the world, but although around 40 per cent of the population own one to date, often these models are not advanced enough to run VR simulations because they are lacking gyroscope sensors or the hardware that analyses the position of the phone in the physical space. However this is predicted to change rapidly and make the technology used by the Disaster Preparedness Simulator more accessible to schools.

The simulator is also highly scalable because the content and design were developed in conjunction with local authorities and schools, and based on localised designs, with the aim of complementing the new K-12 curriculum. Targeting rural communities also means that the experience has the potential to scale up across the country, as most public schools have the same design and curriculum for senior high school. However the curriculum is undergoing massive changes at the time of writing and it may change drastically over the next year. Ania have been attempting to capitalise on this moment of curriculum reform to show how immersive technologies can be integrated and impact positively on the quality of disaster preparedness education.

The total budget for the project was affordable comparative to many VR simulation designs, making a continuation of the project - either development of more scenarios or roll out to more schools - highly feasible and scalable.

Effectiveness

There is very limited data on the effectiveness of the simulation and how it meets the goals of the project, although user feedback that was gathered from over 400 students and teachers was positive. Due to the limited timeline of the project, Ania Design Lab were not able to look at whether using this technology and seeing the decisions that students made, resulted in teachers making any changes to how they teach disaster preparedness. This is recommended for a future iteration of the project.

Key Learnings of Relevance for SBDRR

The disaster preparedness simulator is an excellent example of a localised solution to enhance the disaster preparedness education of schools using immersive technology, despite no formal evaluations on the impact being available from the pilot phase. Key learnings of relevance include:

- The importance of community and local authority participation in the design process and that the investment of time in a robust co-design process ultimately saves time in the long run, with less rounds of feedback and adjustment needed
- Community participation give the developers a better understanding of how to generate user-centric content
- The intensively participatory approach was time consuming (75% of the overall process) and sufficient time should be planned into the process to accommodate doing this thoroughly
- There are clear content relevancy and cost advantages of working with a local design company and through local partners
- Even the most scalable virtual reality option is not always scalable in low income or under resourced contexts
- There is an appetite from the education community in the Philippines for more innovative teaching practices

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