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Developing disaster risk reduction skills among informal construction workers in Nepal

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Capacity development has become an embedded component of the aid package offered by international organisations responding to humanitarian crises. The effectiveness of capacity development is, however, rarely monitored or examined. What is more, the local context and the learning preferences of trainees appear often to be overlooked. Yet, the informal construction sector is thriving throughout the world. Using a case study of Nepal, where construction and post-earthquake reconstruction projects are largely delivered by the informal construction sector, this paper analyses, therefore, how and whether informal construction workers successfully develop capacity and utilise trainings to create more disaster-resilient buildings. It goes on to assess how one can draw on the learning preferences of Nepalese construction workers to improve the effectiveness and the sustainability of capacity development initiatives. Lastly, the paper highlights that training programmes informed by the context and the preferred learning style of disaster-affected communities promote and sustain capacity development efforts.

Keywords: community, disaster, informal construction, learning, Nepal, training

Introduction

Globally, 3,751 disasters were recorded over the course of the past decade, affecting more than two billion people and causing USD 1,658 billion in damage (not including wars or conflict-related famines) (IFRC, 2018). Disasters disproportionately impact negatively on poorer nations, where frequently there is less capacity and fewer resources to prevent, prepare, and respond to them. When a large-scale event occurs, the international community reacts via the provision of humanitarian aid. The majority of aid organisations incorporate capacity development[i] into their relief initiatives, aiming to promote sustainable development, whereby communities are better placed to prevent, plan for, and respond to future crises. The importance of capacity development among actors ranging from local communities to national institutions has been emphasised throughout international agreements, including:

- Agenda 21, a non-binding action plan of the 'Earth Summit' held in Rio de Janeiro, Brazil, from 3–14 June in 1992, which focuses on national mechanisms and international cooperation for 'capacity-building' in developing countries;

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- the Plan of Implementation of the World Summit on Sustainable Development, convened in Johannesburg, South Africa, from 26 August–4 September 2002, which concentrated on promoting the technical capacity and the capacity of healthcare systems in low-income countries; and
- the Sustainable Development Goals (SDGs), set by the United Nations (UN) in 2015, with the objective of SDG 17.9 being to 'enhance international support for implementing effective and targeted capacity-building in developing countries' (United Nations Department of Economic and Social Affairs, 2017).

International aid organisations allocate substantial amounts of time and resources to the training and capacity development of local staff and communities. Yet, the effectiveness of these endeavours and the methods employed are rarely monitored or appraised; even when evaluations are conducted, most are short term, as they are driven by budgetary time cycles, and usually they fail to capture long-term consequences. Indeed, as an element of the international relief package normally offered before, during, and after a disaster, it is an area lacking any significant research.

This paper contributes to the filling of this gap by investigating how the learning preferences of those who are trained could be harnessed to improve the effectiveness and sustainability of such capacity development. Using a case study of Nepal, where an informal construction[2] sector largely delivers construction and reconstruction projects, this paper explores how and whether informal construction employees effectively learn, make decisions, develop capacity, and utilise trainings. It does not seek to examine the extensive theories of workplace learning, but rather to identify the broad aspects that manifest among Nepalese informal construction workers, demonstrated through a participatory game created as a part of this study.

Disaster risk in Nepal

Nepal is considered to be one of the most disaster-prone countries on the planet, ranking fourth among those at risk of climate change-related hazards, eleventh in terms of susceptibility to earthquakes, and thirtieth with regard to flood risk. These and other hazards (such as lightening) cause huge loss of life and property and affect the livelihoods of millions of people annually (Ministry of Home Affairs, 2009; United Nations Office for the Coordination of Humanitarian Affairs, 2015). In addition, the decade-long civil war that ended in 2006 after claiming the lives of more than 13,000 people (United Nations Office of the High Commissioner for Human Rights, 2015) hindered disaster risk reduction (DRR) efforts (Jones et al., 2014) and further exacerbated the vulnerabilities of the country.

The magnitude-7.8 Gorkha earthquake on 25 April 2015 wrecked the country, killing 8,831 people and leaving another 2.8 million in need of humanitarian assistance, destroying and damaging more than 800,000 homes, and pushing in excess of 700,000 Nepalese over the poverty line (IFRC, 2016). The estimated financial

loss owing to the earthquake was at least USD 10 billion, approximately 50 per cent of the gross domestic product (GDP) of Nepal (IFRC, 2016).

