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DISCUSSING POST-DISASTER RECOVERY PRACTICES VIA LUDIC ACTIVITIES: THE CASE OF NEPAL

Diana CONTRERAS [1], Anisha Maharjan [2], Dinesh GHIMIRE[3], Ranjan DHUNGEL[4], Michael Whitworth[5], Sean WILKINSON[6], Valentina MACCHIARULO[7], Giorgia GIARDINA[8], Rohit Kumar ADHIKARI[9], Paul JAQUIN[10], Paul BURTON[11], Jenny PATTISON[12], Fatemeh FOROUGHNIA[13], Kökcan DÖNMEZ[14], Krishna CHANDRAN[15], Pietro MILILLO[16], & Garry DE LA POMERAI[17]

Abstract: *On April 25 2015, at 11:56 local time, Mw 7.8 earthquake struck Nepal, killing nearly 9,000 people, injuring 22,000, and leaving millions homeless. Seven years later, the Earthquake Engineering Field Investigation Team (EEFIT) deployed an earthquake return mission to monitor changes in community resilience, recovery, and reconstruction progress. A methodology to learn about post-disaster phases, based on ludic activities, was adapted to discuss post-disaster recovery practices in Nepal to close the on-site part of this return mission. The adapted methodology comprised four activities: (1) preliminary questions about experience with earthquakes and knowledge of the urban environment; (2) group competition of assembling jigsaw puzzles (3) discussion of the concept of recovery and characteristics of post-disaster recovery phases; and (4) allocating scale models of vehicles and construction machinery to post-disaster recovery phases plotted on a banner. We concluded that the fact that the participants had experienced earthquakes encouraged them to state that they knew how to respond to an emergency in case of an earthquake. They were very aware of the post-disaster recovery phases and the probable secondary effects of an earthquake, but they were confused about terms related to the urban environment. Suppose there was a post-disaster recovery plan in place at the time of the Gorkha earthquake and a current pre-impact recovery plan in Nepal. In that case, it needs to be disseminated among the population. Furthermore, it is necessary to adapt the methodology to each case study area, as it was necessary to include new scale models of vehicles used in Nepal in the last activity. It is recommended that this methodology be implemented in small groups.*

[1] Lecturer, Cardiff University, Cardiff, United Kingdom, contrerasmojicad@cardiff.ac.uk
[2] Green development officer, Scott Wilson (SW), Kathmandu, Nepal.
[3] Senior Engineer, Community Self Reliance Centre, Kathmandu, Nepal.
[4] Director, National Society for Earthquake Technology (NSET), Kathmandu, Nepal.
[5] Executive director, NSET, Kathmandu, Nepal.
[6] Professor, Newcastle University, Newcastle upon Tyne, United Kingdom.
[7] Research Associate,TU Delft, Delft, Netherlands.
[8] Associate Professor, TU Delft, Delft, Netherlands
[9] Research Fellow, University College of Londong (UCL), London, United Kingdom.
[10] Principal Structural, eZED, Queenstown, New Zealand.
[11] Retired Professor, University of East Anglia, Norwich, United Kingdom.
[12] Associate, ARUP, London, United Kingdom.
[13] Ph.D. Candidate, TU Delft, Delft, Netherlands.
[14] Ph.D. Student, Boğaziçi University, Istanbul, Turkey.
[15] Independent, Kathmandu, Nepal.
[16] Assisstant Professor, University of Houston, Houston, USA.
[17] Independent consultatn, Scott Wilson (SW), Kathmandu, Nepal.

