Innovation in the Course Disaster Risk Management to Improve the University Student's Competence for Multidisciplinary and Participatory Work

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AREAS OF INTEREST

Disaster Risk Managment, Risk assessment, life cycle benefit analysis, structural dynamics, structural reliability, social sustainability

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Innovation in the Risk Management course to improve undergraduate university students' skills for multidisciplinary and participatory work

Abstract

The ability to work in multidisciplinary teams and communicate solutions efficiently is one of the main requirements asked for by employers and international accreditation committees to engineering graduates around the world. However, traditionally the curricular contents of each professional career related to the construction sector, emphasizes the application of its specific knowledge in an isolated manner.

This is a reality in Peru as well. Engineering students are neither trained to work in teams nor in multidisciplinary projects. This hinders the production of projects with a holistic vision and the ability to respond with greater relevance to the needs and physical and social characteristics of different territories.

This document presents the results of an innovation project in undergraduate university education oriented to the development of the students' skills for working in teams and in multidisciplinary endeavors in a Disaster Risk Management (DRM) course. The project follows three lines of action: (1) Redesigning of the curricular content of a Civil Engineering specialty course to integrate professors and students from the Architecture and Urban Planning specialty. (2) Working in coordination with an Architecture and Urban Planning specialty course, focusing jointly on a common problem situation and a carrying out a case study including desktop and field work. (3) Identifying an intermediate city on the Northern coast of Peru affected negatively by climate change as case study, aiming for the students to develop risk management plans and public space design.

The course's theoretical, methodological and procedural contents are aimed at conducting a risk diagnosis and delivering solution schemes. These contents include participatory and social responsibility academic methodologies that combine local knowledge and technical know-how in order to generate new knowledge.

Innovation is applied to the production of information through two participatory workshops: the first one for risk diagnosis and solution guidelines, and the second one for validation of the solutions. The workshops comprised field work, urban reconnaissance walks, work tables and presentations, carried on by various groups composed by professors, students, and local actors (authorities, municipal and sectorial officials, local undergraduate students and local residents). Participation of local actors in these activities was key and contributed to their own capacity building. Professors and students acted as counselors and benefitted from the local actors' expertise.

The improvement of the students' skills through a multidisciplinary and participatory approach was a positive achievement. This becomes evident in the integration of the solution criteria proposed by the Architecture and Urban Planning and Civil Engineering students in both courses. The multidisciplinary and participatory experience went beyond the academic field, since the projects were co-produced with the local actors, validated by them and delivered to the municipality. The city authorities included them in their plans for future actions.

Introduction

An innovation project in undergraduate university education is carried out in order to modify the structure of a Civil Engineering specialty course from a traditional format to one that contributes to the development of new skills in the students for multidisciplinary [1] [2] and participatory [3] [4] [5] work in disaster risk management (DRM) applying knowledge from the Architecture and Urban Planning specialty and working in teams with their professors and students.

Generally, engineering graduates lack the ability to perform well in multidisciplinary projects because the curricular contents of their undergraduate courses are defined and reviewed from a technical perspective, emphasizing the application of specific knowledge in an isolated manner and leaving out a panoramic and multidisciplinary approach to the issues. In addition, the syllabi of the Civil Engineering courses have little room for learning how to work in a participatory manner involving the community.

The objective of the redesigned course is to provide the students with a comprehensive vision of the activities of DRM to face diverse natural phenomenon such as earthquakes, floods and landslides with an interdisciplinary and participatory approach that allows the co-production of information and solutions together with multidisciplinary students' teams and local stakeholders involved in DRM. It is an elective course that orientates senior civil engineering and Architecture students to the specialty in DRM. The course was redesigned by professors of three disciplines (Architecture, Urbanism and Civil Engineering) with the objective to make room for interaction, both in the academic and in actual and concrete settings, which helped to enhance the learning processes and the collaborative work between the three academic disciplines, and laid out the foundations for facilitating the professional practice in multidisciplinary teams. This articulated process of interdisciplinary work differs from the traditional multidisciplinary approach of parallel perspectives that can often be found in courses with sequential independent modules taught by professors from various disciplines. The course's redesign was also a response to the need to embed the territory-based approach in disaster risks management, especially given the fast pace of the climate change process at a global scale.

