FINAL REPORT

Loughborough University Teaching Innovation Awards

Name(s)	School(s)/Department(s)
Ksenia Chmutina, Lee Bosher, Rob Schmidt III (and Falli Palaiologou)	ABCE
Email	**Phone number**
K.chmutina@lboro.ac.uk	01509228526

Project title

Disaster Risk Reduction is Child's Play

Abstract (200-250 words)

Recent disasters all around the world have highlighted the importance of incorporating disaster risk reduction (DRR) considerations into design, construction and operation of the built environment; however many built environment professionals (e.g. architects, civil engineers, planners) have not received the training required for dealing with DRR. These observations suggest that, if DRR considerations are going to become better integrated into the (re)development of our increasingly urbanised world, then there is a need to better integrate DRR principles into the core professional training at a Higher Education level of some of these key built environment professionals.

There are a number of pathways to accomplish this but sometimes the approaches used have not been suitably engaging. Currently most of the teaching in built environment disciplines is done through theory-based teaching and learning methods, yet quality education requires alternative pedagogies that are blended, interactive, adaptive and diversified. The 'Disaster Risk Reduction is Child's Play' project, delivered to the UG students at the School of ABCE, aimed to create a range of interactive models using LEGO and other modular toys that demonstrate a range of important resilient DRR features that are uniquely designed to cope with floods, earthquakes, hurricanes, and other hazards and threats, and encourage multi-disciplinary collaboration among future built environment professionals.

Issue(s) addressed by project

1) *Lack of subject-specific teaching*: whist the importance of engaging multiple built environment professionals with DRR is widely recognised, questions remain whether this increasingly broad range of practitioners actually have the professional DRR competencies. DRR is currently not a key part of the civil engineering curricula in the UK or globally. Bosher and Chmutina have been addressing this issue and have recently published a textbook on 'DRR for the built environment' (Wiley, 2017), which aims to become a core text in civil engineering and construction related programmes; this book has been used as the basis for this project.

2) *Lack of architects' inclusion*: too often decisions about DRR measures are afterthoughts and thus made too late; it is thus critical that architects who often work on a construction project from its initial phases are also aware of DRR measures and the impacts these may have on the overall vulnerability of the site and the broader associated built environment.

3) *Lack of multi-disciplinary engagement*: interaction between engineers and architects is not suitably mainstreamed in education; earlier interaction, particularly through an educational setting, allow for an improved understanding of different ways to approach a problem coupled with differing sets of knowledge and values. The engagement of a wider set of stakeholders assures that more effective and efficient strategies of incorporating DRR earlier on in the conceptual phase of the project as well as have an enhanced capacity to carry through to implementation.

This project addressed these three issues by directly targeting the education of future engineers and architects.

Aims

It is increasingly being acknowledged that there is a need for a raised awareness of DRR within engineering and architectural communities. There are a number of pathways to accomplish this but sometimes the approaches used have not been suitably engaging. The aim of this project was to create a range of interactive models using modular construction toys (e.g. LEGO, K'Nex) in order to demonstrate structural DRR measures that would increase the resilience of buildings to a range of different natural hazards. We propose the development of a new series of 'Lego architecture' and K'Nex models that will include a range of important resilient design features; they will be uniquely designed to cope with floods, earthquakes, hurricanes, and other hazards and threats.

Specific objectives

- To define design as the process of investigating a problem and proposing creative responses through the application of modular models.
- To investigate appropriate resilient structural measures made of modular construction toys
- To apply engineering and architectural knowledge as well as creativity and intuition
- To motivate interaction between architecture and engineering students in a problem-based context

Activities/methodology

- Two full day Saturday *workshops* for UG civil engineering and architecture students, taking a 'flipped classroom' approach'. Each workshop comprised of four sessions:

1. Introduction to disaster risk reduction, with a hands-on session during which the students tested seismic performance of different structures using K'Nex (Figure 1)