Introduction

On April 25 at 11:56 (06:11 UTC), an earthquake with a moment magnitude scale of M_w 7.8 struck Nepal. Numerous landslides followed the earthquake in the hills and mountains of the affected region (Wilkinson et al., 2019). Around 9,000 people were killed, 100,000 people were injured, around 500,000 houses were destroyed, and another 269,000 were damaged, including historical and cultural monuments recognised as UNESCO World Heritage (WH) Sites (Preventionweb, 2015). Several sections of the Asian Highway 42 in the high hilly terrains were blocked and dysfunctional for over two years (Shrestha, Pudasaini, & Mussone, 2021). In 2011 the Sikkim-Nepal border earthquakes caused losses of US$24.46 million to the country's economy in the infrastructure sector due to the numerous rockfalls and landslides along this highway that blocked this road (Tempa, Chettri, Aryal, & Gautam, 2021).

In the project Learning from Earthquakes (LfE) UK, we collected data about the progress of the recovery process for the tenth anniversary of the earthquakes, where the Earthquake Engineering Field Investigation Team (EEFIT) has deployed reconnaissance missions. Those missions were: 2009 L'Aquila (Rossetto et al., 2009), 2010 Haiti (Booth, Saito, & Madabhushi, 2010), Maule, Chile (Lubkowski et al., 2010), 2011 Christchurch, New Zealand (Wilkinson et al., 2011), 2011 Tohoku, Japan earthquake (Pomonis et al., 2011) and the fifth anniversary of the Gorkha earthquake in Nepal (Wilkinson et al., 2019). In the framework of the project LfE, UK, EEFIT has organised two return missions: the 2022 Nepal and 2022 Indonesia return missions. To conclude the on-site part of this 2022 EEFIT return mission to Nepal, in which the authors participated, we organised a closure workshop in which we applied a methodology to discuss post-disaster recovery practices in Nepal based on ludic activities (Contreras, 2022). This methodology was initially designed to introduce participants to the characteristics of each post-disaster phase concerning road infrastructure and business continuity, but the first author later adapted it for the 2022 return mission to Nepal to encourage the discussion and learn about recovery practices implemented after the earthquake. The methodology is based on ludic activities designed as a non-structural mitigation action to reduce cascading risk and enhance business continuity. Activities include answering questions related to earthquake experiences, completing puzzles as a city metaphor during reconstruction, and associating scale models of vehicles and machinery with a specific post-disaster phase (Contreras, 2022). This workshop took place on the headquarters of Scott Willson (SW) in Kathmandu and participants were invited during the opening workshop of the 2022 EEFIT return mission to Nepal: 'From Nepal to the world: Shared knowledge on earthquake recovery and reconstruction', on May 23 2022.

Ludic activities through serious games have been developed to raise awareness and support learning (Pereira, Prada, & Paiva, 2014) by using the potential of games to engage people and transfer knowledge (Susi, Johannesson, & Backlund, 2007). Game-based approaches require cross-disciplinarity, longer time slots for classes, mixed groups, social learning, and team teaching models to use the game and gameplay as learning approaches. People must be engaged, motivated, surprised, and challenged to learn and discuss (Pereira et al., 2014; Turkay & Adinolf, 2012). A fun environment facilitates discussion among participants, knowledge sharing, and exploration of new strategies (Castella, Trung, & Boissau, 2005; Dieleman & Huisingh, 2006; Lamarquea et al., 2013; Susi et al., 2007). Hence, gaming is useful for understanding the complexities and challenges of coping with natural phenomena and boosting resilience (Mossoux et al., 2016). An example of a serious game in the context of disaster is 'Hazagora: Will You Survive the Next Disaster?' In this game, participants learn the mechanism of geohazards, their role in controlling their community's vulnerability profile and strategies to build a society resilient to the impacts of geological phenomena (Mossoux et al., 2016). Other games have also been designed to raise awareness of one or several hazards, such as 'Stop Disasters!' (UN/ISDR, 2004), 'Riskland' (UN/ISDR, 2004), 'Disaster Hero' (FEMA), 'Save Natalie!' (International Decade for Natural Disaster Reduction), 'Volcano Disaster' and 'Volcano Video Productions' (de Freitas, 2018; Vogel, 2006).