The course was redesigned in terms of methodology and evaluation method, in order to encourage self-learning and the integration of knowledge and skills acquired in previous courses. The course's new syllabus included conceptual and methodological interdisciplinary contents related and articulated to the development of DRM plans e.g. Mitigation, preparedness and emergency attention plans. The use of Information and communication technology innovation, ICTs, was enhanced in order to promote interdisciplinary, critical and participatory learning in the students of both academic disciplines. At the end of the course, the students present their final project: a DRM plan for a city or district. Developing DRM plans is a challenge for students since collaborative work with other students, course professors, guest professors and local actors are involved, so that they are applicable in a real environment.

Three field trips were made to a city in Northern Peru selected for the case study, for: (1) Previous coordination before the delivery of the course with participation of the professors ; (2) field work for the co-production of data and solution schemes for the DRM plan with participation of students and course professors; and (3) validation of the students' DRM plans by local actors, this trip was held after finishing the semester, with participation of course

professors and a group of selected students. Innovation in the field work consisted of participatory workshops comprising urban reconnaissance walks, participatory mapping, work tables, and presentations, which were carried out in groups that included professors, students, and local actors. Participation of local actors in these activities was key and contributed to their own capacity building. Professors and students provided counseling and benefitted from the local expertise.

This paper is divided in five parts: (1) Conceptual framework where main conceptual and methodological aspects of the interdisciplinary themes and participation are exposed; (2) A baseline assessment of the Civil Engineering students ability for multidisciplinary and participatory work, which allows to show students previous strengths and weaknesses in these themes; (3) the redesign and planning of a course for the creation of DRM plans, where content of the curse is presented, as well as innovative aspects of teaching and available tools; (4) the development of the DRM plans, where the application and adjustments to the planned work are presented (5) the assessment of improvements in the students, where the acquired knowledge on DRM and their ability for participative and multidisciplinary team work are discussed.

1.-Conceptual framework

The multi-interdisciplinarity concept comes from the work of Klein [6], who defines the different levels of integration needed between disciplines to face society's problems with a holistic approach. Multidisciplinarity is associated with a level of integration that is null or low, and interdisciplinarity with a medium-to-high level of integration.

In this approach, multidisciplinarity is defined as the juxtaposition of disciplines in terms of methods, knowledge and information. Disciplines remain separate and the knowledge structure of each one remains intact. Problems are addressed from different points of view and perspectives. Multidisciplinarity thus implies a weak articulation in which a discipline uses the knowledge of another one to contextualize its own problems or combines its results with those of the other discipline to complete the "puzzle".

The aim of interdisciplinarity is to transfer methods and concepts from one discipline to another in a permanent or lasting manner. In this sense, it also goes beyond disciplines and can even contribute to the birth of new ones, but continues to be within the framework and objectives of disciplinary research. Table 1 shows a comparison of the concepts presented here.

Participatory methodologies are part of an approach that propounds the co-production of every component of a project, from the production of information to the project linking theory with practice. The development of participatory diagnoses requires a set of tools to create awareness about the territory and move from an abstract to a concrete representation of the project's space [7]. This methodological process is part of the approach of PRA (Participatory Rural Appraisal) proposed by Chambers 1994 and cited by Damonte and Garcia, 2016 [8] who point out the importance of forming interdisciplinary groups, of academic and local stakeholders external, in combination with interviews, observation and visual diagrams tools. Among these tools, the most important for the development of the participatory diagnosis are the urban reconnaissance walks, the participatory mapping, the work tables and the plenary sessions. The resulting information is the basis to create a simulation of an improvement or development in the case study place. By not separating

theory from practice, the local actors' expertise is included, confidence between scholars and citizens is strengthened, and the creation of an interdisciplinary and participatory working method with social actors is facilitated [9].

Table 1: Level of integration in multidisciplinarity and interdisciplinarity

	Multidisciplinarity	Interdisciplinarity
Level of Integration	Null-Low	Medium-High
Articulation of data, methods and information	They are juxtaposed, there is an encyclopedic sequence, and there can be coordination.	They are integrated, linked, mixed, and restructured.
Interaction between disciplines	It takes advantage of complementary skills. One discipline contextualizes the other. A method or concept of another discipline is borrowed without it meaning a change in practice.	It develops a lasting dependence on the methods or concepts of other disciplines.
Level of collaboration	Disciplines share information and tools. Bridges are laid. Cooperation does not necessarily happen on a daily basis.	Disciplines cooperate daily. It requires team work.
Compatibility between disciplines	Highly compatible	Not compatible

The urban reconnaissance walks cover specific city sectors in order to identify their problems and possibilities. The reconnaissance walks also allow understanding the different scales and problems of land occupation [10]. Participatory mapping involves the creation of maps by local actors, producing local and community-based empirical information. These maps are considered communication, recognition and legitimization tools for those who take part in the process. The work tables are carried out with local actors and include guided and critical dialogues on specific topics. Finally, the plenary sessions are presentations carried out by local actors to communicate the team work results and validate the co-produced diagnosis.

