

Biyu Tabu Nibew:

Supporting Education for Snakebite Management in Indigenous Contexts through Participatory Design

In partnership with
Institute of Public Health, India & Grantham Institute, United Kingdom

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Abstract—The One Health approach aims to integrate, sustainably balance and optimise the health of people, animals, and ecosystems [1]. There has been a tremendous rise in concern across various scientific fields over the last decade with increasing awareness of each component's interconnections and dependence on one another [2]. The objective of this project is to support educational access for human-wildlife conflict among indigenous communities in North-east India, with a focus on snakes and snakebite management. The approach used is a participatory design methodology that includes an ethnographic study, co-design workshops, and interviews with users and stakeholders. The investigation aims to understand how design can be used to localise an aspect of One Health from theory to practice, taking into account the contextual needs of the environment. The geographical location of the case study focuses on the states of Assam and Arunachal Pradesh, specifically examining the area of Pakke Tiger Reserve. This investigation consists of (1) an ethnographic study of indigenous groups (Aka, Miji and Nyishi) living in conservation areas in North-east India, and their interactions with snakes (2) the design and evaluation of a participatory edu-info game *Biyu Tabu Nibew*¹ about snakes and snakebite management for children between the ages of 12-15 years from indigenous groups (Aka, Miji and Nyishi). This investigation serves as a blueprint for how design can be applied to fields of wildlife biology and public health in indigenous contexts, resulting in the use of frugal innovations to create educational access using place-based knowledge and locally sourced material.

Keywords—One Health, indigenous research, human-wildlife conflict, participatory design, community engagement, frugal innovation

I. PREFACE

I am deeply interested in the dynamic relationship shared between humans and their environment. Talking to Dr. Prashanth N Srinivas from the Institute of Public Health (IPH) and Dr. Nandini Velho from Green Hub (GH) inspired me to consider how design can promote human and environmental

health in areas where people live in close proximity to nature. This motivated me to select North-east India – with its incredible physiographic and ecoclimatic conditions, indigenous flora and fauna [3] – as the location for the project case-study.

There are approximately 104 million indigenous people in India (termed *Adivasis*, or First Inhabitants), representing 8.6% of the nation's population, with many tribal groups remaining unrecognised [4]. As per the Census of India (2011), Adivasis account for 25% of the poorest in the country, with literacy rates at 40.7% in comparison to the national average of 74.04% [5]. North-east India is home to the largest concentration of Indigenous Peoples [4], with snakes being a prominent species in such ecological zones. In rural areas, the lack of education and practical knowledge heightens the risk of snake encounters.

While the Ministry of Human Resource Development (2020) acknowledges that indigenous children “find their school education irrelevant and foreign [. . .] both culturally and academically [5]”, not much has been done for the inclusion of tribal knowledge in mainstream education. This project is an exploration of the design of a culturally responsive tool through participatory creativity and innovation.

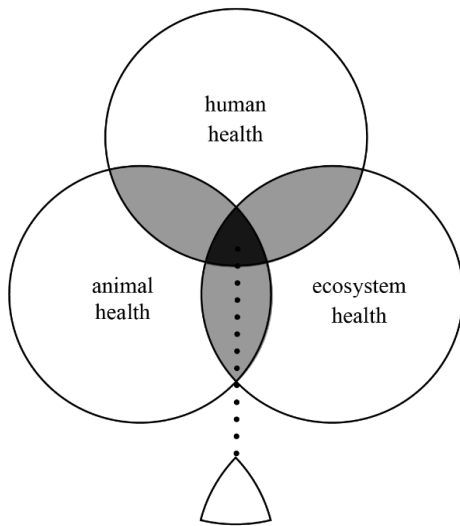
II. INTRODUCTION AND BACKGROUND²

A. Benefits of One Health

COVID-19 has renewed scientific and policy interest in developing an integrated approach to preventing, detecting and responding to global public health emergencies. As shown in Fig. 1., the One Health approach can improve food security and safety, protect global health security and integrate livelihoods with biodiversity and animal health [6]. Furthermore, this movement has gained traction as a means to curb threats of zoonotic diseases and achieve the UN Sustainable Development Goals [7]. However, implementing the approach in lower middle income countries like India remains challenging due to a lack of practical guidance on how to cultivate and support cross-sector collaborations [7].

¹ Derived from Aka, Nyishi and Miji languages respectively. Literally translates to ‘Snake, Snake, Snake’ in English.

² A full list of terms and definitions used in this study is provided in Appendix A, Table 1.



One Health can include:

- Antibiotic resistance
- Food safety + security
- Key species + challenges

Fig. 1. Overview of the One Health Approach
Source: Adapted from CDC

North-east India, funded by the Wellcome Trust India Alliance [16].

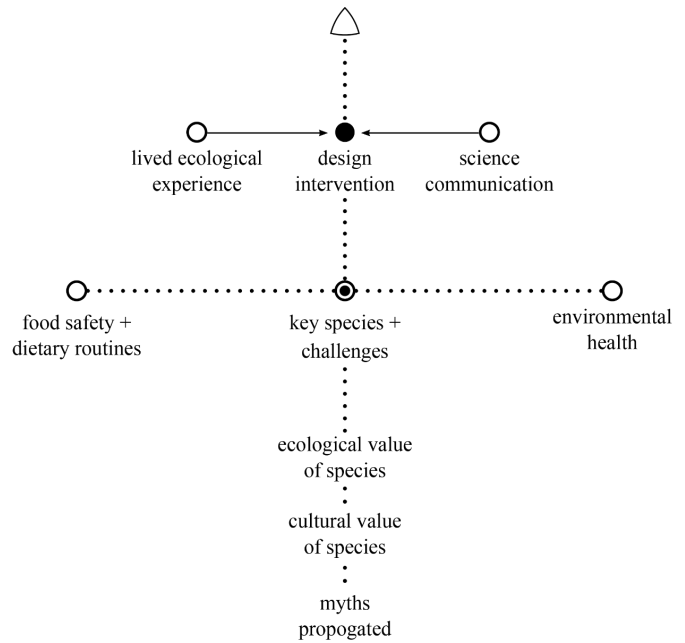


Fig. 2. Vertical analysis of One Health
Source: Adapted from CDC

B. Snakebite Management and Tribal Health Systems in North-east India

As shown in Fig. 2, this project adopts a vertical analysis of One Health, studying the interactions and challenges faced by indigenous communities pertaining to snakes and snakebite management. While the number of snakebite cases in North-east India remain unknown, nearly 60,000 Indians die of snakebite every year [8]. It is important to note that 85-90% of snakes worldwide are non-venomous, and the majority of them display non-aggressive tendencies and bite primarily to defend themselves or when threatened [9]. A multitude of factors contribute to this cycle of snake killings and human-faced challenges, such as weak health systems, lack of data, low production of antivenoms and so on [10]. These conflicts reflect human negligence about the role of snakes as ecosystem engineers [9], and highlight the lack of health-seeking behaviours amongst rural communities [11].

III. LITERATURE REVIEW

A. One Health and Indigeneity

One Health aligns with indigenous perspectives that hold animals, people, and the environment together in a holistic view of health [12]. Key studies and projects conducted for this purpose [13 and 14] highlight social determinants and patterns of health inequalities, providing important insights about public health in relationship with indigenous values. Riley et al. in [12] provide further evidence to support the application of One Health in indigenous contexts, emphasising the need to involve indigenous people and environmental health to benefit communities. In 2022, India launched its first One Health consortium project at the Wildlife Research Training Centre with funding from the Department of Biotechnology (DBT) as part of the Ministry of Science and Technology [15]. Around the same time, the Institute of Public Health (IPH) set-up the Planetary Health Interpretation Centre in Arunachal Pradesh,

B. Factors Lending To Tribal Health And Vulnerability

Tribal populations in rural India are recognised as socially and economically vulnerable groups with their lifestyle, food habits, income and access highly dependent on dynamic socio-cultural shifts [17]. Moreover, although sections of urban India experience phenomenal economic growth, the improvement in health-care infrastructure remains quite uneven across the country, especially in the north-eastern parts, where extensive rural-urban disparities and limited access to health-care services remain huge challenges [17]. Research indicates that indigenous populations face heightened rates of diseases associated with the environment and animals; and the One Health approach has been successfully utilised to grasp and mitigate these health risks [12]. The results of these studies highlight the importance of conducting high-quality research in indigenous communities, utilising rigorous methods, local leadership, and actively engaging indigenous perspectives to achieve successful outcomes [12].

C. Community Engagement And Indigenous Research Methods

Conducting social research and interventions in Asia, particularly among indigenous rural populations, requires heightened empathy and cultural awareness due to the region's diversity, especially when employing research and intervention methods rooted in Western contexts [18]. As a way of decolonising research, a holistic and pragmatic approach is critical for building trust and establishing positive partnerships [19]. Keeping these findings in mind, this project adopts the methodology of Participatory Action Research (PAR) to create outcomes that are culturally relevant, promote empowerment, inclusivity and respect [19]. As the field of indigenous research is historically understudied and systemically under-represented, a case-study with a similar objective [18] was used as a guide to ensure the study designed for this project was culturally appropriate and beneficial for all involved stakeholders.

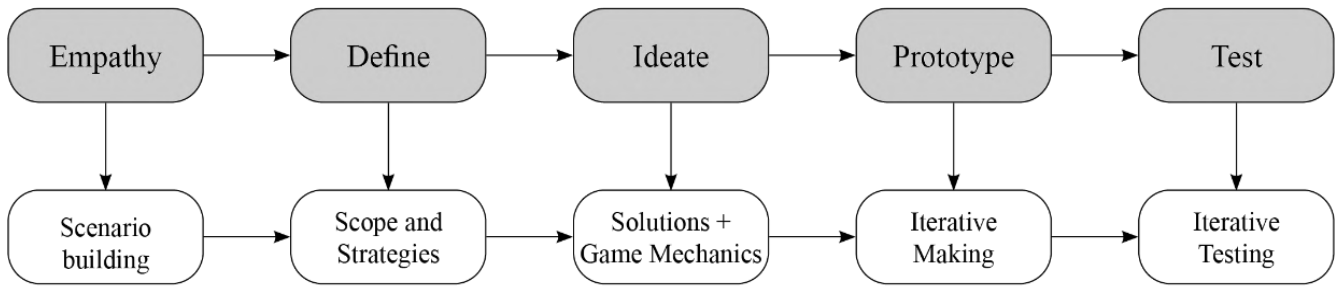


Fig. 3. 'Plug-and-play model' - game design thinking approach with play-based elements. Adapted from Jacey-Lynn Minoi et al.