The event was not unexpected, though; it had been documented nationally and internationally that a major earthquake was overdue in Nepal (Hand and Pulla, 2015). Armed with this knowledge, local and foreign agencies implemented programmes to promote disaster risk reduction and resilience. Since 2009, Action Aid, CARE, Handicap International, Mercy Corps, Oxfam, the United Nations Development Programme, and the World Health Organisation, among others, had been engaged in activities that aimed to promote disaster-resilient communities and specific earthquake-related DRR projects.

Nepal, like other low-income countries in receipt of official development assistance, has witnessed the channelling of an increasing proportion of aid through international non-governmental organisations (NGOs) (Suleiman, 2013) as part of the transition from government to governance, meaning that not only have they proliferated in number, but also that they have acquired increasing leverage vis-à-vis the state (Jones et al., 2014). Evacuation drills in schools, resilient services and systems, and 'good practice' building codes and standards to ensure more earthquake-resistant buildings are just a few examples of the initiatives put in place.

Since the initial drafting of the Nepal Building Code (NBC) in 1993–94, the Department of Urban Development and Building Construction has led a series of training programmes on earthquake-resistant construction for almost 9,000 masons. In addition, the National Society for Earthquake Technology (NSET) has undertaken a series of initiatives aimed at the construction sector, including the Shake Table demonstration,[3] technical instruction for engineers and masons, train-the-trainer exercises, and the provision of support to 30 municipalities to improve building permit processes and the implementation of the NBC, which was approved by the Government of Nepal in 2003. The central administration has also established sound building acts and regulations that recognise the importance of earthquake-resistant structures (but do not cover other hazards) (Chmutina and Rose, 2018).

Nevertheless, more than 98 per cent of buildings in Nepal are constructed by informally employed local workers whose knowledge of DRR measures is generally limited and largely gathered on the job (Dixit, 2004; Chmutina and Rose, 2018). The country's building regulations acknowledge the dominant role of the informal construction sector, and propose technical guidance as 'rules of thumb', suggesting that non-specialists could check simple but essential structural details (World Bank, 2015). However, the level of compliance is limited owing to a low level of awareness of the NBC among informal construction stakeholders (Chmutina and Rose, 2018). Consequently, most residential buildings do not receive any rational design for structural integrity and can be prone to collapse during a disaster.

The construction sector

Nepal is one of the world's 10 least urbanised countries, but it is also among the top 10 fastest urbanising countries globally, and is forecast to remain as such until 2050, with

a projected annual urbanisation rate of approximately two per cent (United Nations Department of Economic and Social Affairs, 2018). Hence, its construction sector is ever more pivotal to increasing or decreasing the country's vulnerability to disasters. Buildings and infrastructure are the main source of injury and death during an earthquake. Around three-quarters of all fatalities during an earthquake are due to the collapse of a building (Kenny, 2009).

More than 80 per cent of buildings in Nepal are classified as non-engineered to poorly engineered, and poor building performance has been singled out as the most important constituent source of earthquake risk in Nepal (Jha, 2015). Non-engineered buildings are those where the construction has not gone through the formal building permit process and it has not been designed or supervised by a qualified designer or engineer. The NBC and Nepal's building acts and regulations outline the legal obligations administered by local government to which builders or clients must adhere, especially in relation to the urban environment—it is less common in rural areas (Nienhuys, 2015).

The NBC establishes a permit system, peer review, monitoring, certification of construction practices, and implementation of land use planning measures (World Bank, 2015), but most residential buildings in the country do not receive any rational design for strength. The building permit process considers only compliance with planning and building bylaws, such as height and solid waste disposal. In addition, there is no system of controlling the professional standards of engineers and designers through reference to professional qualifications, membership, or legal means. Moreover, despite the existence of sound building legislation, the consideration of seismicity or other hazards in the design of a building depends on the initiative of the individuals involved (Shrestha et al., 2017).

Even though there is a more rigorous permit process, construction practices have not improved significantly since the Gorkha earthquake of 2015 (Shrestha et al., 2017). The building construction mechanism remains largely vernacular, informal, and dictated by the resources of the owners and local availability of construction materials (Bothara et al., 2015).