These tools facilitate the transmission of knowledge and the communication of information about the locality, and the elaboration of projects to contribute to local development. Besides placing value on local actors' rights, they also seek to generate commitments and accountability in them to achieve sustainable solutions [11].

There are three stages for the development of projects with participatory methodologies: 1. Reconnaissance of the space, its problems and possibilities; 2. Dialogues, agreements, consensuses and commitments; and 3. Development of an urban project. These stages are not sequential and can be revisited during the process.

2.- A baseline assessment of the Civil Engineering students ability for multidisciplinary and participatory work

In order to create a baseline, an exit survey was designed and applied to the students of the course taught in the semester previous to the redesign of the course. It was a descriptive,

closed-response survey focused on the students' perception on multidisciplinarity, participation and knowledge integration.

The survey was conducted in November 2016 and 33 out 39 enrolled students responded. The results showed that students are aware of the need for multidisciplinary approaches in risk management: 94% of the respondents believe that the participation of professionals from different academic disciplines is required, and that they must interact together in the various stages of the projects. In addition, a high percentage think that planning and management of local development (64%) and urban design (73%), both linked to the Architecture and Urban Planning specialty, are topics that should be strengthen. Topics related to Civil Engineering (structures, water and environmental resources, transport and roads, planning in construction) obtained percentages between 33% and 21%. Only 18% considered that the ethics course should be strengthen (Figure 1). Likewise, the survey shows that the students have clearly identified the activities that will have an impact in improving their work skills in multidisciplinary teams: 64% of the students consider that lectures given by specialists from other disciplines will lead to improvements in this topic. Creating a final project was also identified by the students as a good exercise to improve their interaction with professionals from other disciplines (61%). In regards to participatory methods, students have a favorable opinion: 73% agree that risk management projects should involve and empower the end beneficiaries, and 88% agree that the knowledge and perceptions of these beneficiaries should be taken into account.

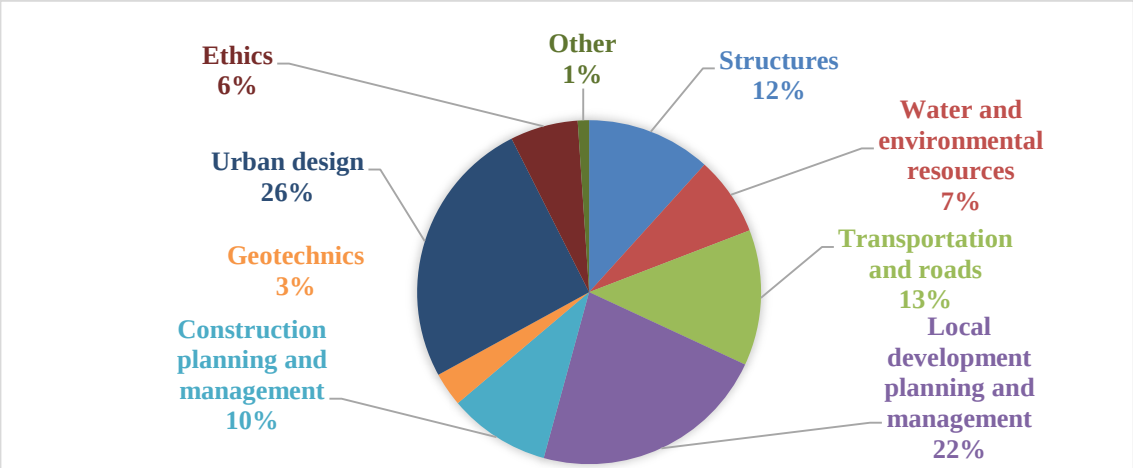

Figure 1: Results of survey of Civil Engineering students about topics that should be strengthen in their formation to be able to elaborate projects of DRM

3.- Redesign and planning of a course for the creation of an integrating, multidisciplinary, and participatory project

Innovation in the redesign of the course included interdisciplinary and articulated conceptual and methodological contents that were identified and developed based on the authors' experience developing research projects with multidisciplinary research groups at Pontificia Universidad Católica del Perú (PUCP).