Minoi et al. [18] provide the use of a play-to-engage model used in rural indigenous schools in Sarawak, West Borneo, which was adopted for this project as shown in Fig. 3 and 4. Recognizing the ubiquity of play, this model incorporates design elements and design thinking, facilitating the generation of innovative ideas and resolution of complex issues [18].

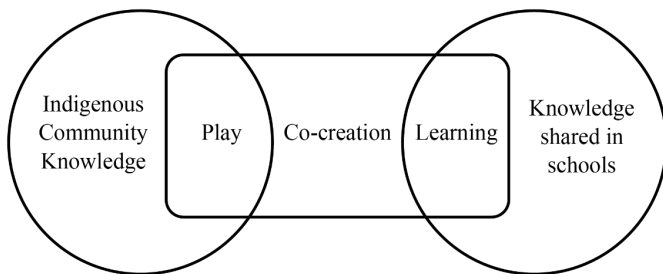


Fig. 4. Co-creation for learning with indigenous communities Adapted from Jacey-Lynn Minoi et al

IV. METHODOLOGY

The research study and end product designed have been created in collaboration with experts from wildlife biology, public health, education, game design and craft communities through a process of interviews, co-design workshops, iterative prototyping, and feedback sessions. As shown in Fig. 5 on the next page, the overall process used is a Double Diamond Approach [20], with different stages of the project drawing from relevant theoretical frameworks of ethnography, education, community engagement and game design thinking. This allowed for the social, cultural, and environmental contexts of the project objective to be explored by means of divergent and convergent thinking [20]. Two field trips were undertaken to inform the case-study, with one between the *discovery and define phases* and the second between the *develop and deliver phases*.

A mixed-methods approach was used to gather, analyse and interpret both quantitative and qualitative data from interviews, co-design workshops and expert feedback conducted through multiple stages of the project. The data collection for qualitative data included the use of a Tascam DR-40X sound recorder, a Sony Cyber-Shot camera, and notes for observations and insights. A light adaptation of Braun and Clarke's Thematic Analysis (TA) was used to generate themes from the codesign workshops and semi-structured interviews with stakeholders. Likert scales were employed to give

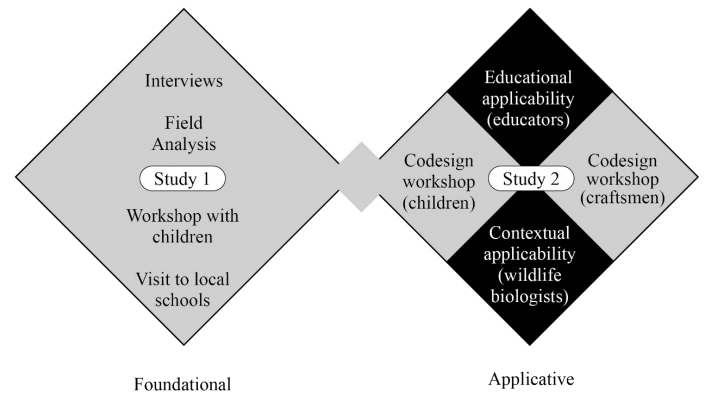


Fig 6. Model of Study for Ethnographic Research Source: Adapted from The Field Study Handbook by Jan Chipchase

quantitative value to qualitative data in the semi-structured interviews and codesign workshop sessions.

As per Fig. 6, ethnography was selected as the most appropriate approach to conduct the research phase of the project, and *The Field Study Handbook by Jan Chipchase* [21] was used to create a holistic strategy for field research that enabled closeness, empathy and a deeper understanding of the users' contextual implications.

In setting up the context of the project, the Institute of Public Health, India and Grantham Institute, Imperial College London, UK were onboarded as partner organisations. Green Hub, an organisation in India, served as a key stakeholder and local host for the project.³

³ This study received the ethics approval of the Ethics Committee of the Dyson School of Design Engineering on 25 January, 2023. All risk factors including the participation and study of children from indigenous groups, vulnerability, risks and concerns as well as language barriers were established in detail and included in the project plan.

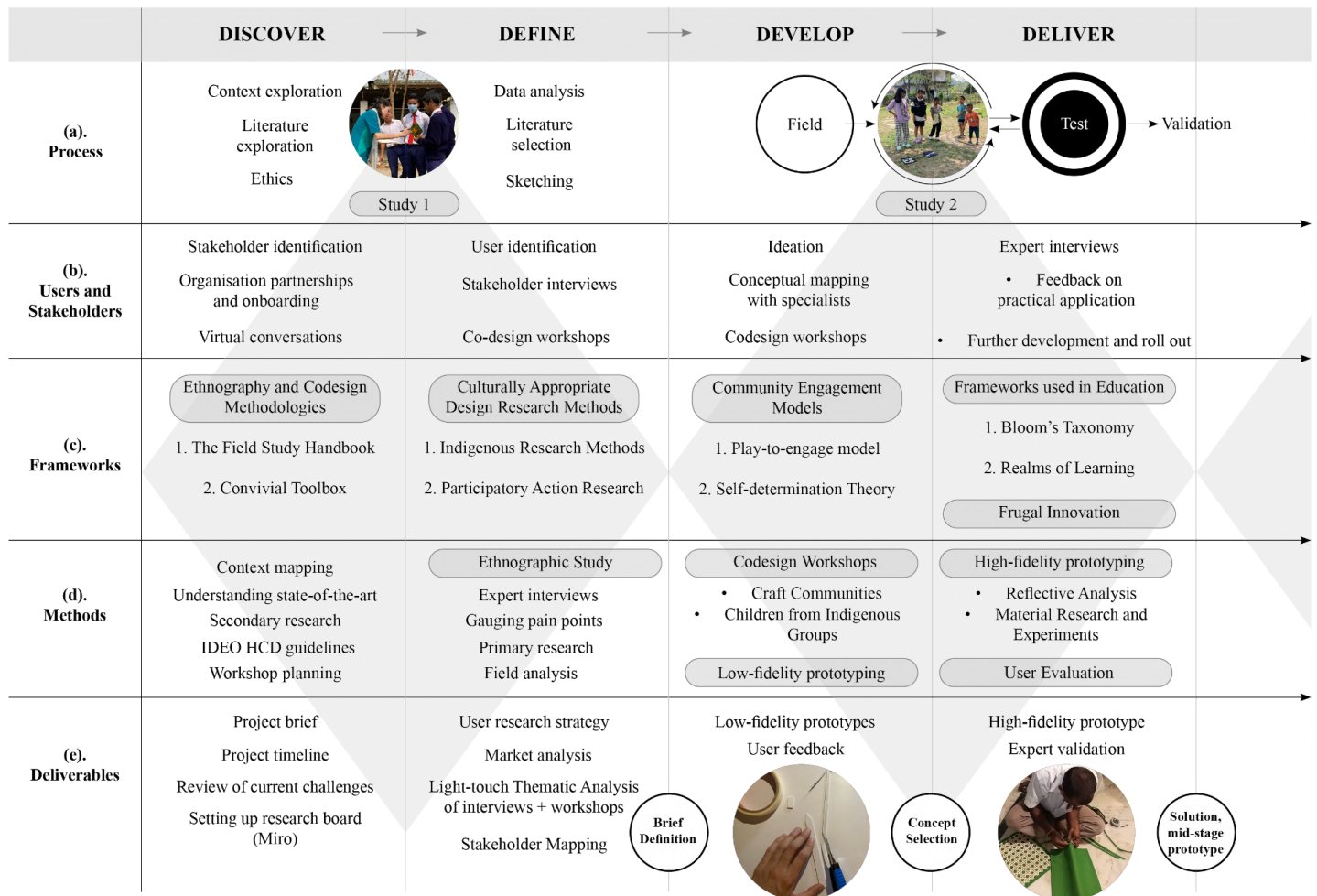


Fig. 5. Methodology⁴

V. STUDY 1: ETHNOGRAPHIC STUDY OF INDIGENOUS GROUPS OF AKA, NYISHI AND MIJI LIVING IN NORTH-EAST INDIA

A. Aim

- 1) To identify an area of human-wildlife conflict
 - a) To understand challenges faced by indigenous communities pertaining to that conflict
 - b) To collect stories (qualitative data) and data (quantitative data) about community beliefs regarding that conflict
- 2) To understand the role of education in indigenous contexts

B. Indigenous Groups - Users and Stakeholders

Indigenous groups of Aka, Nyishi and Miji were identified as key stakeholders living around the study location of Pakke Tiger Reserve, and were deemed as the most appropriate user group for the purpose of the study.

C. Study Protocol and Participants

1) Interviews

A network of people were interviewed using semi-structured formats. The objective was to understand their perspective on

the relationship between indigenous communities and their environment, challenges faced and community beliefs about species.

Participants (N=11) were a mix of people from indigenous groups and migrant populations of Assam and Arunachal Pradesh, had knowledge of the local environment, were committed to studying the wildlife and restoring local ecologies through their various professional endeavours.

They included Field Researchers, Educators and Wildlife Biologists from GH, as well as the Range Forest Officer (RFO)



Fig. 7. Image from an interview conducted with Manisha Halai (GH) of Kathan village, Arunachal Pradesh.

⁴ High quality figure attached in Appendix A

and his staff from the Arunachal Pradesh State Forest Department. An example is shown in Fig. 7.

2) Workshops

Participants (N=40) were children from indigenous groups of Aka, Nyishi and Miji tribes, as well as migrant populations. They were recruited via GH from two local schools: Lower Bhalukpong Government Middle School and Ruth Foundation English School. An example is shown in Fig. 8.

Activities included:

a) Gathering Community Beliefs through Storytelling:

Groups of 4 children were given an image of a species found in North-east India (e.g One-horned Rhinoceros, Monocled Cobra, Red Panda and Green Rat Snake), and asked to share their encounters with that species orally. Their presentations were recorded by means of video, audio and notes.

b) Perceptions and Responses to Threatening Species:

This was conducted on an individual basis to gather information without group influences. Each student was asked to write a letter addressed to their favourite species, and a letter to the species they considered the most dangerous.



Fig. 8. Image from the workshop conducted at Lower Bhalukpong Government School

3) Findings:

a) Quotes from interviews that highlighted community beliefs:

TABLE 2

Sample of quotes from 2 respondents (N=11)

“We believe that if a snake is ever seen, it should be killed on sight. People think that once a snake sees a person’s face, it will memorise it and will come and kill the person at night.”