Methodology

The methodology comprised four activities: (1) preliminary questions about experience with earthquakes and knowledge of the urban environment; (2) learning with puzzles as a ludic activity without information on postdisaster recovery; (3) explanation of the concept of recovery and the activities in each post-disaster phase; and (4) learning with vehicles and construction machinery, a ludic activity, accompanied by brief theoretical information about post-disaster recovery. The methodology is depicted graphically in Figure 1.

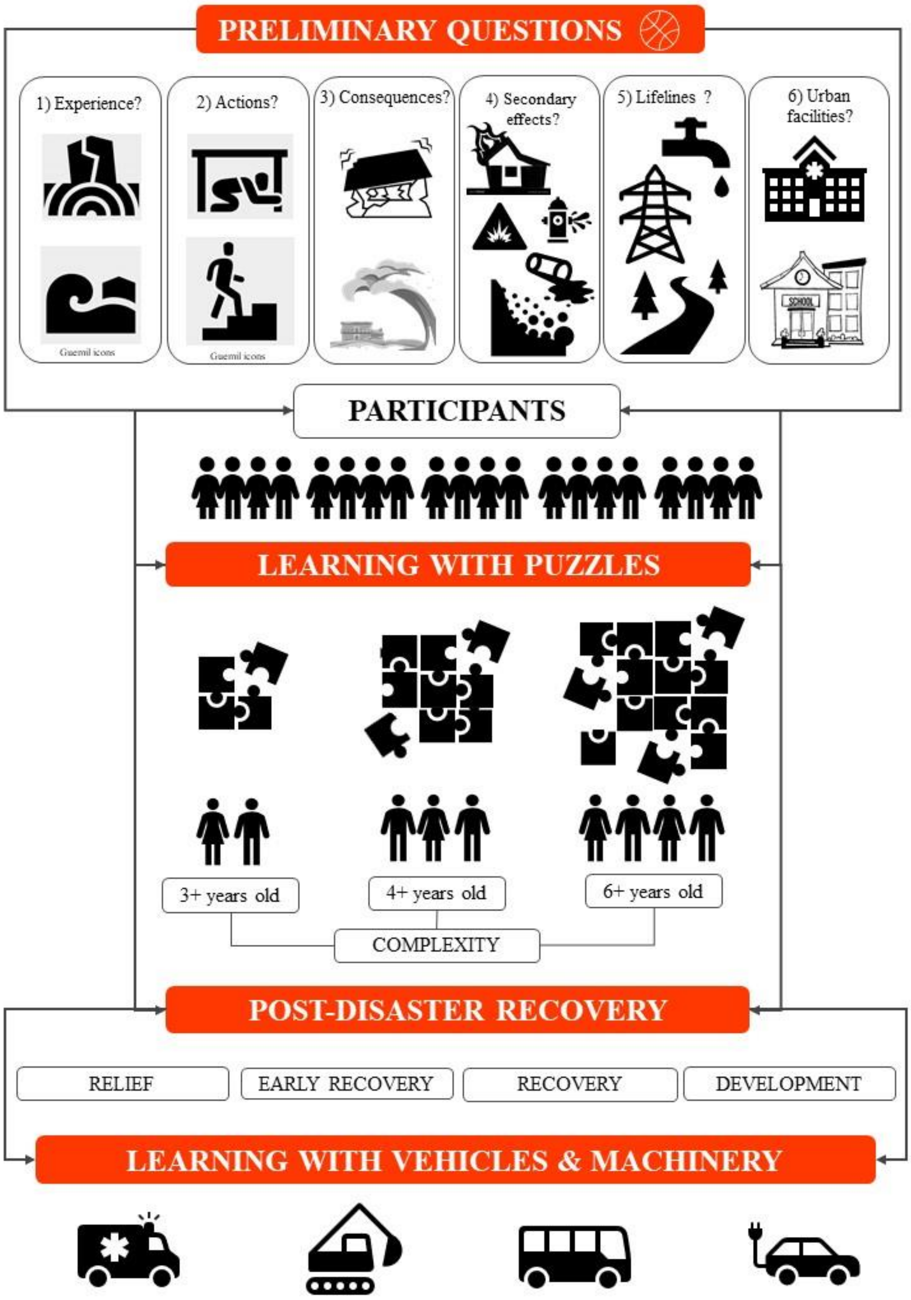

Figure 1. Methodology. Source: Contreras (2022), Figure 3, Page 5.