The course was redesigned both in terms of teaching approach and interdisciplinary learning. The co-teaching of classes was proposed in order to contextualize risk management in the city, in the territory, and in society. From a theoretical and methodological perspective, there

were two lines of action: Multi-interdisciplinary and participatory, including their implementation in actual contexts. These lines of action were developed with theoretical, procedural and attitudinal contents that were included in the syllabus by integrating knowledge from both academic disciplines. Students were encouraged to participate in an active and collaborative way including presentations of their progress and working in groups that comprised students from both the Civil Engineering and Architecture and Urban Planning specialties. The practice of the two action lines was specially strengthened during field work, which involved carrying out activities in actual contexts and interdisciplinary and participatory work with local actors. The social responsibility and ethical criteria required for the participatory work of students, professors and local actors were also included in the course's redesign.

ICTs were used as a complement to facilitate communication and collaboration between actors, so that the information co-produced in the classroom and on the ground was efficiently shared. The theoretical contents about the territory were complemented by a workshop-class on the use of the geographic information system (GIS), taught by a Geography professor. Likewise, engineers from other risk-management-related specialties were invited both for lectures on specific topics and to give advice to the students and assess the course projects.

The redesigned course has three components: theoretical classes, practical activities and field work. The final project consists in the elaboration of DRM plans in a real environment. The final project was evaluated in a very rigorous way, with rubrics that included multi-interdisciplinary criteria.

The theoretical part comprised conceptual, procedural and attitudinal contents that received constant feedback from both academic perspectives in a continuous learning process. The main concepts related to each topic are shown in Table 2. In the practical part, students applied the acquired theoretical knowledge on a case study using secondary information (photos, news, satellite images, previous studies, census statistics, cadastral information, etc.) and GIS tools (Figure 3, left side). In the redesign, the case study was changed from a hypothetical to an actual one.

In regular classes, the interpretation and application of concepts was carried out in groups through collaborative exercises that were started in the classroom and later delivered through ICTs on set dates. Before the field trip, professors show the students both the actual situation and problems of the city and the participative methodology proposed by Damonte and Garcia [8]. With this, students have their first approach to the location and can identify the risks in it, which helps to enhance the tools of the methodology for data collection, analysis and processing with local actors. Students learn, with this method, to identify local actors (decision makers and neighbors), and to listen and observe, since they adjust the tools themselves and co-produce the information and the affordable solutions.

For the participatory methodology application on the site, information co-production tools were created and explained to approach the actual case in participatory workshops. After finishing the field work, the students elaborated their plans in a interdisciplinary way, sharing information between both disciplines. According to their background, civil engineering students do contribute with their knowledge of basins treatment, slope stability, structure stability and waste disposal of solids and sewerages, among others; Architecture students do contribute with their knowledge on public space design, urban zoning, land use, urban

mobility and landscape. Guest professors contributed with advice to a better development of the projects and also participated in their evaluation process. As part of the project, the students created posters that were shown at an on-campus exhibition.

Table 2: Conceptual, procedural and attitudinal contents for cross-cutting risk management issues from the various disciplines' perspectives

Cross-cutting issue	Architecture and Urban Planning	Environment and Shanty Towns	Civil Engineering
Identification of risks and their factors; danger, fragility, resilience and exposure.	Urban growth, social vulnerability.	Resilience, poverty, socioeconomic level.	Magnitude, return period, precipitation, erosion, soil type, intensities, topography, danger, area of influence, physical vulnerability, valuation of infrastructure.
Mitigation for risk reduction	Conservation of historic centers and heritage, landscaping, zoning and land use. Urban development plans, resettlement.	Reforestation, water treatment, greenhouse gases reduction, green walls, life cycle, carbon footprint.	Structural reinforcement, rain drainage, slopes protection, canalization, rubble removal from slopes, terraces, resettlement.
Disaster preparedness	Identification of safe areas in public spaces, evacuation routes.	Training, local actors, drills.	Monitoring, early warnings, evacuation and safe areas maps, signaling.
Contingency planning in health, humanitarian aid and environment rescue areas.	Shelter design, zoning and accommodation in shelters for victims, temporary housing.	Water treatment, excreta and garbage management in emergency situations. Debris management.	Identification of safe areas for shelters. Requirements calculation, estimation of damages, debris management.