In urban areas, Nepal's private construction sector primarily depends on unregistered enterprises headed by *Naikeas*—team leaders who supply labour for construction projects. *Naikeas* typically have a core team for building projects that includes skilled and unskilled labourers, and they comprise men and women, although women do not reach skilled worker status and mostly work as brick carriers. Male unskilled labourers can transition to becoming eventually skilled workers via on-the-job training. *Naikeas* coordinate the team for each construction project and liaise with various stakeholders, including the owners and engineers that carry out building inspections. They are paid on a piece-rate basis for the subcontracted portion of the work, or on a fixed-fee basis, such as a percentage of the wage of the labourers. The labourers are paid a daily wage rate, which does not include social benefits, including sick leave or idle-period compensation. This informal construction system offers great flexibility in terms of the speed of building and lower costs; however, the quality of work often

suffers (Jha, 2015), and there is a lack of professional accountability, with the client bearing all of the risks and responsibility if the structure collapses.

Prior to the earthquake in 2015, a large amount of investment went into providing training for the informal construction sector—by the Government of Nepal, the NSET, and international NGOs—to encourage the application of more earthquake-resilient practices. In some cases, the training proved effective in that a number of more earthquake-resilient buildings were created. The majority of *Naikeas*, though, did not apply the skills and continued to operate as usual (Chmutina and Rose, 2018); why they did so remains unclear.

This raises a number of questions, including: who delivered the effective knowledge and training and how?; what are the priorities of *Naikeas* when constructing a building?; what makes training fail in some cases and not in others?; what knowledge of erecting disaster-resilient buildings do *Naikeas* already possess?; and, most importantly, do we know how informal construction workers learn? This paper will attempt to answer some of these questions later, but first it is important to engage with the theories of learning.

Understanding learning

Workplace learning

A distinction needs to be made at the outset between learning and training or education. Training and education are delivery systems, whereas learning is more broadly defined as 'the way in which individuals or groups acquire, interpret, reorganise, change or assimilate a related cluster of information, skills and feelings' (Marsick, 1987, p. 4). By emphasising learning rather than training, the importance of appropriate, structured learning activities is not devalued. Often an overriding interest in how best to provide training detracts attention from the natural opportunities for learning that materialise every day in a person's working life (Marsick and Watkins, 2015). Frequently training entails situations that are outside of an individual's natural context, and as such, a struggle ensues in transferring the learning to his/her normal work environment (Marsick and Watkins, 2002).

Theories of workplace learning have evolved dramatically over the past three decades. Most of them can be broadly placed in two categories: learning as a product; and learning as a process. The former concentrates on the learners acquiring novel attributes, whereas the latter centres on learners developing by actively engaging in the processes (Hager, 2011). An initial focus of workplace learning on individual, mainly formal, learning has expanded to encompass formal and informal learning, and multiple types of learning, such as organisational, group, and individual learning. The theoretical resources employed have outstripped standard concepts such as vocational education and learning, on-the-job training, and skill and competency acquisition by individuals, and now incorporate more complex, multi-layered considerations, including adult learning, relations, communication, meaning-making, and identity formation (Hager, 2011).

Both individual and social learning are important dimensions of workplace learning. Some workplace experiences see the individual as displaying self-control, learning a behaviour or technique even when there is no external reinforcement to guide him/her (ATD Staff, 2012). Learning from others, or vicarious learning, is common in workplace learning: the learner acquires the skills from someone else by watching their actions closely and then recreates them (ATD Staff, 2012).

Learning through social interactions

Social learning, while an element of workplace learning, is much wider and goes beyond that particular context. Bandura's (1977, p. 22) social learning theory explains that learning occurs by observing, imitating, and modelling for others: 'Most human behaviour is learned observationally through modelling: from observing others, one forms an idea of how new behaviours are performed, and on later occasions this coded information serves as a guide for action'. Social learning theory capitalises on social interactions, emphasising the importance of observing and modelling the behaviours, attitudes, and emotional reactions of others (Sangiuliano, 2020). The theory has been described as a bridge between behaviourist and cognitive learning theories as it encompasses attention, memory, and motivation. Social learning theory explains human behaviour in terms of continuous reciprocal interaction between cognitive, behavioural, and environmental influences. David (2015) identifies four necessary conditions for effective modelling:

- attention—various factors increase or decrease the attention paid, including distinctiveness, complexity, functional value, one's sensory capacities, arousal level, perceptual set, and past reinforcement;
- retention—remembering to what you paid attention, including symbolic coding, mental images, cognitive organisation, symbolic rehearsal, and motor rehearsal;
- reproduction—reproducing the image, including physical capabilities and self-observation of reproduction; and
- motivation—having a good reason to imitate, including motives such as past traditional behaviourism, imagined incentives, and seeing the reinforced model.