- Manisha Halai
Kathan Village, Arunachal Pradesh

“One of the myths is that if you are bitten by a snake, there are certain stones that you can rub on the bite and a traditional healer or a practitioner would help out with that.”

- Dr Nandini Velho
Wildlife Biologist and Educator, GH

b) Samples of sketches from the workshop:

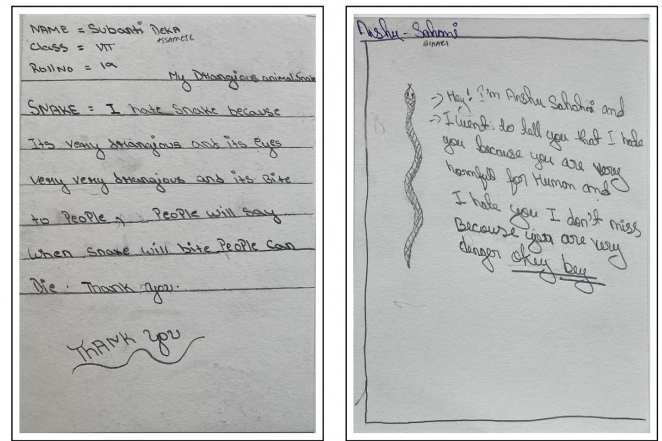


Fig. 9. Samples of sketches by students from the workshop (N=40). Additional images attached in Appendix A.

D. Results and Discussion

The quantifiable raw data from the workshops was tabulated (refer Appendix A, Fig. 10) and a frequency table was created (Table 3) to analyse the percentage of children which considered specific species as dangerous. Qualitative data from the interviews and workshops was analysed using TA (Table 4) to generate themes.

TABLE 3

Frequency table created of top 3 species based on data gathered for the activity ‘write a letter to a species that you consider dangerous’ (N=40)

Species	Percentage	Most frequently used word/s
Snake	43.47%	dangerous
Tiger	10.86%	dangerous, attack
Cat	8.69%	dirty, long nails, attacks

TABLE 4

Results of the themes that emerged based on TA of interviews (N=11)

<p>1). Area of identified human-wildlife conflict</p> <p>a). Specific Challenges</p> <p>b). Stories and Data</p>	<p>The prominent area of human-wildlife conflict was identified as that of snakes and snakebite management.</p> <p>Included a set of interconnected factors such as the lack of snake species identification, the lack of behavioural knowledge required in situations of snake encounters and misinformation about health-seeking behaviours in cases of snakebites.</p> <p>The prevalence of fear-based community beliefs and social taboos which prevented people from seeking help in cases of snakebites.</p>
<p>2). Role of Education</p>	<p>The lack of place-based education in local school systems which affected indigenous children’s contextual, practical knowledge about the environment they live in, the health infrastructure available and best practices to follow with species encounters.</p>

As shown in Fig 11, the need to be fulfilled was identified as designing educational tools that would improve knowledge among children in indigenous communities about snakes and snakebite management.

TABLE 6

Elements of SDT used in the game development

Components	Use
Competence	To ensure the identified users have the skills to play the game
Autonomy	To ensure the identified users have the freedom to choose whom they can play the game with
Relatedness	To ensure the identified users can play the game with those they share a close relationship with (community members) and they can produce something together (community engagement)

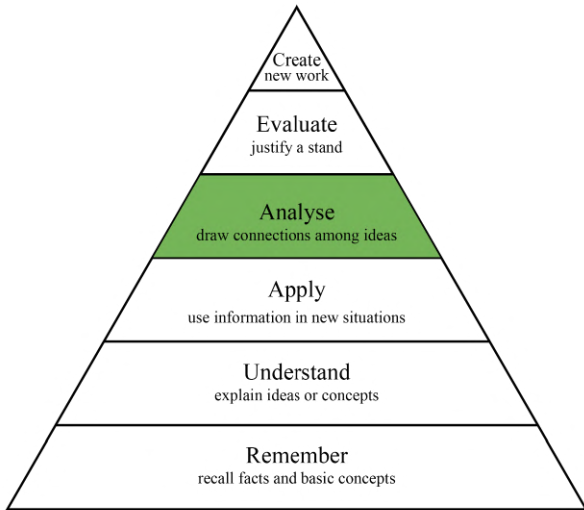


Fig. 14. Bloom's Taxonomy used for designing educational content

Three game concepts were developed including elements such as dice, playing mats, paper cards, and a spinning wheel (refer Appendix A, Fig. 15). These were presented to experts from fields of Wildlife Biology and Education to assess their potential effectiveness based on the learning objectives of the game. Adjustments were made based on the feedback, and the concepts were developed into low-fidelity prototypes using cloth, masking tape, paper and chalk.

D. First Iterations and Low-fidelity Concepts

1) Study Protocol and Participants

Participants (N=32) were children from indigenous groups of Aka, Nyishi and Miji, and migrant populations. They were recruited via GH, with one workshop taking place at Lower Bhalukpong Government Middle School and the second at the Planetary Health Interpretation Centre. Two fellows from GH co-facilitated the workshop with the researcher. An example is shown in Fig. 16.

2) Co-design Workshops:

Aim:

- a) To build gameplay based on the low-fidelity prototypes
- b) To test if the learning objective of the game was being met

Children were divided into 3 groups and took turns to play each game (A, B, C) in a randomised order. At the end of the

workshop, children participated in a group voting system to determine the playability of each game, followed by an individual voting system to select their most liked game. The facilitators assessed each game using a Likert Scale based on the criteria of the Realms of Learning (HCD) Framework [27] which includes components of practicality, technicality, contextualism and constructivism.



Fig. 16. Image from the codesign workshop conducted with children from indigenous groups of Aka, Nyishi and Miji tribes

3) Findings

a) Sample of data gathered from the group voting system conducted amongst children:

1. I would rate playing game A as



Fig. 17. Child-friendly Likert Scale used to assess group preferences amongst Game A, B and C (N=3 groups of 32 student in total)

b) Sample of data gathered from the individual voting system conducted amongst children:

1. My favourite game was

- A
- B
- C

Fig. 18. Multiple choice question used to assess individual preferences amongst Game A, B and C (N=32)

c) Sample of data gathered from the facilitators:

1. I thought the children could play this game (practical component)

Game	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
A				✓	
B					✓
C				✓	

Fig. 19. Likert Scale comparison of Game A, B and C based on the Realms of Learning Framework (N=3)

4) Results and Discussion

TABLE 7

Group votes to determine playability based on the Likert Scale. Evaluation based on responses from children (N=3 groups of 32 students in total):

Game Concept	Percentage Rated on Playability
A	93.34%
B	100%
C	93.34%

TABLE 8

Individual votes to determine most liked game
Evaluation based on responses from children (N=32)

Game Concept	Number of Votes - Rated on Enjoyability	Percentage Score
A	11	34.375%
B	16	50%
C	5	15.625%

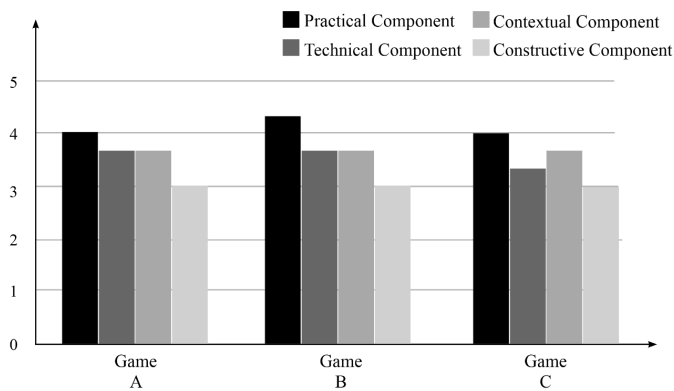


Fig. 20. Data comparing the games based on the Realms of Learning Framework. Evaluation based on responses from facilitators (N=3)

Based on the combined results of the co-design workshops, Game B was selected as the prototype which most successfully achieved the learning objectives of the game. Feedback was incorporated, and the next iteration of the prototype was designed.

E. Frugal or 'Jugaad' Innovation

As shown in Fig. 21 and 22, a model of frugal innovation by Radjou et al from [28] was adopted to lower the barrier to entry and increase the cultural appropriateness of the product. Principles of the Jugaad⁶ Innovation model were used as guidelines to create a socially relevant product. Materials for the different parts of the game were selected on these grounds. Images of the final prototype are shown in Fig. 23.

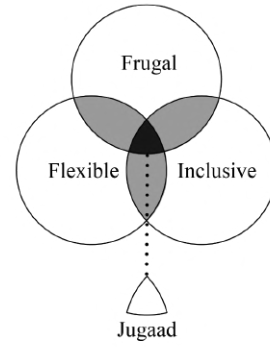


Fig. 21. Model of Frugal Innovation termed as 'Jugaad' Adapted from Radjou et al

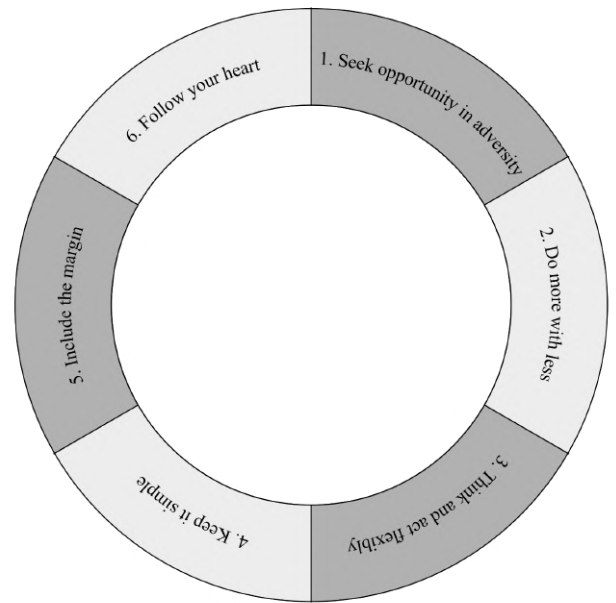


Fig. 22. Six Principles of Jugaad Innovation Adapted from Radjou et al

F. High-fidelity Game - Material Selection

TABLE 9

Materials, properties and selection criteria

Materials Selected	Material Properties and Selection Criteria	Elements of Biyu Tabu Nibew the materials were used in
Woven bamboo sheets	Durable, low-cost, easily available, culturally appropriate, can be woven locally	Playing mats
Cloth	Low-cost, easily available	Base lining for mats
Small pebbles	Found material, easily available	Playing object
Wood for dice	As a replacement material for the pebbles - easily available, low-cost, can be sculpted locally	Playing object

⁶ Translates to 'non-conventional but simple work-around, frugal innovation, often termed a *hack*'

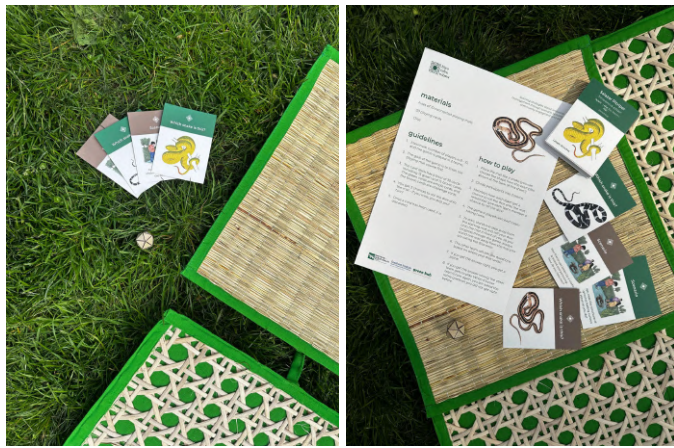


Fig. 23. Images of the final prototype created for *Biyu Tabu Nibew*

G. Expert Validation

Three semi-structured interviews were conducted to assess the scientific validity of the content, the use of scenario building as a learning strategy, and the relevance of this approach in tackling similar areas of human-wildlife conflict.