In order to train the students to lay out, discuss and substantiate their DRM plans, group progress presentations were organized in class and before experts that put the students in a hypothetical work situation applying role-playing techniques (Figure 2, right side).

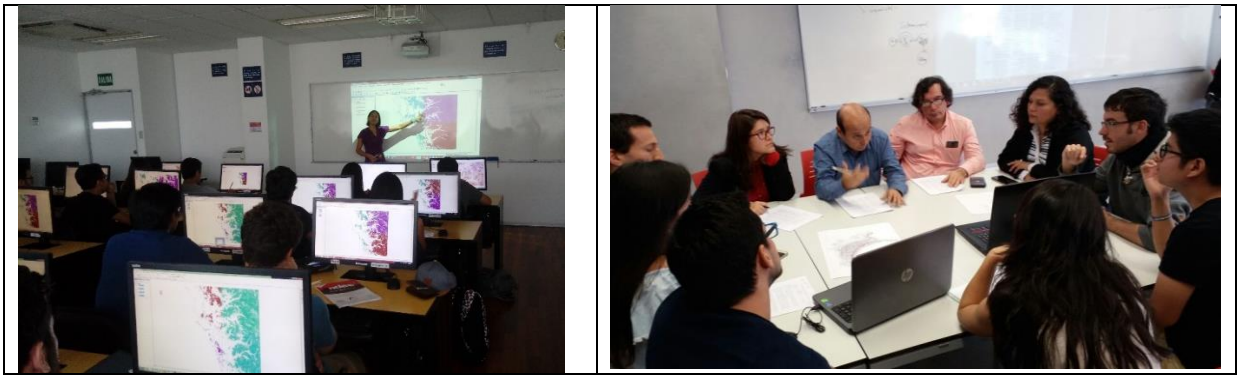

Figure 2: Guest professors from the Geography specialty and various Civil Engineering specialties, commenting on the progress of the students' projects.

4.- Development of the project

Work on the project comprises three phases: (1) Preparation of a risk diagnosis and guidelines for solution, (2) design of the DRM plans, and (3) validation of the plans. Chepén, an intermediate city on the Northern coast of Peru that had had recent difficulties in its risk disaster management was selected as study case (Figure 3).

Figure 3: Panoramic view of the city of Chepén, located between steep hills, and the farming area dedicated to rice, the main local produce.

Prior to the beginning of the academic semester, the teaching team traveled to Chepén, where the following activities were carried out: presentation of the field work activities and their contributions to the city to the Provincial Mayor; work table with various city officials, to know their needs and reach an agreement on their commitments with the municipality; a collaboration agreement was signed between the Provincial Municipality of Chepén and the PUCP; a reconnaissance walk of the city was made and five intervention spaces were identified (Figure 4). This was the basis for the identification of the risk problems of Chepén and comprised the co-production of information, risk diagnoses and solution for the five intervention spaces. The logistics for transportation, lodging, and food for the field work to be carried out in the middle of the semester were also coordinated.