Bandura (1977) highlights the connection with self-efficacy—that is, the belief in one's ability to accomplish their goal—which provides the foundation for human motivation, well-being, and professional accomplishment. These characteristics are extremely important to the success of a functioning site-based management system, which is trying to develop capacity, to implement change, and to sustain continuous improvements.

Bandura's social learning theory is linked with the situated learning theory of Lave and Wenger (1991), who assert that learning is situated; that is, as it normally occurs, learning is embedded within activity, context, and culture. In addition, it is usually unintentional rather than deliberate. Lave and Wenger (1991, p. 29) call this

a process of 'legitimate peripheral participation'. Knowledge needs to be presented in authentic contexts—settings and situations in which that knowledge is usually present and employed; learners become involved in a community of practice that embodies certain beliefs and behaviours to be acquired. Communities of practice are groups of people who share a concern or passion for something they do and learn how to do it better as they interact regularly. This allows for, but does not require, intentionality. The beginner or novice becomes more active and engaged within the culture, moving from the periphery of a community and eventually reaching the centre and assuming the role of an expert (David, 2017). A community of practice necessitates three components (David, 2014):

- a domain—a community of practice has an identity defined by a shared sphere of interest, it is not simply a network of people or a club. Membership implies a commitment to the domain;
- a community—members of the domain must interact and engage in shared activities, help each other, and share information with one another. They build relationships that enable them to learn from each other. Hence, merely sharing the same job does not mean a community of practice; and
- a practice—a community of practice is not a group of people with the same interest or attendance at an event. Members of a community of practice are practitioners. They develop a shared body of resources, including tools, experiences, and methods of managing typical problems. This style of interaction needs to be developed over time. Informal conversations held by people of the same profession help them to impart and develop a set of cases and stories that can become a shared repertoire for their practice, whether they realise it or not.

Learning through playing

Humans have played games for centuries,[4] and recent years have seen an increasing focus on the use of playing to learn and gamification theory (see, for example, Seaborn and Fels, 2015; Hamari et al., 2016; Mossoux et al., 2016; Qian and Clarke, 2016). Gamification is the application of game mechanics to non-game activities to influence people's behaviour (Beza, 2011; Plass, Homer, and Kinzer, 2015). The main objective of gamification is to encourage greater engagement with people and help to create richer experiences in everyday life through game mechanics (Kim and Lee, 2013). The term remains hindered by diverse meanings and employment in a contradictory fashion, and the concept faces division regarding its academic worth owing to underdeveloped theoretical foundations and a dearth of standardised guidelines on its function (Seaborn and Fels, 2015). Furthermore, little empirical work has been done to validate gamification as a meaningful model and to provide evidence of its effectiveness as a tool for motivating and engaging users in a non-entertainment context.

Nonetheless, games are increasingly used by international aid agencies to augment disaster risk awareness and to enhance risk assessment and decision-making. The

International Federation of Red Cross and Red Crescent Societies (IFRC, 2019) has more than 30 online games pertaining to hazards, climate change, and climate risks on its website, whereas PreventionWeb (2019) lists more than 45 games centring on DRR on its website. The question to ask, therefore, is: why is learning through gaming so appealing to both funders and users?

McGonigal (2010) identifies four distinctive behavioural traits of gamers:

- the desire to act and the belief in achieving success—that is, urgent optimism;
- the ability to trust and form stronger social bonds through game playing—that is, social fabric;
- the belief that the task in which the person is engaging is meaningful; hence the dedication towards the game task itself—that is, blissful productivity; and
- the strong attachment to a meaningful and awe-inspiring story in which the individual is personally involved and on which he/she is striving to make a mark—that is, epic meaning.

The principal idea behind gamification is that game design and game elements confer such power upon people that it can transform their relation with services, products, policies, or even everyday tasks that can be monitored, tracked, and modelled within a 'game space' (Beza, 2011). It enables gamers to test theories and ideas with a freedom to fail without real-world consequences, and with full transparency and real-time feedback, permitting gamers to learn from mistakes and errors. Gaming can engender emotional activation—compared to games, reality can be depressing whereas gaming can focus with relentless optimism on the energy of those involved. Game design can be such that it is individuals competing against one another or working in teams that must collaborate to complete the mission. Finally, gamification provides a sense of control; the gamer is the decision-maker (Kapp, 2012).