TABLE 10

Experts involved in the validation process

Expert Name	Background Expertise
Dr Nandini Velho	Wildlife Biologist and Educator, Green Hub
Shradha Rathod	Conservation Biology Co-author: Snakes of Pakke Tiger Reserve
Dr Prashanth N Srinivas	Assistant Director, Institute of Public Health

All three experts gave positive responses about the relevance of the participatory process, the gameplay strategies of scenario building, and the practical applicability of the final outcome.

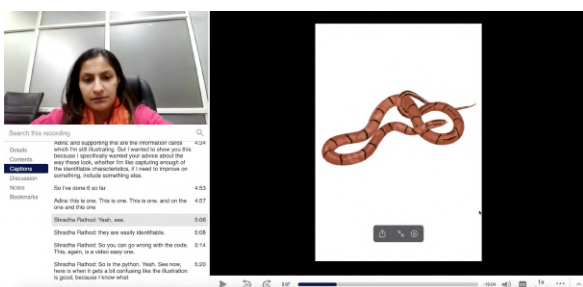


Fig. 24. Screenshot from zoom validation session with experts

TABLE 11

Sample of quotes from experts (N=3)

<p>“...I definitely think it can be used for another species. And if you look at species that face similar or negative interactions with humans, this can definitely be used as a tool there. And again, this can be used in different places so long as it's contextualised with information that is relevant to that space, with a sort of ethical creativity that is reflected from the process of making and the process of co-production.”</p> <p style="text-align: right;">- Dr Nandini Velho</p>
<p>“...when it comes to scenario building you are actually creating a fictional situation, and it instigates the imagination and curiosity. It's (the game) very engaging, and I think the kind of knowledge that they get is long term - most importantly, it'll feed into cooperation, collaboration, empathy.”</p> <p style="text-align: right;">- Shradha Rathod</p>
<p>“... these will be materials that are aesthetically more likely to be in line with what people want. You'll also have a sense of familiarity that the users will feel. But, on the other hand, the downside can be that limited exposure to durable materials. So it will be some kind of trade off, but I think I would much prefer shorter-lived but aesthetically and culturally pleasing games versus a very durable, unfamiliar product.”</p> <p style="text-align: right;">- Dr Prashanth N Srinivas</p>

VII. DISCUSSION

A. The key contributions of this project lie in:

- 1) Achieving a practical, interdisciplinary collaboration between fields of public health, wildlife biology and education in indigenous contexts.
- 2) The use of a participatory design methodology from beginning to end, actively involving stakeholders in the design process to ensure their needs have been met.
- 3) The use of frugal innovation methods to create physical components of the game that are locally sourced and contextually relevant.
- 4) The creation of a culturally sensitive educational tool.

B. Further Development

In order to gain a deeper understanding of the educational impact and long-term behavioural changes achieved, the final prototype will require to be tested by means of a longitudinal study using an iterative process of mixed-methods evaluation. The collaboration with IPH and GH for this process will continue.

Biyu Tabu Nibew will be presented at an upcoming seminar at IPH in June, 2023 to share the learning outcomes gained from the project. Additionally, the researcher has been appointed as an Honorary Associate at IPH to work with health equity clusters at the Planetary Health Interpretation Centre in North-east India.

TABLE 12

Limitations of the project

Limitations	Description
Demographic for codesign workshops	It should be noted that the selected indigenous groups of Aka, Miji and Nyishi are only representative of a fraction of the tribal communities that are present (such as the Bodo, Idu-Mishmi, Monpa and so on) in the region..

Vulnerable and understudied populations	As these tribal populations are historically understudied and systemically under-represented, there is a massive lack of data on factors of their social, economic, cultural and physical well-being.
Characteristics of sample size	As the users for the project output were children, research and evaluation methods used had to be sensitive and child-friendly. This affected the nature of results gathered, as quantitative scales (like the Likert scale) could not be used in their pure form and had to be adapted.
Residence in remote areas	The selected region of North-east India is fairly remote and removed from urban clusters. This impacted the ease of accessing materials, mobility between field sites and pace of work.
Lack of data on species	As per 'Snakes of Pakke Tiger Reserve,' India hosts about 330 species of snakes. The exact number of snakes in North-east India is still unknown, with the most extensive documentation as that of 46 species found around Pakke Tiger Reserve.
Testing	In order to understand the overall success of all the components, a longitudinal study is required to assess the knowledge gained and the potential behavioural changes achieved.
Linguistic Barriers	North-east India holds an estimate of 220 languages in multiple language families. While the official language is English, most spoken dialects and tribal sub-languages have no written record.

VIII. CONCLUSION

This project highlights the need for advancing successful cross-sectoral collaborations across the human-animal-environment interface in India. The findings of this kind of partnership indicate that the application of a participatory approach is complex and multi-layered, and elements of local leadership, contextual design science and culturally sensitive methods are necessary for shaping outcomes that are relevant and promote the well-being of all stakeholders involved. Taking notes from this case-study, the majority of the forest area in Arunachal Pradesh is managed by individuals, clans, and traditional village institutions under community custodianship [29]. Focused education programmes that take the reality and needs of such environments into account can significantly increase indigenous ownership, autonomy and knowledge - uplifting communities that are representative of social, cultural and ancestral heritage.

Biyu, Tabu, Nibew is the outcome of one such case-study that can inspire participatory approaches to address human-wildlife conflicts in many more similar conservation areas.

Word Count: 3,099 words

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multidisciplinary processes provided clarity on the practical application of the work.

I express my deep appreciation for Ashok Tallang, whose efforts made the on-the-ground research and participatory work achievable. I am grateful to the staff members, principals, and all 50 students from indigenous and migrant communities at Lower Bhalukpong Government Middle School and Ruth Foundation English School for their warmth, hospitality, and curiosity. I also thank the Arunachal State Forest Department for hosting the project and granting access to their forest staff.

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AUTHOR BIO

Adira Andlay is a multidisciplinary designer working across fields of education, ecology and social impact to create systems and tools that promote behavioural well-being. She uses design methodologies to develop contextually relevant interventions that support ecological balance, climate action and community welfare.

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[Biyu Tabu Nibew:](#)[Supporting Education for Snakebite Management in Indigenous Contexts through Participatory Design](#)

Click above to access the digital appendix. All data is stored on secure servers.

The material includes:

- Images and videos of the final game *Biyu Tabu Nibew*
- Audio and video documentation of ethnographic study, codesign workshops, and interviews with stakeholders
- Data obtained from ethnographic study, codesign workshops, and interviews with stakeholders
- Ethics obtained and consent forms from stakeholders and users

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TABLE 1

List of terms and definitions used in this study

Term	Definition
1. Aka, Miji, Nyishi Tribes	<p>The Aka tribe are a tribal group of people living in the East Kameng & West Kameng District of Arunachal Pradesh. Their language belongs to the Tibeto-Burman family.</p> <p>The Miji tribe inhabit the districts of West Kameng, East Kameng and a minuscule region of Kurung Kumei in Arunachal Pradesh, India. Their population of 37,000 are found near the lower parts of the sub-Himalayan hills bordering Assam; they speak the Sajalong language.</p> <p>The Nyishi community is the largest ethnic group in Arunachal Pradesh in north-eastern India. Their population of around 300,000 makes them the most populous tribe of Arunachal Pradesh, and their language belongs to the Sino-Tibetan family, however, the origin is disputed.</p>
2. Co-design	A design-led process that uses creative and participatory methods.
3. Double Diamond Approach	A framework for innovation that aims at tackling some of the most complex social, economic and environmental problems (UK Design Council, 2019)
4. Ethnography	A qualitative research approach used in social and behavioural sciences involving the systematic study of a group's culture, habits, customs and everyday practices.
5. Human-centred Design (HCD)	A problem solving technique that places people at the centre of the development process.
6. Indigenous Peoples/ Communities	Indigenous Peoples are inheritors and practitioners of unique cultures and ways of relating to people and the environment. They have retained social, cultural, economic and political characteristics that are distinct from those of the dominant societies in which they live (UN)
7. Mixed-methods Approach	Involves the use of quantitative and qualitative data to collect more in-depth findings.
8. One Health	An integrated, unifying approach that aims to sustainably balance and optimise the health of people, animals and ecosystems (WHO)
9. Participatory Action Research	An approach to action research that emphasises participation and action by members of communities affected by that research. PAR emphasises collective inquiry and experimentation grounded in experience and social history.
10. Participatory Design	A democratic approach to design that actively involves all stakeholders (e.g. partners, customers, citizens, end users) in the design process to help ensure the result meets their needs and is usable.
11. Protected/ Conservation Areas	A clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values (IUCN)