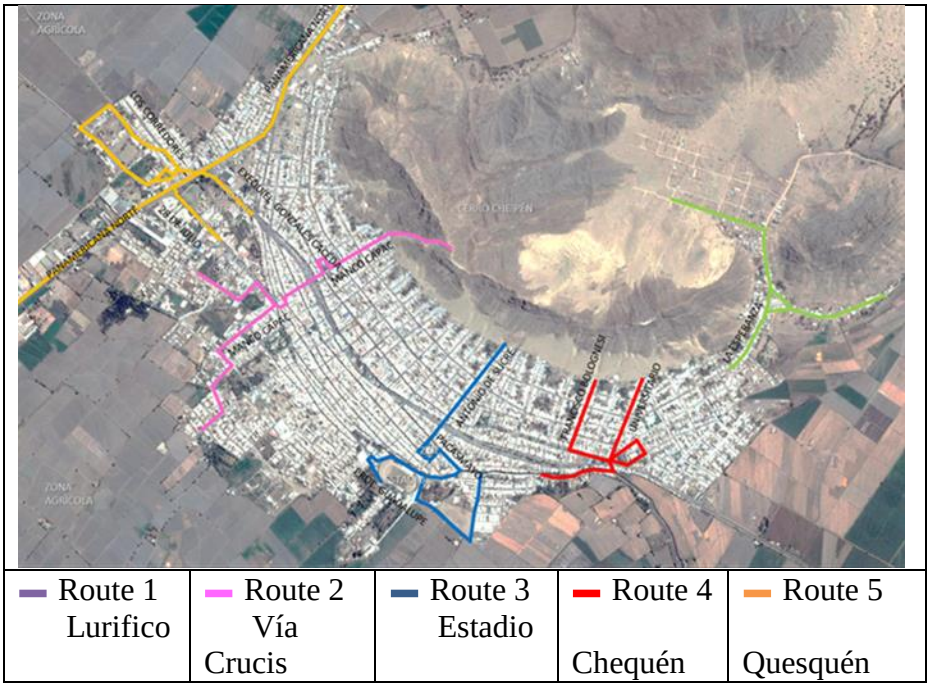

Figure 4: Map showing the five urban reconnaissance walks proposed for the study of natural risk reduction in the city of Chepén, from consolidated to formal and informal expansion areas. Source: Teaching team based on information from Google Earth.

Field work was carried out in the middle of the academic semester. It lasted three days and comprised three main activities: urban reconnaissance walks, a participatory workshop and work tables.

In the urban reconnaissance walks, the entire PUCP team and municipal officials visited the surrounding areas of the five identified intervention routes, in order to verify the consistency between the secondary information collected and the actual territory, and to make the required adjustments to the materials to be used in the participatory workshop the following day.

The participatory, collaborative and interdisciplinary workshop was carried out in the city of Chepén with the participation of the teaching team, all the students and the local actors, as well as the professors and students of the Urban Planning Seminar course at the Architecture and Urban Planning specialty at PUCP. A particular emphasis was put into making the group of local participants as diverse as possible, including among them authorities and officials from the following institutions: the Provincial Municipality, the Local Educational Management Unit (UGEL) of Chepén and the Regional Education Management (GRELL) of La Libertad; the Drinking Water and Sewer System Services (SEDALIB) of La Libertad; the fire department, the municipal security service (Serenazgo), the Municipal Police and the Police Station of Chepén, as well as higher-education local students from the Juan Bosco Higher Technological Institute (ISTP), local leaders and residents of the five city sectors selected for the field work.

This workshop had a positive learning impact due to the interaction of the various participant actors. For the application of the participatory methodology to the actual case, record cards, questionnaires and maps of routes were created to identify the areas of greater risk and possible solutions in case of floods, landslides and earthquakes.

In the participatory workshop, a brief presentation of the concepts and the activities' methodology was carried out and five groups were created, one for each of the urban reconnaissance walks, and all included local actors (Figure 5). The participation of local actors in the urban reconnaissance walks facilitated interactions with residents, including those affected by floods, making it possible to obtain first-hand information on how these people react during a natural disaster, and a real vision of the possibilities for the preparedness and mitigation plans. It also encouraged the exchange of opinions and perceptions about the state of infrastructures and public spaces from the different disciplines' perspectives, in order to make a comprehensive risk diagnosis of the areas under study. Potential public spaces and infrastructures for the plans were visited, to gather information on the necessary conditions of shelters, and studying collectively the feasibility of their use from the point of view of both academic disciplines: Civil Engineering (damage state of infrastructure, road gradients, materials used in the construction of buildings, safety of slopes, etc.), and Architecture and Urban Planning (road accessibility, land uses, road continuity and obstructions, types of human settlements, proximity to facilities, etc.).

Figure 6 shows some of the effects of the floods caused by rains in the upper reaches of Chepén and a shelter in a local rural town.

The second part of the workshop comprised discussions, systematization of information and reaching agreements. The participants worked collectively in groups using flipcharts with drawings, timelines, tables, etc. (Figure 7). The contributions and opinions of every actor were well received in every stage of the workshop, creating a rewarding knowledge exchange. The participatory diagnosis resulting from the workshop was presented by local actors in a plenary session, in which professors and students had a counseling role (Figure 8). All the information was co-produced by the interaction between actors of different disciplines and residents, and allowed to assess the feasibility of the solutions in every stage, from its inception to its operational start-up.

Once the participatory workshop was over, each group of students continued working on the diagnosis, making the pertinent adjustments and outlining general solution guidelines for the identified problems. The following day, these guidelines were presented and discussed in work tables with city management officials.