There is evidence that the effectiveness of the education is greater when learners select their preferred delivery medium (Liu, Chiang, and Huang 2007). Phillips and Vaughn (2009) further demonstrated that drawing on the local culture to inform the education style and delivery can significantly boost the effectiveness of the exercise. Gardner (2000) discusses the importance of leveraging multiple intelligences, so rather than IQ (intelligence quotient) tests, there is a suite of intelligences, including: bodily-kinaesthetic intelligence; interpersonal intelligence; linguistic intelligence; logical mathematical intelligence; musical intelligence; naturalist intelligence; and spatial intelligence. Gardner's (2000) concept of multiple intelligences allows for multiple possibilities of learning.

The following section discusses the methodology adopted for this research, notably the creation of a dice game developed through understanding of the common use of such games among Nepalese men (Smart and Wehrheim, 1977). The game was developed to explore its effectiveness as a training method for Nepalese informal construction workers.

Methodology

An interdisciplinary research strategy was developed to carry out this study, comprising structured interviews and focus groups. Structured interviews were held first with 100 *Naikea* members between January and April 2017 and covered the breadth of different roles of team members, from brick carrier to skilled worker. Structured interviews were selected for a number of reasons, most notable of which was the Nepalese research team's opinion that they are most appropriate for the country. In addition, they ensured an efficient process, which was important to minimise the time burden experienced. Next, two focus groups were convened in June 2017 with 30 of these 100 informants, enabling verification of the initial findings and deeper analysis of the issues. (Both of these aspects are discussed in more detail below.[5])

Restricted resources meant that the research team was limited in terms of the scale of the study; consequently, it concentrated on one geographical location, Banepa, which is a typical rapidly urbanising town less than 30 kilometres from the capital city of Kathmandu. It is a key commuter town and a regional trading hub, with a population of almost 25,000 people. Banepa is located in Kavrepalanchok District and is composed of 11 wards. More than 97 per cent of households reported housing damage as a result of the earthquake in 2015, and more than 90 per cent of those who did so had to live subsequently in temporary shelters. Residents cited shelter and housing as their greatest need in the wake of the disaster (Shelter Cluster, 2015). Moreover, Banepa is also susceptible to floods and landslides.

Most buildings in the town are mixed use, consisting of businesses and accommodation, which is usual in urban Nepal. As a result, the findings are transferable to urban areas throughout the country, and more importantly to other countries where the urban built environment is prone to disasters and is predominantly created by an informal construction sector.

A common language

Prior to commencing the research, the team explored and critically examined the key concepts and vocabulary to develop a common understanding and appropriate terminology for Nepalese and local languages. The research team, composed of eight Nepali researchers, who were hired in Nepal to aid data collection,[6] and two researchers from the United Kingdom, explored a range of methods and techniques for engaging the informal construction sector. As noted above, a two-stage approach was selected, consisting initially of interviews and then a focused engagement session, the nature of which evolved continuously because of the acquisition of ever-deeper insights into the informal construction sector (see the following sections for more information). The interview questions were developed collaboratively, first in English, before being translated and back translated[7]; they were then piloted to ensure that the meaning and understanding of the questions were the same in English, Nepali, and other local languages. Lastly, a protocol was established for meeting, accessing, and inviting members of the informal construction sector to engage with the Nepalese

researchers, including obtaining local authority permissions and a briefing session to discuss the aims and limitations of the study with the *Naikeas*.

Data collection and analysis

Data collection was divided into two phases. During the first phase, local authorities provided a list of all *Naikeas* who have been operational for more than 10 years in Banepa. The Nepali team leaders met with the *Naikeas* to explain the research process and to request their involvement and permission to speak with their members. The Nepali team leaders presented the objectives of the study to *Naikea* groups and arranged interviews when convenient.

The research team conducted interviews with 100 informal construction workers who had all been actively employed for more than 10 years in the sector and had been working in earthquake-affected urban areas. The interviewees comprised men (87) and women (13) of different ages, representing the full spectrum of roles within *Naikea* groups, from brick carrier to skilled worker. A series of preliminary findings and questions emerged from this data.

The second phase involved a focus group that took the form of a dice game (the rules of which are provided below in the subsection entitled 'the game: disaster dice'). The extensive popularity of dice games among adults in Nepal, combined with understanding that construction workers exchange knowledge and ideas during social interactions, led the authors to develop the following hypothesis:

- a dice game is an effective DRR training method for Nepalese informal construction workers.

All informal construction workers involved in the research had played dice games as children and adults.