Fig. 5. Methodology

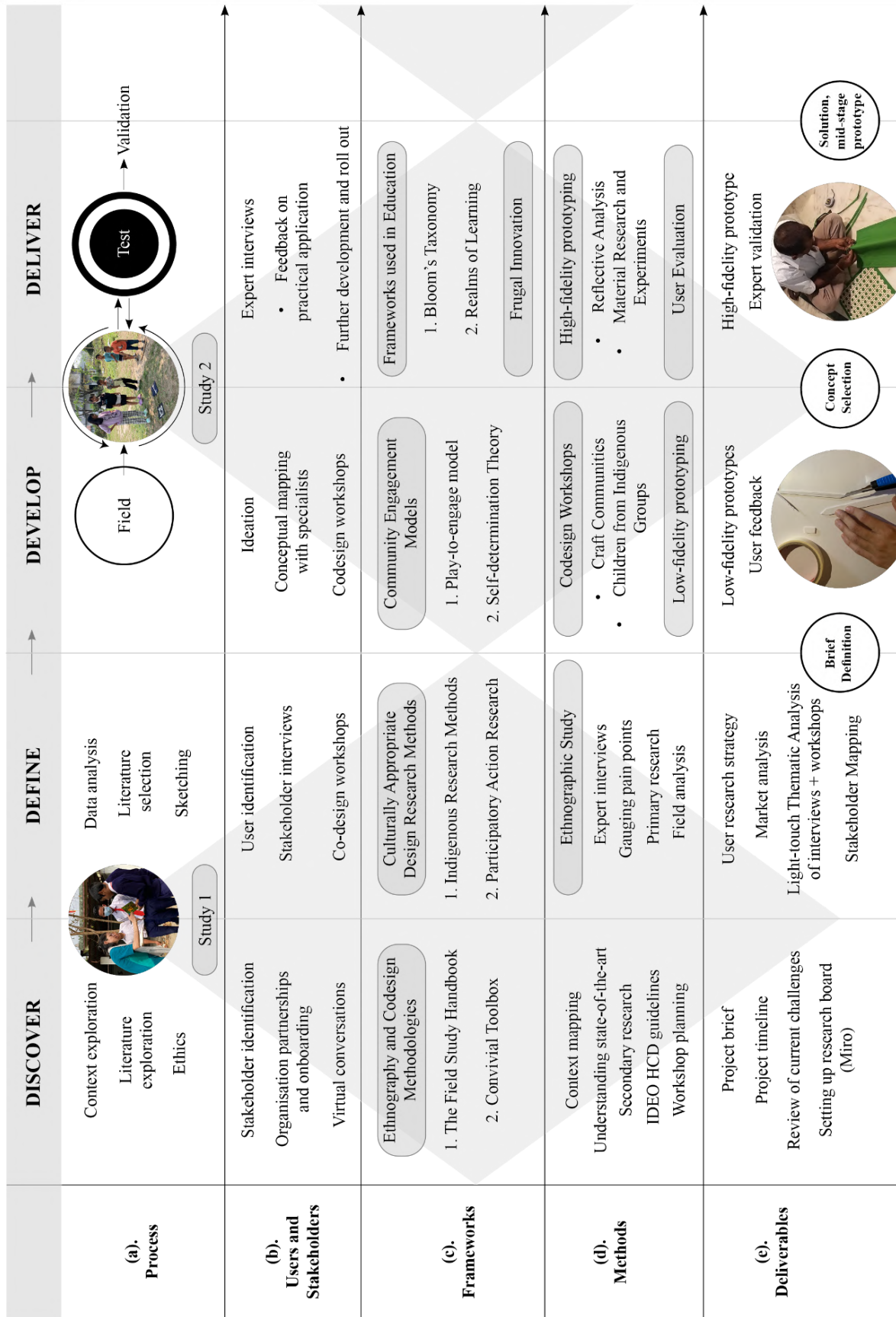
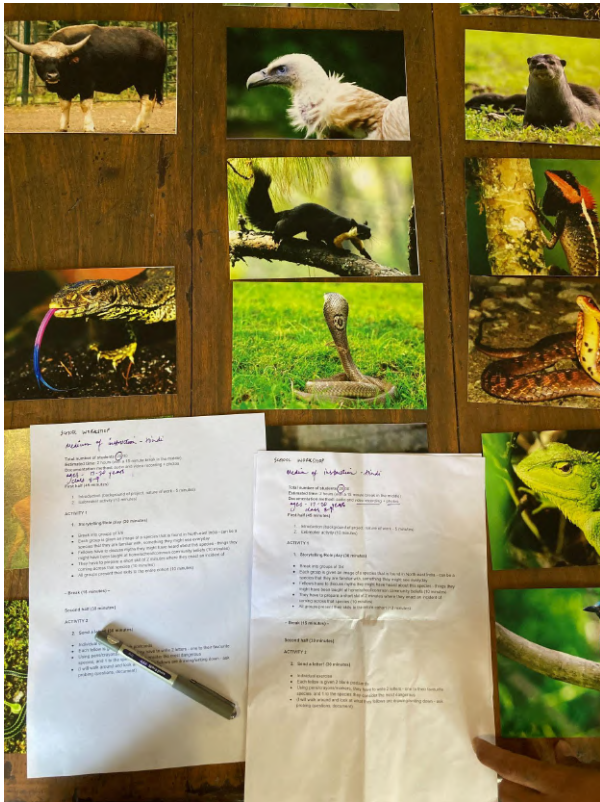


Fig. 9. Examples of workshop material and responses



NAME = Subanti Deka
 Class = VII
 Roll No = 10
 My Disgusting animal book

SNAKE = I hate snake because
 Its very disgusting and its eyes
 very very disgusting and its bite
 to people . People will say
 when snake will bite people can
 die . Thank you.

THANK YOU

NAME = Subanti Deka
 Class = VII
 Roll No = 10
 My Disgusting animal book

SNAKE = I hate snake because
 Its very disgusting and its eyes
 very very disgusting and its bite
 to people . People will say
 when snake will bite people can
 die . Thank you.

THANK YOU

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THANK YOU



NAME = Subanti Deka
 Class = VII
 Roll No = 10
 My Disgusting animal book

SNAKE = I hate snake because
 Its very disgusting and its eyes
 very very disgusting and its bite
 to people . People will say
 when snake will bite people can
 die . Thank you.

THANK YOU

Fig. 10. Tabulated Data from Workshops

Data gathered from activities conducted in the workshops were analysed and tabulated. This was done to compare and contrast differences and similarities among children for species they perceived as threatening, any previous interactions that might have led to the formation of these beliefs, and indicators of how they would behave in a similar situation again.

Name (anonymised)	Tribe	School	Liked Species	Details of Liked Species	Disliked Species	Details of Disliked Species	Misc.
BC	Nepali	Ruth	Deer	herbivorous, eats grass	Starfish	because not found here	
DM	Miji	Ruth	Deer	herbivorous, beautiful, horn, found in deep forest, not harmful or dangerous	Elephant	dangerous, destroys houses, kills human, big heavy legs + body, news of destruction spread through TV	
EB	Boro	Ruth	Dog	useful for humans - protection capacity from danger	Tiger	eats other animals and kills humans	
SK	Bihari	GMS	Butterfly	beautiful, no fear	Snake	fear, nightmare	Banded Krait - highly venomous
AN	Nepali	Ruth	Dog	intelligence, friendly, loyal, helpful capacity	Cat	dangerous, attacks, drinks human's milk	
SD	Assamese	GMS	Rabbit	cute, soft hair	Snake	dangerous, snake bite, death	
VS	Miji	Ruth	Starfish	small, beautiful colours	Earthworm	dirty, slippery	
PM	Boro	Ruth	Parrot	beautiful, cute	Starfish	poisonous	
AJ	Aka	Ruth	Rabbit	beautiful	Dog	dangerous, bites humans, has been bitten many times, has a lot of dog marks on his body	
JS	Miji	Ruth	Dog	loyal, understand humans, cute, don't get angry fast	Cat	aggressive, long nails, dirty blood, smells bad	
MBT	Nepali	Ruth	Dog	cute, loyal, long nails and teeth	Cat	aggressive, long nails and teeth	
SK	Aka	GMS	Ghayal	important for AP	Snake	dangerous	
DS	Miji	Ruth	White Fox	saw in childhood, feels a personal connection	Hen	stricken her when she was taking eggs from the hen, had to run away	
EK	Miji	Ruth	Cat	never gets lost, provides company	Lion	eats people and animals	
TR	Santhal	Ruth	Dog	-	Spider	-	
MG	Nyishi	Ruth	Cat	beautiful, fun to play with, expert in catching rat	Dog	been bitten many times	
KW	Boro	Ruth	Dog	sensitive, helpful	-	-	
SK	Bihari	GMS	Fish	playful, fun to watch when in the water	Snake	fear, snake gets angry when woken up from sleep, feels like killing him	
KT	-	Ruth	Dog	protective capacity, protects house, helps in danger	Cat	Dirty their bed, tears tests papers and homework	
C	-	Ruth	Ghayal	State animal of AP, feels proud when he sees the animal, feeds salt to the animal	Tiger	attacks other animals, scared, never seen so hates	
PT	Aka	Ruth	Dog	protective capacity - from humans + other animals	Snake	-	

Fig. 11. Problem wheel developed for snakes and snake bite management (based on interviews with stakeholders)