Preliminary questions

We formulated 14 questions with anonymous answers using *Mentimeter*, an interactive presentation tool with three options to show answers: multiple-choice, open-ended answers and word cloud. At the beginning of the workshop, we provided the participants with a QR code (Figure 2b) that they scanned and had access to the questions already entered on Mentimeter. Once the moderator presented the question on *Mentimeter* (Figures 2C and d), participants selected the answer of their choice, in case of multiple options, or wrote open-ended answers and keywords,

Figure 2. Participants answer and discuss preliminary questions. Photos: Anisha Maharjan and Diana Contreras.

Discussing using puzzles

This ludic activity was undertaken before discussing recovery phases. The activity employs three kinds of puzzles that differ in size and complexity (for 3+, 4+ and 6+ years old children), as shown in Figures 3 a, b and c. Two puzzles were already partially completed by the time of the workshop, ranging from almost completed in the case of the 3+ years old puzzle, half-completed for the 4+ years old and not started in the 6+ years old. Participants were divided into three teams; only two participants were assigned to the puzzle with lower complexity (3+ years old – 15 pieces), three to the puzzle with middle complexity (4+years old – 39 pieces) and four to the more complex one (6+ years old – 100 pieces). This part of the workshop was arranged as a competition in which teams sought to finish first. Puzzles used and the distribution of the participants is observed in Figures 3 d,e and f.

Figure 3. Discussing with Puzzles: a), b) and c) puzzles used and d), e) and f) distribution of participants. Photos: Diana Contreras.

The size of the puzzle represented the size of the city. The number of pieces represented the number of buildings that make up the city. Pieces already assembled in the puzzle signified buildings not affected by the earthquake. In contrast, the pieces to be assembled represented the number of damaged or collapsed buildings needing repair and/or reconstruction. The number of pieces represented the number of damaged or collapsed buildings. The puzzle complexity (3+, 4+ and 6+) reflected three scenarios with different difficulty levels represented by a diverse number of fatalities, injuries and secondary effects (landslides, fires, explosions, leaks and spills) caused by the earthquake. The participants were stakeholders (affected community, emergency managers, government officials and policymakers). Team members had to plan, organise and complete the puzzle as soon as possible. This activity resembles the creation of reconstruction plans during the post-disaster phase when stakeholders must agree on a recovery plan (Contreras, 2022).

Post-disaster recovery phases

After finishing the puzzle activity, the similarity of this ludic activity to reconstruction planning was explained to the participants. Then, the concept of post-disaster recovery and the characteristics of each post-disaster phase were described in six slides based on examples from recovery processes undertaken after the 2019 Albania (Andonov et al., 2020; Contreras, Wilkinson, Alterman, & Hervás, 2022; Freddi et al., 2021), 2020 Zagreb (Croatia) (Atalić, Uroš, Šavor Novak, Demšić, & Nastev, 2021; Contreras et al., 2021; So et al., 2020), 2009 L'Aquila (Italy) earthquake (Contreras, Forino, & Blaschke, 2018) and 2015 Gorka earthquake in Nepal (Contreras et al., 2023). The description of each post-disaster phase includes the activities to undertake and the estimated time needed to accomplish the goals necessary to enter the next post-disaster phase, thus emphasising the role of infrastructure and urban facilities as destination points. Post-Disaster Phases and the presentation to participants in the workshop are depicted in Figure 4.