Two focus groups, involving 24 people overall (12 male and 12 female informal construction workers) and representing a full range of *Naikea* levels (from female unskilled workers to contractors), were conducted to gain a deeper individual understanding. Furthermore, they allowed the team to frame and operationalise DRR training and capture a variety of shared narratives, as well as features of the cultures of *Naikeas*, as participants built on the insights of peers from common communities of practice (Bryman, 2012).

The format of the focus group, a dice game, established a more comfortable environment given the cultural and educational background of the participants. During the game, the participants were divided into two groups: the first included more skilled younger workers, whereas the second included older but less skilled workers. Such a division was deliberate: the facilitators felt that the less skilled workers would not be willing to express freely their opinions in front of their more senior (in terms of skills and *Naikea* standing) colleagues.

Each interview and focus group discussion was recorded and analysed thematically. Thematic analysis was chosen owing to the complexity of the dataset and the

need for a flexible investigative process to yield a structure (Howitt and Cramer, 2011). The UK research team delivered data coding training to the Nepalese researchers, as they identified this as an area of low capacity. The training enabled the whole research team to develop collaboratively and to agree on the framework used to code all of the interviews.

How do construction workers in Nepal learn?

Understanding the nature of workplace learning in the context of informal construction workers in Nepal presents an opportunity to capitalise on it and ultimately to develop effective and sustainable capacity development programmes. As Cullen, Harris, and Hill (2012) suggest, assessing work from the perspective of its learning potential is fundamentally different to appraising it simply in terms of the competencies needed to perform the job well.

Two key learning-related aspects came to light during this project: learning through training on the job; and learning via social interactions. As Chmutina and Rose (2018) point out, informal construction workers have learnt effectively from on-the-job or apprenticeship-style training, involving actual, live construction projects as opposed to simulations, test projects, or case studies. However, training facilities take workers out of their normal environment, which often leads to knowledge not being fully transferred to the work setting (Marsick and Watkins, 2002). This was found to be the case for much of the formal training provided to construction workers in Nepal. It is important, though, to bear in mind the temporal nature of construction projects: it is impossible to deliver a training course that would last throughout the building process; usually, therefore, only particular aspects of a project are covered. This makes it vital to find a more holistic form of training that would help to mainstream DRR and ensure that the implementation of DRR measures becomes embedded.

Training previously offered to construction workers by the Government of Nepal, the NSET, and international NGOs included simulation projects, classroom-based exercises, the Shake Table demonstration, and municipality events such as the annual earthquake safety day. In addition, training is largely targeted at skilled workers on the understanding that they will distribute the knowledge among colleagues on site (Chmutina and Rose, 2018). Nevertheless, only one-third of the interviewees were aware of the trainings currently on offer—levels are particularly low among unskilled workers (Chmutina et al., 2018).

Almost one-half of those interviewed (49 per cent) preferred 'on-the-job' training by co-workers. However, this may not always lead to an increase in skills, as it is not clear what exactly the workers learn and to what extent the skills are applied; in addition, it is not known how precisely such knowledge is shared (Chmutina and Rose, 2018). What is more, 19 and 16 per cent of participants preferred training via video and television, respectively.

The interviews also revealed that information was frequently exchanged among informal construction workers through social interactions. The messages and information received in social settings often informed the practices and decision-making applied on existing and future construction projects. This social knowledge exchange (that is, learning from others) was identified on a range of levels, such as between co-workers or from father to son. The interviews and focus groups showed a strong tendency towards learning as a process and vicarious learning was deemed to be highly valuable by most participants. Here, a community of practice plays an important role: more than 85 per cent of the workers stated that they preferred training on live projects as opposed to in a classroom or in a simulation, and a similar proportion also preferred to learn through social interactions with co-workers, mentors, and others outside of work or formal training exercises.

Informal and incidental learning appear to be important elements of learning by Nepalese construction workers, although further research is needed to appreciate fully the intricacies of these methods and their potential use in informing means of training in the future. Both align with learning outside of formally-structured, institutionally-sponsored activities. Informal learning is predominantly experiential and non-institutional, whereas incidental learning is unintentional and often a by-product of another activity. Incidental learning sometimes manifests as a result of mistakes that provoke the learner to use a different method, tool, or resource. It is never planned, but it can be intentional, such as help constantly sought from a mentor (Marsick and Watkins, 2015).

These initial findings led the research team to examine the nature of social interactions among informal construction workers. Social interactions entailing knowledge exchange among informal construction workers occurred in a wide range of circumstances, including while sharing morning tea during a commute and sitting together on an evening.