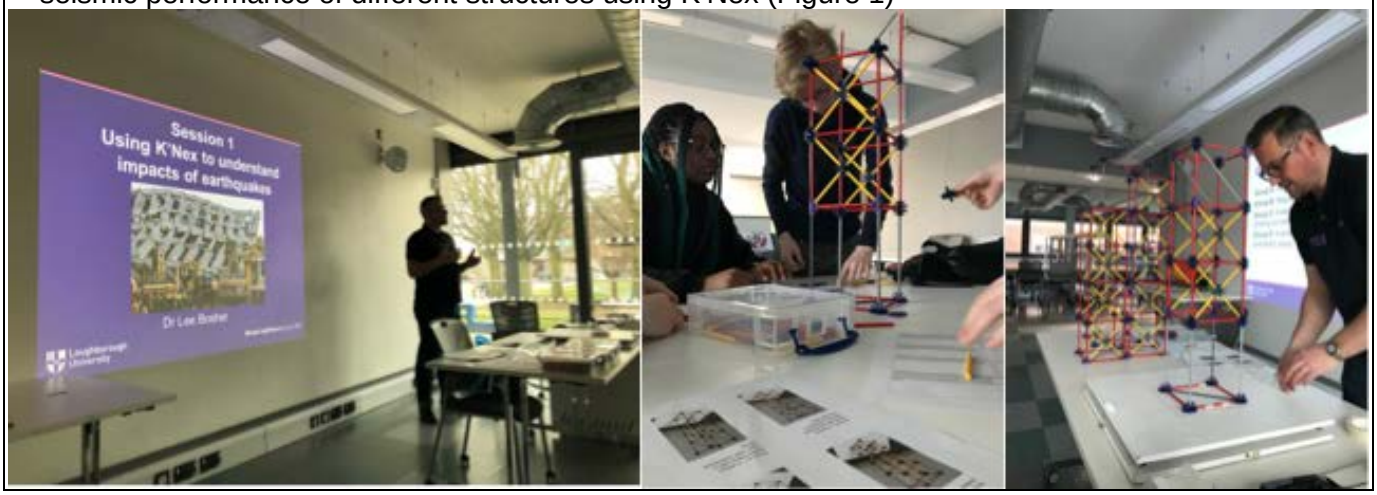

Figure 1 Session 1

2. Introduction to urbanisation and vulnerabilities, with a hands-on session during which students were asked to plan a city using an outlined base map of a city and 3D printed cubes that represented various city elements and densities (Figure 2)

Figure 2 Session 2

3. Introduction to LEGO Designer software, with a hands-on session during which the students were asked to apply the concise theory presented in previous sessions and design a small post-disaster shelter using the software. Groups then presented their ideas and models (Figure 3)

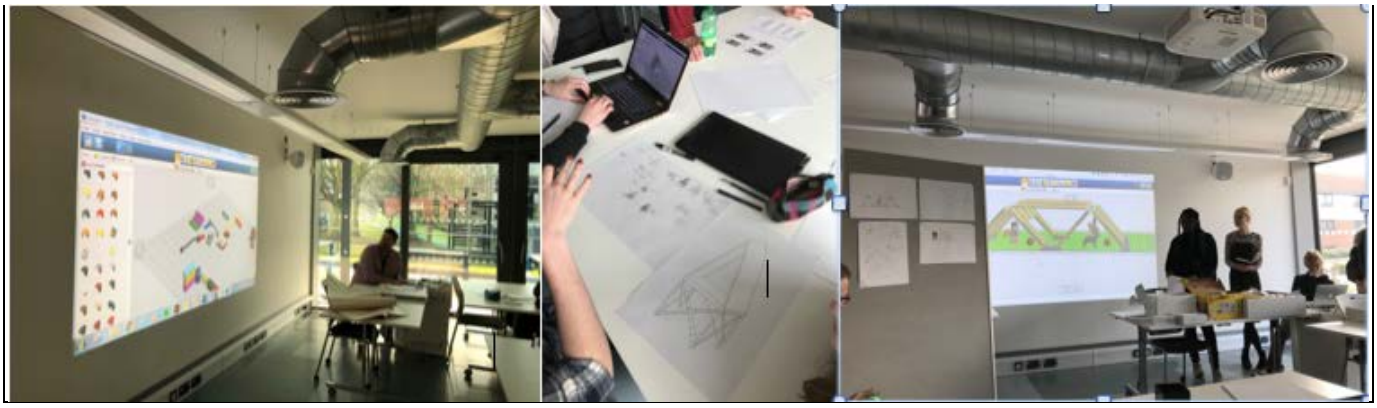

Figure 3 Session 3

4. Development of competition ideas (with the final competition taking place on the 9th of May at the Keith Green Building; the teams will be judged by representatives from CAP, School of ABCE and a practicing architect).

One of the workshops was also attended by a 14 year of school student, who engaged in the project as a part of her STEM award role.

- Series of 'advice' *drop in sessions* to help competing teams to develop their project
- An end of the year *competition* where students will have to work in teams to build a disaster resilient model. The final is organised as an evening gallery where we invite local practitioners and industry representatives and students present their models.
- 'Resilient model building' *teaching session* as a part of the 17CVC010 (DRR for the Built Environment, delivered by Bosher): students were tasked with building models using K'nex that would demonstrate the different impacts of seismic activity.

Project outcomes/findings

- The engagement of the students with the project has proven that it can be *used as a teaching tool*, and whilst we do not know the final results of the competition yet, we can state with confidence that hands-on sessions worked very well and provided students with good understanding of disaster risk reduction.
- We will also be using the materials used at the workshop in *outreach events*, as they allow us to explain complex problems in a playful and simple manner.
- The project has provided a great opportunity for civil engineers and architecture students to *work together* and discuss each others' expertise and needs.
- It also gave opportunity for the students who took part in the competition to *enhance their CV*; this is particularly useful for the architecture students, who were able to add the competition results into their portfolio.