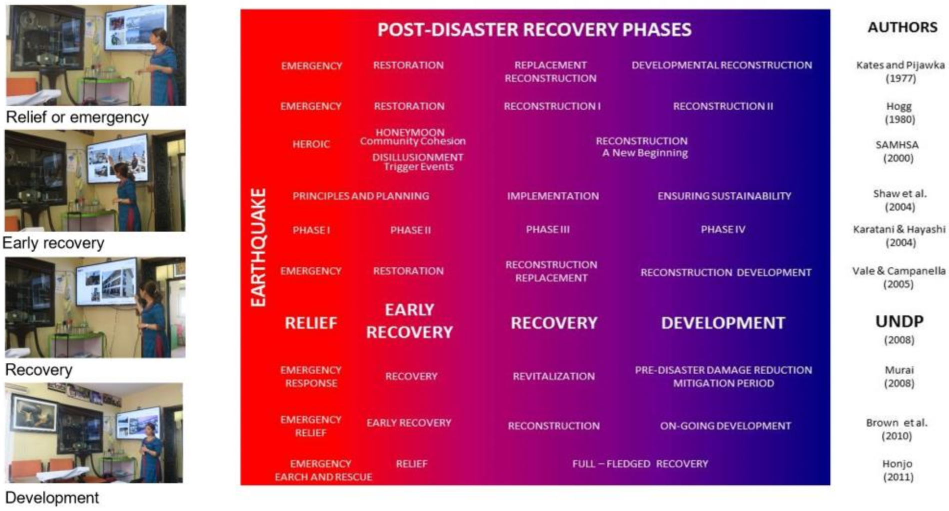

Figure 4. Post-disaster phases. Source: Contreras (2016). Fig. 2. Pag. 279. Photos: Anisha Maharjan.

Discussing using vehicles and construction machinery

The names of the post-disaster phases were plotted in a banner in polyvinyl chloride (PVC) fabric based on Figure 4. The set of vehicles consisted of four groups: (1) emergency response vehicles, (2) vehicles and construction machines, (3) public transport and 4) public and private vehicles. These groups correspond to the relief, early recovery, recovery, and development phases. The set of vehicles and construction machinery are portrayed in Figure 5. We adapted this part of the workshop for the case of Nepal, adding four transport media to the initial set of vehicles and construction machinery considered in the initial methodology. These vehicles widely used in Nepal are motorcycles (Figure 6a), cycle rickshaws (Figure 6b), auto-rickshaws (CNG) (Figure 6C) and diesel auto-rickshaws (CNG) (Figure 6d). Participants of the workshop working and discussing during this activity were portrayed in Figure 7.

Figure 5. vehicles and construction machinery. Emergency response vehicles: a) ambulance (van), b) ambulance (car), c) fire truck (aerial ladder platform truck), d) fire engine (pumper), e) helicopter, f) police van, g) mobile station. Early recovery phase: a) skid steer loader, b) wheel loader, c) backhoe, d) dump truck, e) school bus, f) public bus, g) tram,h) taxi. Recovery phase: a) crane, b) cement mixer, c) dump truck, e) post truck, f) train, g) beverage truck and Development phase. Vehicles: a) garbage and recycling truck, b) tourist bus, c) van, d) motorhome, e) car with boat, f) sports car. Source: Contreras (2022). Figures 6,7,8, and 9, pages 8,9 and 10.