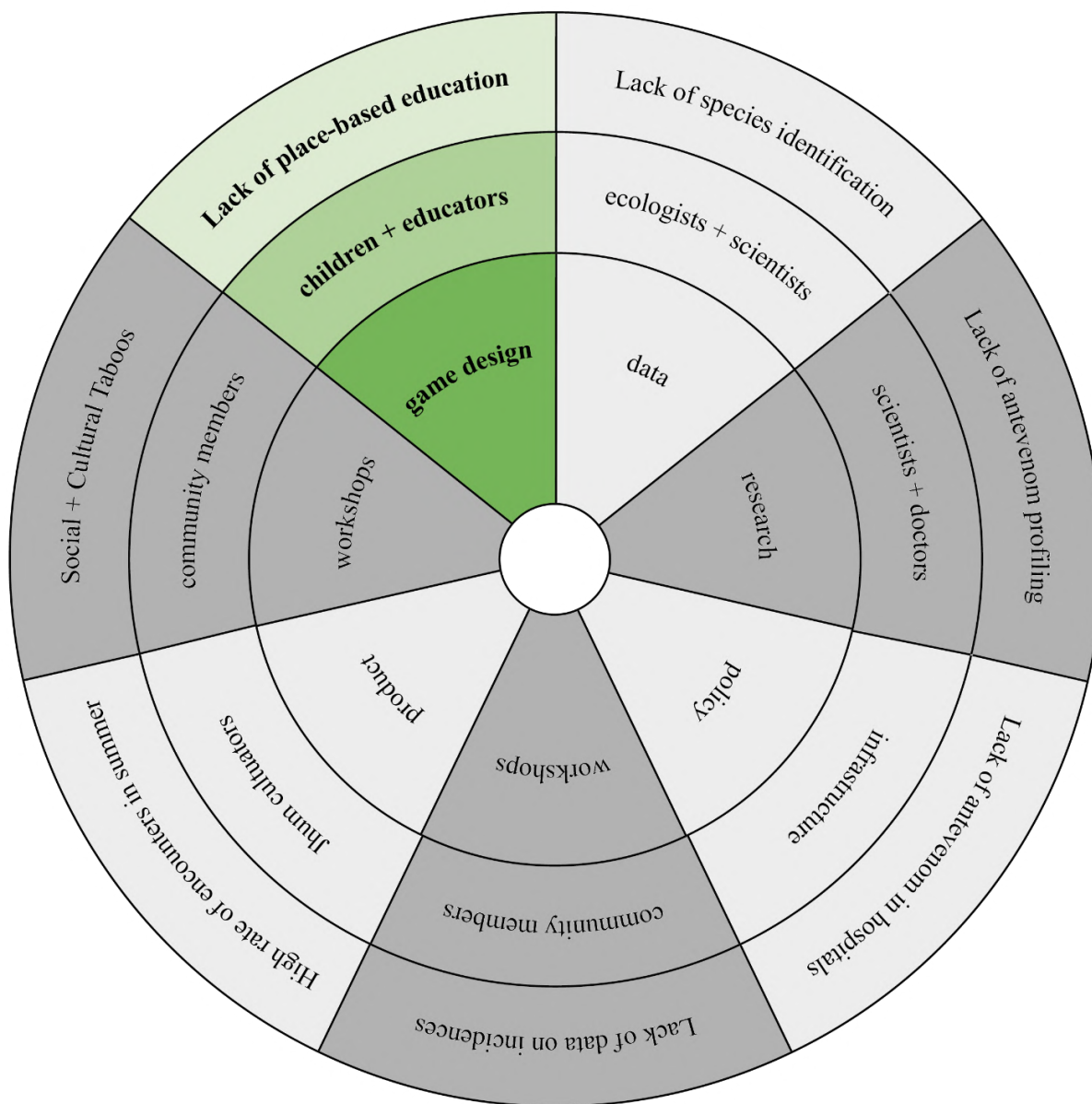


Fig. 13. Market landscape of games in India



Fig. 15. Game Concepts A, B and C

a) Game Concept A

Name: Dice + Mat game

Number of Players: 2 teams, with 5-6 people in each team

Materials: 2 mats, 1 deck of snake + scenario cards, 1 d20 dice

Rules:

- You have to play in 2 teams
- The deck for the game has a total of 30 cards
- Maximum number of points that can be achieved = 200
- The deck has questions and answers both

Gameplay:

- Highest roll starts
- If Team A gets the higher roll, they roll the dice again. If the dice lands on number 6, 1 member from each team has to run to number 6 on their respective mats.
- If a member from Team B reaches number 6 on their mat first, then they get to answer the question.
- Member from Team A picks up the top card from the deck and asks Team B the question.
- If Team B gives the right answer, they win 10 points. If they give the wrong answer, they don't win any points. The card goes to the bottom of the deck.

b) Game Concept B

Name: Dice + Mat game

Number of Players: 2 teams, with 5-6 people in each team

Materials: playing mat connected with rope, two decks of cards (easy v/s difficult), a rock/pebble, a coin

Rules:

- You have to play in 2 teams
- The deck for the game has a total of 30 cards - 15 easy and 15 difficult
- You get 3 chances to throw the stone - if you miss, you skip your turn
- Recommended number of players in each team = 6
- The team that finishes the course first wins
- No cards are discarded
- If you lose, you stay on the same block. If you win, you get another turn like pool.

Gameplay:

- Coin toss to see which team starts
- Team B wins coin toss
- Team B throws pebble on square 1
- Team A asks Team B a question from a green card from the deck
- Team B gets it right - card goes to the bottom of the deck, it's Team B's turn to throw the pebble on square 2

- If Team B gets it wrong, card goes to the bottom of the deck, it's Team A's turn to throw the pebble on square 1

c) Game Concept C

Name: Dice + Mat game






Number of Players: 2 teams, with 5-6 people in each team

Materials: A spinning board, A deck of 52 cards containing cards in 5 colours

Rules:

- You play individually, max number of players = 4
- You always play clock-wise
- This game has a second, third, fourth place
- Deck comes separated by colour
- Venomous and non-venomous cards have illustrations + clues to get children to guess the species
- Cards have answers at the back
- First person to get 1 of all colours wins

Key:

	venomous snake - identify
	magic card - diff magic applications
	non-venomous snake - identify
	trick card - models v/s mimics
	situation card - answer

Gameplay:

- Player 1 spins the wheel
- Spinner lands on green, draw a card
- Player 1 picks up the corresponding card from the deck
- Has to identify the non-venomous snake
- Gets its right - keeps the card
- Gets its wrong - doesn't get the card, goes to the bottom of the deck

a) Game Concept A

Dice and bingo game



DnD Dice Roller

of Dice: Sides: Mod:

Quick Rolls: Quick Roll Mod:

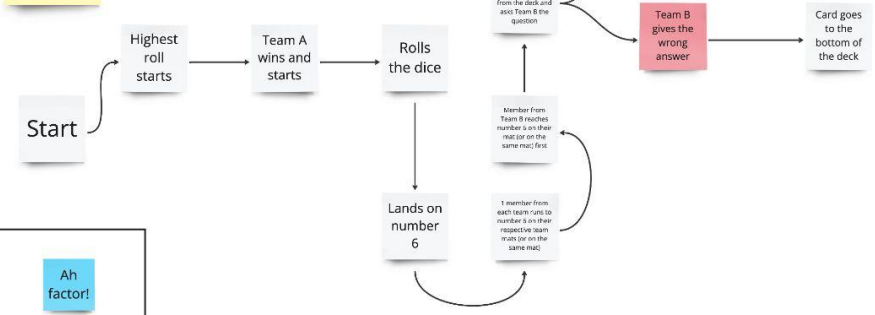
Disadvantage: Advantage:

Roll:

Rolled: 1d6+0 Result: 5
 Rolled Advantage: 2d20+0 Result: (9 & 20) Highest: 20
 Rolled: 1d20+0 Result: 11

	D4	You will roll a D4 to see how much damage is caused when you see any of these weapons: Dagger, great club and scythe.
	D6	You will roll a D6 to see how much damage is caused when you see any of these weapons: Club, javelin, sickle, handaxe, short sword, throwing business sword, hand crossbow and sling.
	D8	You will roll a D8 to see how much damage is caused when you see any of these weapons: Mace, spear, quarterstaff, long sword, rapier, scimitar, crossbow, short bow.
	D10	You will roll a D10 to see how much damage is caused when you see any of these weapons: Battle axe, war hammer, great sword, long spear, longbow.
	D12	The only weapon that uses a D12 (not including magic or special weapons) is a great axe.
	D20	The D20 is the most important die to have with if you do health, mechanics, disarming and any other skill check, plus you use it to check if you have hit your opponent!

User Journey



Rules

- You have to play in 2 teams
- The deck for the game has a total of 30 cards
- Maximum number of points that can be achieved = 200
- The deck has questions and answers both

Grey Areas

- Do they win something tangible?
- Is there a next stage to winning?
- Can the deck have different kinds of cards?
- Can some cards give more points? (ie magic cards that can be used later?)
- An object to help keep score? - A blackboard?
- 1 mat v/s 2 mats
- Attention span + duration of game

1	17	7	4
5	10	6	8
15	9	11	3
13	19	20	12
16	2	18	14

20	2	17	4
5	14	3	8
10	19	11	12
1	13	15	16
7	18	9	6

Materials

- 2 life-size bamboo mats
- 1 deck of snakes + scenario cards
- 1 life-size d20 dice
- A small blackboard to keep score

Learning comes in through

Q/A

Here, I would design

- Bamboo mats with randomised numbers
- D20 dice
- deck of snake + scenario cards
- A small blackboard to keep score

Low-fidelity

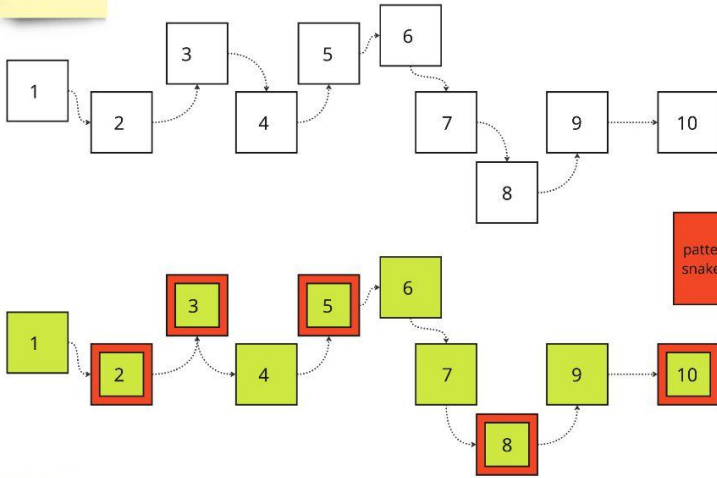
- cloth with squares and chalked on numbers
- D20 dice (bought)
- deck of snake + scenario cards (basic text + photos)
- A small blackboard to keep score

High fidelity

- Bamboo mats with randomised numbers
- D20 dice
- deck of snake + scenario cards
- A small blackboard to keep score

b) Game Concept B

Formation + card game



Materials

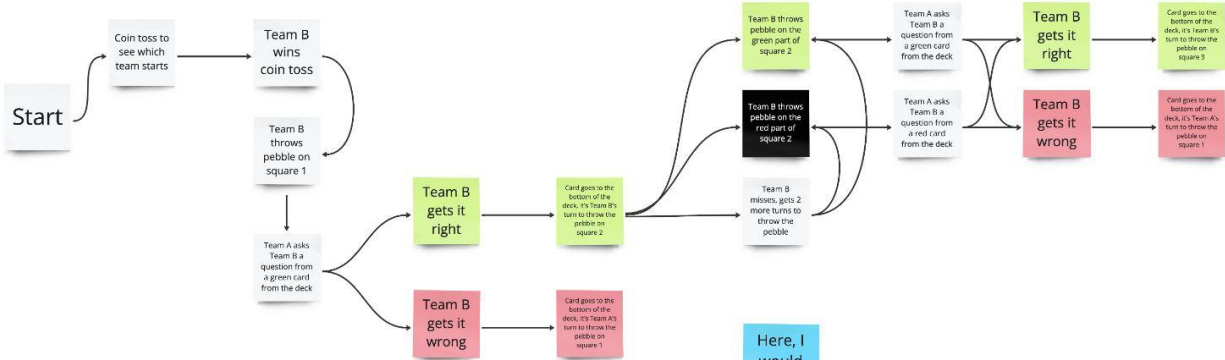
- Playing mat (circles/square s) connected with rope
- Two decks of cards - easy v/s difficult
- A rock/pebble
- A coin

Learning comes in through

Q/A

User Journey

easy q hard q



Rules

- You have to play in 2 teams
- The deck for the game has a total of 30 cards - 15 easy and 15 difficult
- You get 3 chances to throw the stone - if you miss, you skip your turn
- Recommended number of players in each team = 6
- The team that finishes the course first wins
- No cards are discarded
- If you lose, you stay on the same block. If you win, you get another turn like pool.