Challenges:

- We found that *engagement of the students in non-curricular activities* can be highly problematic. The workshops have been advertised to suit the needs of different groups of students - yet only few student signed up (with the preferred day being Saturday rather than week days). We have used a variety of ways to advertise the workshop and were supported by the School's Programme reps - yet the attendance was low nevertheless. We feel that the best way to deliver similar exercise next year will be during the induction week and at specific sessions, as we feel that once students actually see what the workshops is about, they will be much more inclined to engage. We also found that architecture students, who are used to hands-on work, are much more willing to engage with the tasks that were set; civil engineering students did not feel as comfortable.

Project outputs/deliverables

- Modular construction *models* of disaster-proof buildings, and detailed plans of how to build these (to be presented a showcase on the 9th of May 2018)
- A *side event* in collaboration with the University of Auckland (where a similar project has been taking place) delivered at the 'Understanding Risks Forum' in Mexico City on the 15th of May
- *Conference presentation* at the Learning and Teaching Conference, Loughborough University
- Pedagogical *paper* on benefits, challenges and scalability of using modular construction toys in DRR is currently in preparation.

Impact on teaching and learning (for your students, your School and including links to University strategy) [*This will be the longest and most significant section*]

The project was built on the University strategy, and therefore its impacts fit within the strategy segments.

Impact on students - Educating for Success, and Raising Standards and Aspirations:

- *Learning opportunity* and thinking outside the box: the competition provided a foundation for understanding of global needs and challenges posed by the lack of disaster risk reduction in engineering and architecture practices, and provided students with an opportunity to consider how they - as future built environment professionals - can help address these issues taking into account a wider global context, and the vulnerabilities and opportunities it presents.
- Opportunity to experience '*real life' engagement with other 'professions'*: this project allowed architecture, civil engineering, and construction programmes students to work together. Whilst this is 'normal practice' in the industry, students do not get many opportunities like this during their University years;
- Appreciation of '*learning by doing'* approach: civil engineering and construction students had an opportunity to test their ideas thus figuring out whether such learning approach works for them.

The feedback from the students will be collected on the 9th of May thus we cannot provide the reflection on the activity yet.

Impact on the School: Growing capacity and Influence, and Investing in our staff

- Exercises that were created for this project will be used during the *Recruitment and Open days* and for outreach work.
- The *collaborative workshop* with the University of Auckland (where Prof JC Gaillard is using similar methods to teach geography students) is organized and will be first trialed in Mexico City. If successful, we will be running similar workshops at various international conferences to raise awareness about the benefits of using modular construction toys for raising awareness about disaster risk reduction among construction industry and general public.
- An opportunity for exciting *teaching collaborations* between academic staff: too often we do research collaborations but teaching is delivered individually. This project allowed four members of staff (2 in the Architecture group, one in water group, and one in Infrastructure group) to work together in order to develop and deliver teaching material.

Dissemination plans including location of developed resources for Loughborough colleagues to access (resources can be attached to this document or linked to – in which case please provide an accessible location of resources)

The activities have been disseminated via Twitter, Facebook, email and the School newsletter.

Future dissemination activities include:

- Newsletter article reporting on the competition
- Workshop in collaboration with the University of Auckland at the Understanding Risks Forum on the 15th of May 2018 in Mexico City
- Pedagogical paper on the opportunities of using construction modular toys in disaster risk reduction education
- Presentation at the Learning and Teaching Conference (27th June 2018, Loughborough University)

All the developed resources are physical and will be kept at the Keith Green Building, where students and staff can easily access them.

Use of award money (outline breakdown)

Costs to date:

- Lego sets (Architecture studio playsets *5; Large base plane *5; Classic base plane*10; LEGO creative building basket *5; LEGO connections kit; K'nex Rods (200)) = £1350
- Catering for workshops = £76
- 3D prints = £115.48
- Additional Lego bricks (requested by teams to complete their models for the competition) =£125
- competition prizes (LEGO Cityscape models*5) = £185

TOTAL: £1851

Additional anticipated costs (that will be spent during and after the competition):

- train ticket from London for an architect = £162
- Additional LEGO bricks for future workshops (competition will help us understand what is required; for instance we already know that we need more base plates but we would want to put everything in one order) ~ £500
- Catering for the workshop ~200

TOTAL anticipated: £862

TOTAL OVERALL:£2,713

Please submit the completed documentation by **30 April 2018** to:

Deena Ingham, *Teaching Innovation Awards Panel*
Centre for Academic Practice

cap@lboro.ac.uk