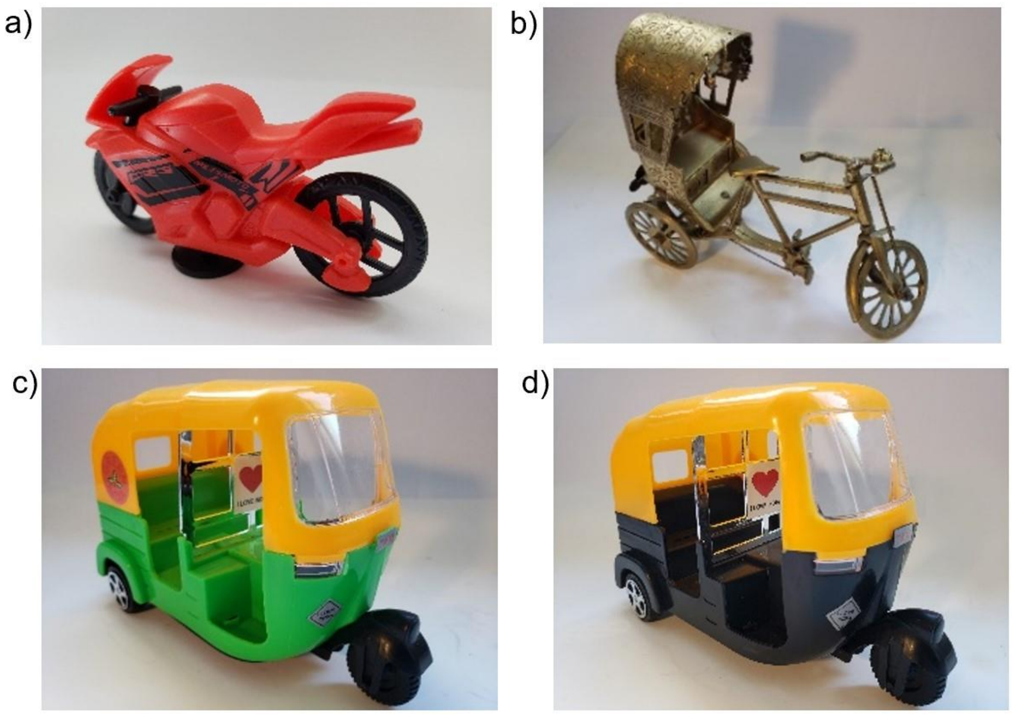

Figure 6. Transport media in Nepal: a) motorcycle, b) cycle rickshaw, c) auto rickshaw (CNG) and d) diesel auto-rickshaw (CNG). Photos: Diana Contreras.

Figure 7. Discussing using vehicles and construction machinery. Photos: Anisha Maharjan.

Results

The workshop was attended by eight participants from the National Society for Earthquake Technology (NSET), Scott Wilson (SW), the National Reconstruction Authority (NRA) and EEFIT. All participants in the workshop have experienced an earthquake; therefore, most of them stated to know what to do in case of one. They considered that in the case of an earthquake, it is necessary to look for a safe place, check with relatives, evacuate the building without running, and head to an open area and close electricity and gas connections. Damages in lifelines, landslides, tsunamis, fires, and epidemics were identified as secondary effects of earthquakes. The names of post-disaster phases were eaily identified. Water supply, electricity, communication, roads, and gas pipes were listed as lifelines. Hospitals and schools were the most frequent urban facilities identified by participants, followed by open/green spaces and police stations; other urban facilities mentioned were stadiums, prayer spaces and community halls. Some participants considered sewerage and drinking supply systems as urban facilities when they were lifelines. Hospitals, schools, gas/petrol stations, roads, emergency systems, armed forces, funeral facilities, communication, water and electricity supply, rescue teams, food stores, security, communication and rescue vehicles and Government were listed as critical facilities. If we define critical infrastructure as the infrastructure you need to respond to an emergency. In that case, only hospitals, water and electricity supply, communications, gas/petro stations, funeral facilities and food stores must be on the list. The participants mentioned business shutdowns, impact on mental health, migration and change in landforms and aquifers line as long-term effects of earthquakes. One participant believed there was a post-disaster recovery plan during the 2015 Gorkha earthquake. Another participant answered no, and the others did not respond. Three participants stated that there was a post-disaster recovery plan at the time of the workshop; two did not, and onlyone did not know. A selection of answers recorded is presented in Figure 8.