Here, I would design

Playable mat connected with rope

A deck of green + red cards

Low fidelity

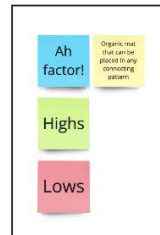
Playable mat connected with rope

A deck of green + red cards

High fidelity

Playable mat connected with rope

A deck of green + red cards

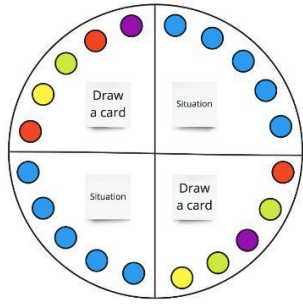


Grey Areas

- Do they win something tangible?
- Is there a next stage to winning?
- Can the deck have different kinds of cards?
- Can some cards give more points? Be magic cards that can be used later?
- An object to help keep score?
- The hard q's will have to be really hard
- How it looks

c) Game Concept C

Snake bite wheel



- venomous snake - identify
- magic card - diff magic applications
- non-venomous snake - identify
- trick card - models v/s mimics
- situation card - answer

Materials

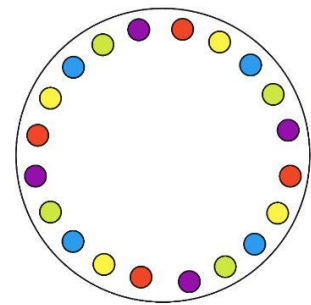
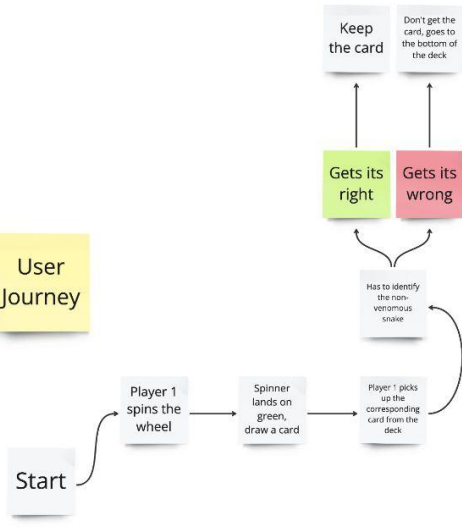
A spinning board

A deck of 52 cards containing cards in 5 colours

Learning comes in through

Q/A

User Journey



Revised



Rules

- You play individually, max number of players = 4
- You always play clockwise
- This game has a second, third, fourth place
- Deck comes separated by colour
- Venomous and non-venomous cards have illustrations + clues to get children to guess the species
- Cards have answers at the back
- First person to get 1 of all colours wins

Grey Areas

- Make it time bound in some way? How long does it go on?
- Spinning wheel doesn't need to be in quarters - can just be randomised dice
- Number of magic cards? Proportion of cards in UNO