Given these preliminary findings, the researchers began to develop a hypothesis that much social learning occurs while playing dice games in social settings. As such, gamification offers another effective way of training Nepalese informal construction workers.

The game: disaster dice

The aim of the game is to develop a team capable of constructing more hazard-resilient buildings while exchanging knowledge of experiences, trainings, and good practice.[8] Researchers were curious about whether or not such a game would prove effective in the context of Nepal in exchanging knowledge among participants of how to apply resilient construction techniques, while also demonstrating the effects of individual and group decision-making, and the consequences of such choices.

The game involved three different coloured extra-large dice (see Figure 1). The number on the first dice rolled correlated with a decision that the gamers had to select; the second dice number rolled correlated with a hazard; and the third dice number rolled correlated with the impact of the hazard (see Table 1).

Figure 1. Disaster-related dice game

Source: authors.

The hazards selected for dice 2 (see Table 1) were those most commonly cited by the interviewees. To support the gamers, the researchers provided large images of recent disasters in Nepal to illustrate the various impacts, ranging from a small-scale fire in the local area that had affected a single neighbourhood through to a major flood that had led to large-scale damage and the collapse of infrastructure. The main idea of the game was to see whether the participants would select the most common hazards and whether the consequence would affect their subsequent choices. Five rounds of the game were played, and the participants developed a profile based on the decisions of previous rounds and experiences of a variety of disasters.

The results of the game afforded the research team great insights into how informal construction sector workers exchange information and arrive at decisions. During each round of the game played, at least one member was able to contribute a piece of good practice or sound information based on awareness of hazards or building techniques, sharing this with the group. It was noted, too, that more attention is paid to the suggestions of more experienced workers, regardless of their knowledge of

Table 1. Dice values

Number shown on the dice	Decision dice (blue)	Hazard dice (green)	Impact dice (red)
1	You have no knowledge of hazards/disasters and build the cheapest building.	Earthquake	No impact
2	You have an opportunity to attend one training. Which training do you select and from who and in what form? You apply your training to your building.	Flood	Very low impact
3	An expert in building disaster-resilient houses. Select a hazard to discuss with them to learn how to withstand this hazard.	Landslide	Low impact
4	You can choose to get some information from one source on how to deal with one selected hazard: expert; NGO/international NGO; mentor; radio; television; government; calendar/comics/pamphlets; colleague.	Fire	Medium impact
5	You can choose two team members to be trained in building for the same hazard or two team members to be trained in one different hazard each. If two people undertake the training in the same hazard the building can withstand the highest impact, but if they are trained in different hazards, the building will withstand the medium-scale impacts of each.	Lightning	High impact
6	You have access to all information on and training in any hazard. What training and information do you want and who else on your building team do you want to get the information/training?	Storm	Very high impact

Source: authors.

DRR. Every informal construction worker that played the game responded positively regarding its effectiveness.

The value of the dice is in the discussion it generates: the dice facilitates a knowledge exchange among participants, allowing them to share their different understandings of risk and decision-making processes, as well as to explore how decisions are made (and by whom) and what influences them. One participant highlighted:

> *This [game] makes you realise that what we build and how we do it can really change how big the disaster is.*

Another key element of this game is that it is non-competitive and strives to create a team approach. Moreover, the participants self-evaluate at the end of each of round, assessing their judgements and the ramifications of their decisions. Two participants made particularly valuable remarks:

> *This game made me start to think about other hazards and not just earthquakes.*
>
> *Coming to this I lost 1,000 Rupees day wage, but I have learnt more than I could have bought with a 100,000 Rupees.*

Lastly, the dice game is appropriate for people with any level of education and literacy. It is transferable to different contexts, including other construction groups, and potentially community groups. In each case, the dice can be adapted to include the six most prevalent hazards in the area or the six priority hazards as identified by the participants. The decision dice can be modified to offer alternatives, such as specific community response mechanisms.

Conclusion

This paper has explored appropriate teaching and learning approaches that could help to enhance understanding of DRR methods among informal construction workers in Nepal. Very limited research has been conducted previously with these groups, and even less on how they learn and develop.

The range of learning theories, practices, and techniques for education and training is vast and varies throughout the world. Evidence demonstrates that culturally- and socially-informed learning processes are more effective, especially those where the learners select their preferred delivery medium (David, 2017). Nevertheless, programmes often are still designed with little or no consultation with those who receive the training, or in a context or using a mode of delivery that is not accessible to all. This is particularly so in relation to those offered by international organisations, which have less understanding of the cultural and social setting and tend to focus on post-disaster response and recovery rather than prevention and preparedness.