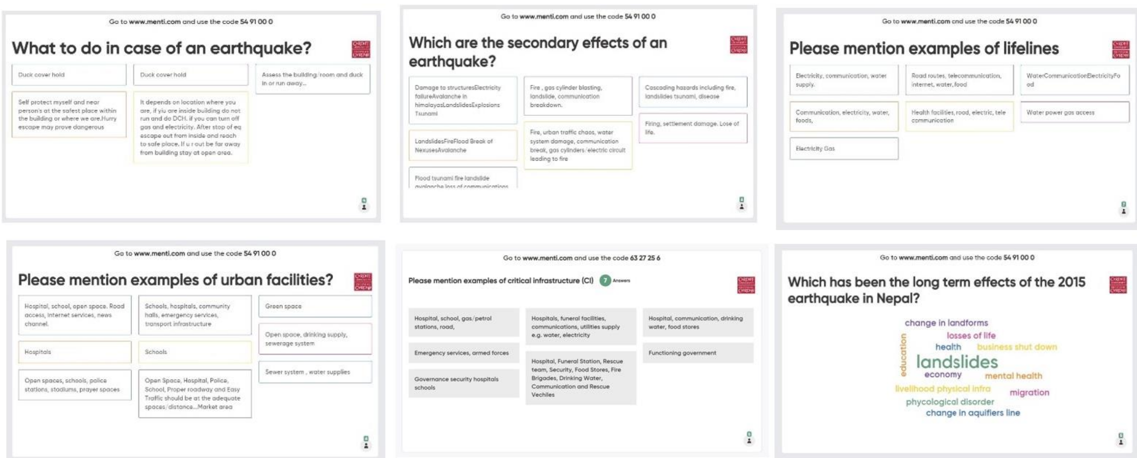

Figure 8. Records of anonymous answers from participants to preliminary questions.

Puzzles with middle (4+ years old) and high (6+ years old) complexity represented reconstruction cases in Nepal, according to the participants. As expected, two participants who got allocated the 3+ years old puzzle won the competition, followed by those who got the 4+ years old puzzle, and those with the 6+ years old puzzle did not finish. The result of the discussion of post-disaster phases after the 2015 Gorkha earthquake using the scale models of vehicles and machinery is portrayed in Figure 10. One particular outcome of applying this ludic activity in Nepal is that the backhoe loader is usually allocated to the early recovery phase during previous implementations of the same methodology; in this case, participants allocated it to the relief or emergency phase. Participants explained their decision to use the backhoe during the relief or emergency phase to remove masses of rock, mud or debris right after the earthquake, which will surely be a secondary effect in a highly mountainous country like Nepal. The urgency will be to unblock roads to facilitate emergency response operations. The impact of COVID-19 in the recovery was discussed, but participants concluded that it was not high.

Figure 9. Discussing vehicles and construction machinery result

Conclusions

The implementation of this methodology is more suitable for small groups (8 to 12 people). Post-disaster phases and emergency response actions were well-known among participants. It is necessary to reinforce the concept of secondary effects of an earthquake, as some participants considered damages in lifelines as a secondary and not a primary effect of the earthquake. Participants were confused about lifelines, urban facilities and critical infrastructure concepts. If there was a post-disaster recovery plan before the 2015 Gorkha earthquake, or if there is one now, it must be disseminated to Nepal's inhabitants.

What makes the difference in the level of difficulty in the ludic activity with the puzzles is more the number of puzzle pieces to put together than its complexity and how to organise among participants to complete it quickly. The need to add new transport media for these workshops in Nepal demonstrates the need to adapt the methodology to each case study area. The case of Nepal shows that motorcycles not considered in the initial methodology and widely used in Nepal will be a handy transport medium anywhere during the relief or early recovery when streets are blocked with debris.

The ludic activity with the vehicles and construction machines was quickly associated with the post-disaster recovery phases, while the activity with the puzzles needed more explanation. In any case, both ludic activities generated excitement across different ages. Topics such as the impact of COVID-19 in recovery need to be discussed among different population groups because despite participants indicating that the pandemic did not have a high impact on the country, reports indicate otherwise (UKaid-WFP, 2021).

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