Here, I would design

A spinning wheel
A deck of 52 cards in 5 colours

Low fidelity

A spinning wheel
A deck of 52 cards in 5 colours

High fidelity

A spinning wheel
A deck of 52 cards in 5 colours

Fig. 25. Empathy Canvas created to understand the pain points

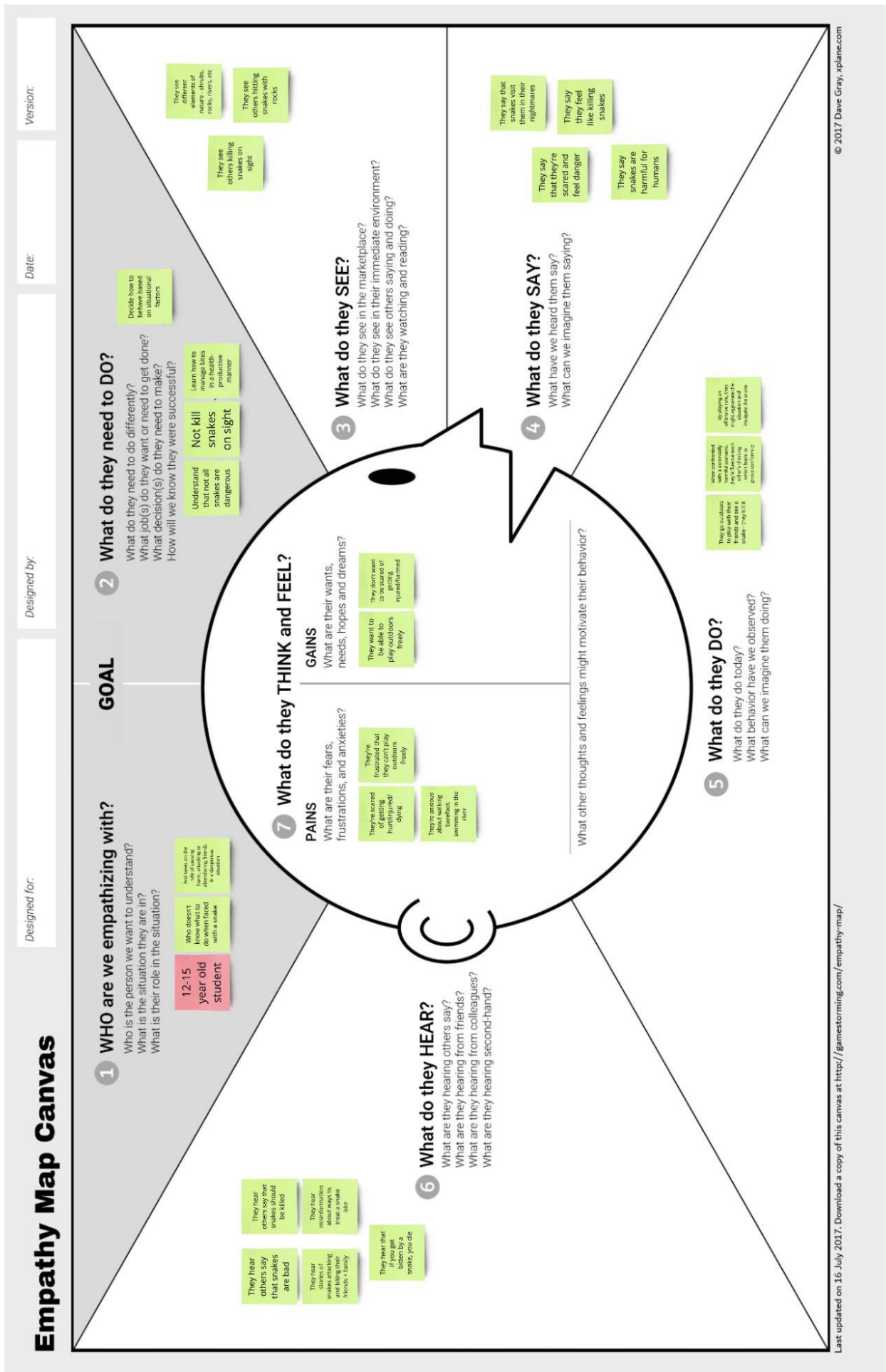


Fig. 26. Low-fi Prototypes for Games A, B and C

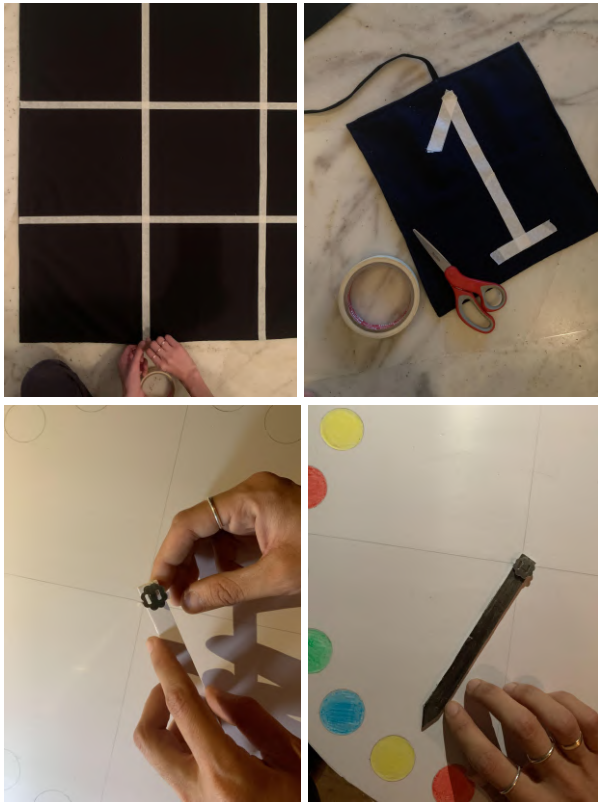


Fig. 27. Craftsmanship and design for final prototype

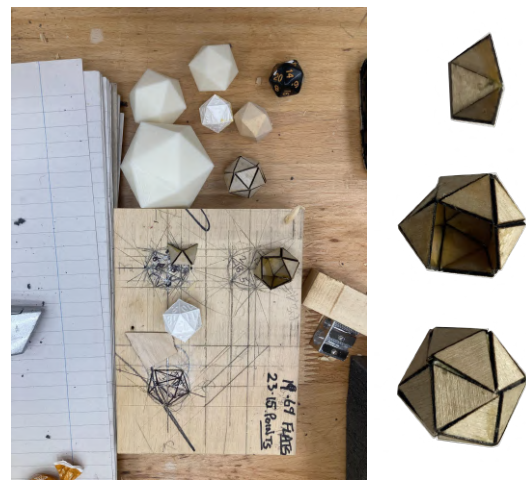
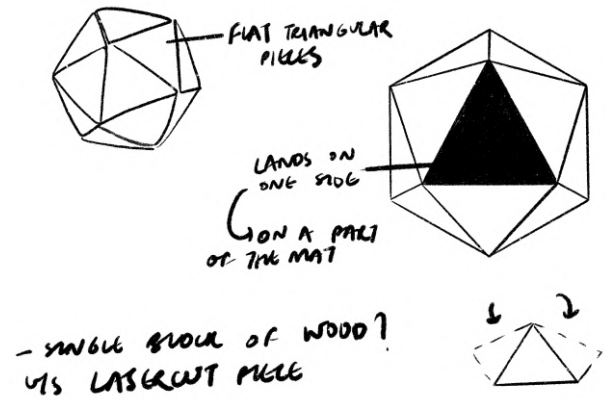
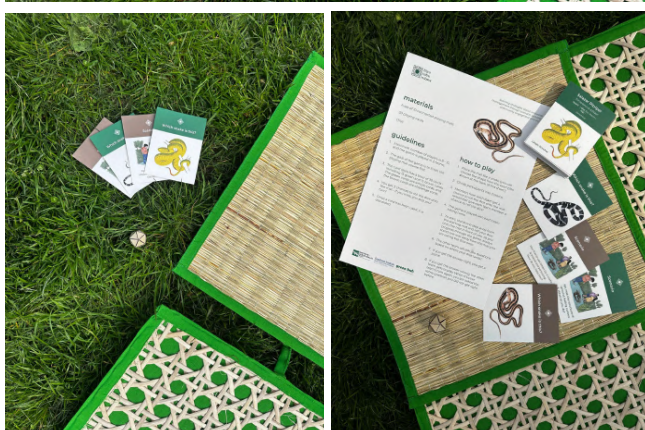
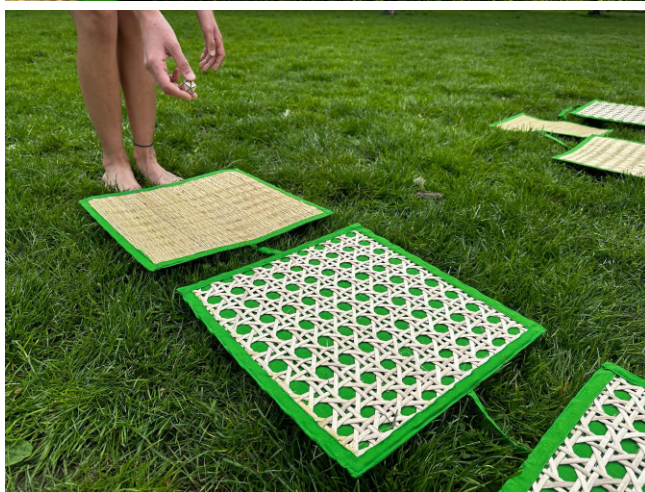
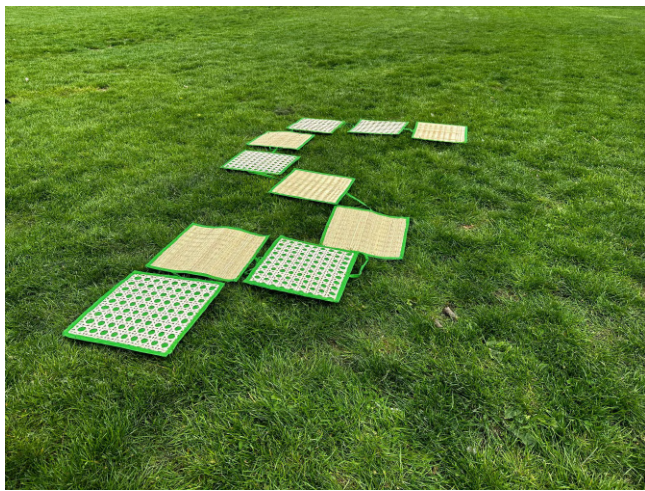

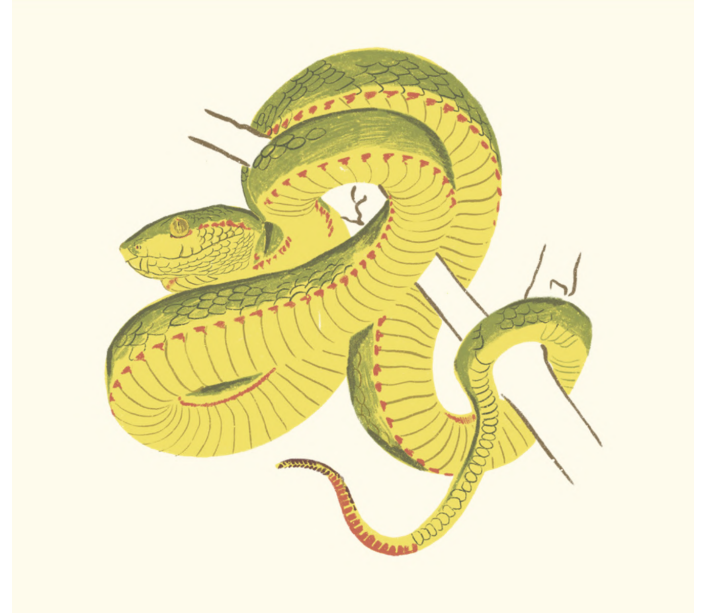


Fig. 28. High-fidelity Prototype



Which snake is this?

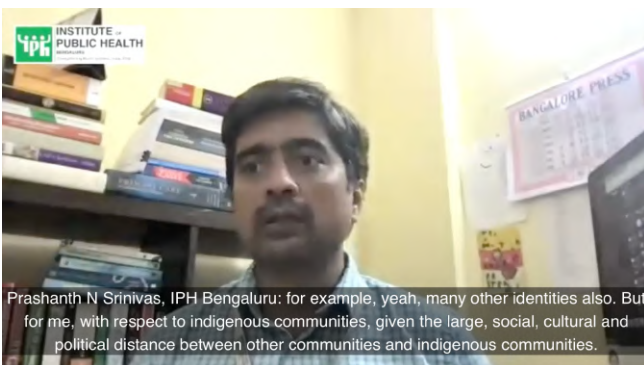


Scenario



Someone's bitten by a snake; you suck out the venom and cut around the bite to release bad blood. Was this the right thing to do?

Fig. 29. High-fidelity Prototype - Digital Handover, May 2023, playing cards printed and shared with students on site



Prashanth N Srinivas, IPH Bengaluru: for example, yeah, many other identities also. But for me, with respect to indigenous communities, given the large, social, cultural and political distance between other communities and indigenous communities.

Fig. 30. Snake Rescue Mission of an Indo-chinese Rat Snake as witnessed in April, 2023



Fig. 31. Rules for Gameplay



learning strategies about snakebite management through scenario building, community engagement and play

materials

A set of 10 connected playing mats

30 playing cards

Dice



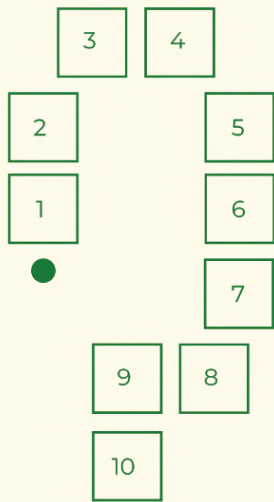
guidelines

1. Maximum number of players is 8 - 10, and the game is played in 2 teams.
2. The goal of the game is to finish the playing mat course first.
3. The card deck has a total of 30 cards - including 15 green and 15 brown cards. The green cards are simple cards, and the brown cards are challenge cards.
4. You get 3 chances to roll the dice onto the mat - if you miss, you skip your turn!
5. Once a card has been used, it is discarded.

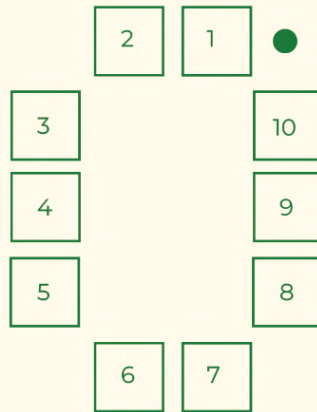
how to play

1. Place the mat like a snake (you can choose the shape from the examples shown at the back of this sheet!)
2. Divide participants into 2 teams.
3. Members from each team get a chance to roll the dice onto the mat - remember give each team member a chance to roll the dice!
4. The game is played with each team taking turns.
5. To start, stand one step away from the starting mat and roll your dice onto the mat in front of you. As you progress through the game, always stand one mat away from the mat you are rolling the dice onto.
6. The other team will ask you questions based on where your dice lands!
7. If you get the answer right, you get a point!
8. If you get the answer wrong, the other team gets to play. When it's your team's turn again, you are asked the same question you did not get right before.

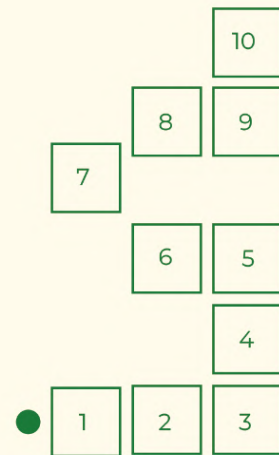
examples for placing the mats



a



b

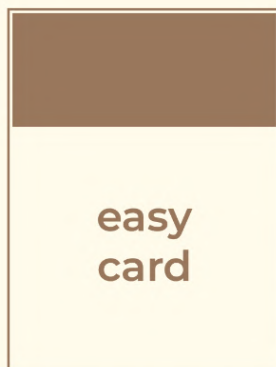


c

game parts

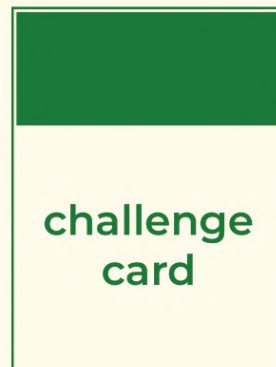
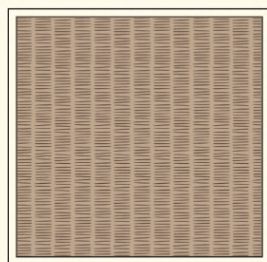


— dice



easy
card

if your dice rolls onto the brown part of the mat, you get a question from a brown card



challenge
card

if your dice rolls onto the green part of the mat, you get a question from a green card