While good practices exist—as the case of Nepalese informal construction workers demonstrates—capacity development activities frequently are not applied, as the method of training is not appropriate or context-specific. Prior to designing and implementing any trainings in the future, there is a need to understand first the members of the audience, how they learn, and how they want to be (or not to be) engaged. There is also a need to comprehend their motivations and de-motivations with regard to applying their training in real life. Nepalese informal construction workers prefer to receive on-the-job training, yet the effectiveness and feasibility of such an approach requires further research.

Furthermore, there is a need to ensure that informal construction workers do not only concentrate on a specific DRR skill, but also appreciate the importance of multi-hazard awareness while learning and sharing knowledge as a group. Here, a game has proven to be an effective learning tool, helping to facilitate knowledge exchange between people of different age and gender, and with different skills and experiences. The disaster dice game engendered focused conversations on specific topics and encouraged participants to share experiences, identify challenges, assess risks, generate ideas, and eventually self-evaluate their decisions and efforts. Greater research is needed in this area to appreciate fully the scope, effectiveness, and any challenges of using gamification for effective learning with Nepalese and indeed other informal construction workers.

This study presents a policy-related opportunity. Government, humanitarian, or development agencies' policies seldom spotlight workplace learning. The informal construction sector has been thriving in 'developed' and 'developing' countries (Jewell, Flanagan, and Cattall, 2005; Chen, 2016), and as such, developing policies that incorporate the workplace learning of construction workers in DRR construction initiatives affords an opportunity to establish more hazard-resilient building stock across the world. Ultimately, capacity development needs to be rooted in the context and learning style preferences of those who conduct construction and reconstruction, to enable effective and sustainable DRR and post-disaster reconstruction. At the same time, it is essential to appreciate that learning and capacity development is a two-way process, between both trainee and trainer.

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Endnotes

1 While capacity-building and capacity development are often used interchangeably, this study spotlights the latter. There are subtle differences between them: 'building' implies that capacity is something that can be constructed by those who have created a preconceived design, whereas 'development' implies that capacities already exist and need to grow (Hagelsteen and Becker, 2013).

2 The implication here is that construction work is delivered through informal contracts. Responsibility is agreed verbally, thus not imposing any liability, and often by people who have not received appropriate or formal vocational training.

3 Some images of the NSET's Shake Table demonstration are available to view at https://www.nset.org.np/nset2012/index.php/photogallery/type-picture/galcategoryid-34 (last accessed on 23 November 2020).

4 Dice, for instance, have been used since before recorded history. The most ancient excavations of dice indicate a South Asian origin and dicing is mentioned in many religious references, including the early Buddhist games list (Possehl, 1996).

[5] Ethical approval was received from the Ethics Committee of the University of York in January 2017. The research did not involve anyone less than 18 years of age. The research itself is not sensitive, but oral consent was obtained from every participant, and it was made explicit that they could withdraw from any part of the endeavour at any time and that their data would be removed. Full anonymity was accorded to all participants, and all data were stored on an encrypted laptop.

[6] One should note that Nepali researchers collected all of the data; researchers from the United Kingdom were not present at the interviews in order to reduce the possibility of bias.

[7] Back translation: a document that has been translated into another language is then translated back into its original language and a comparison is conducted of the two to ensure consistency in the meaning of the words and the language (Tyupa, 2011).

[8] A typical game is as follows: as a team of construction workers you need to ensure that the project you are building is resilient, but you do not know yet what hazard is going to affect it. However, you can decide what DRR measures you are going to implement (constraints apply, though). Roll the blue dice to make a decision on a measure. If it lands on a '3', you can train one of the workers to enhance their DRR skills, but the skills can apply only to one hazard. Which hazard do you choose? (At this point the group has to discuss which hazard to select and which skills to develop to address it, and why.) You now have the skills that can help you to mitigate 'flooding'. Throw the red dice to see what hazard is actually going to affect you. The red dice reveals a '4', which corresponds to fire; it appears that the developed skills are not relevant to the mitigation of this hazard. The game now moves to step three: to gauge the impact of fire, the dice is rolled again and produces a '1'; luckily, the impact is so small that it does not really affect you. Let us start the game again; remember the skills that you have acquired.

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