After the participatory workshop, each group was assigned a project of Preparedness, Shelter Design and Mitigation, and the Architecture and Urban Planning and Civil Engineering students worked together on the projects articulating their respective knowledge and field experience. For example, for the Mitigation Plan students from both disciplines shared (theoretical and practical) information about the retrofitting works needed and about the public spaces where the plan would be implemented. The students from both disciplines contributed with technical solutions such as the use of biomats, drainage systems and the location of safe escape routes and suitable areas for shelters. The students of Architecture and Urban Planning verified that the technical solutions were consistent with the actual urban context and applied them to their own redesign of public spaces, aimed at contributing to the reduction of natural risks.

During the design process of the DRM plans, professors of the related Engineering specialties (Geotechnics, Water Resources and Structures) were invited to participate. A role-playing technique was used, with the guest professors as reviewers and the students as the professionals in charge of the projects. This activity was directed and coordinated by the

professors of the course. The groups presented their projects in class and the asked the guest professors for advice. The guest professors assessed their work with rubrics that included the following criteria: work presentation, formulation of questions or doubts, communication and interaction, team work and quality of their work.

Figure 5: The urban reconnaissance walks included observation, photographic records, filling of data collection cards, drawings and dialogue with local actors and residents.

Figure 6: Some of the effects of the floods caused by rains in the upper reaches of Chepén, and shelters.

Figure 7: Work tables carried out after the urban reconnaissance walks. Local actors worked together with the PUCP team of professors and students of the two disciplines.

Figure 8: Plenary session: organization of the flipcharts for the presentation; the local actors make their presentation guided by the students; and deliberation of the Mayor and the jury, integrated by various city actors.

5.- Assessment of the students' improvements, validation and dissemination

The assessment of the students' improvements was carried out through three activities: (1) students' project validation and interviews with municipal officials and authorities, (2) interviews with former students of the course, and (3) an assessment made by the course professors.

At the end of the academic semester, a two-day trip was made by the teaching team and a group of students from both courses to participate in a validation workshop and to deliver their contributions to the local government. The document containing the proposed plans of preparedness, mitigation, and emergency responses (shelter design) was printed and delivered as the course's final project, and A-0 format posters with a summary of the project were created to be displayed at the PUCP campus. These posters showed that the technical solutions for DRM and the improvement of public spaces developed by the course are related and complementary. They were also useful in the validation process of the plans that were finally delivered to the municipality of Chepén (Figure 9).

Based on interviews with two municipal officials and the Mayor's testimony at the closure of the participatory workshop, it can be concluded that the students have improved their skills for multi-interdisciplinary team work and in the application of the participatory methodology. According to Interviewee 1, the local actors in the public management sector agree that the students of both courses worked in an articulated and collaborative manner and that working in groups was key for a systematic, organized, collaborative and precise work, adding that in the plenary sessions the topics were presented in an accurate and concrete manner. With regard to participatory work, the students' attitude towards the residents of the urban reconnaissance walks areas was very positive. First of all, they managed to get the residents to leave their homes to participate in the urban reconnaissance walks and share their experiences about the El Niño phenomenon. On the other hand, the students showed interest in the residents' opinions, and shared technical information with them (e.g. the urban reconnaissance walk of the 7 de Junio area, and of the extreme poverty areas of Lurifico and Lorenzo Sánchez). In these experiences, the students had a good performance in the application of participatory methodologies and in engaging in two-way communication with the participants. According to Interviewee 2, the students of both disciplines were not only very well prepared (they already had systematized information on Chepén) but also complemented each other very well and worked well with the municipal officials and with the residents of the reconnaissance areas. They were able to identify the factual information that was necessary to develop their plans (emergency response process) and to request it from the officials in charge of the areas of interest (urban development, local economic development, works, citizen participation, land-use planning and civil defense). It should be noted that the students' requests helped some municipal officials to systematize their own information, which was previously incomplete. Chepén's officials stated that the students carried out a conscientious work and had a positive valuation of the information collected from local actors. Interviewee 2 stated that all the students' work had been very fruitful in terms of reflecting what the residents said, which had not been addressed in a comprehensive manner previously due to lack of specialists.

The students' projects were feasible, consistent and applicable to the actual city context, which was highly appreciated by the city officials. During the workshop's closure, the Mayor said that the municipality's contingency plans were being drawn up using the course projects as reference.

In interviews, the former students of the course stated that they have substantially improved their skills for multi-interdisciplinary work and their participatory approach. Some are using these skills in their professional activity, as is the case of two recent graduates. As one of them said, "[the course] really helped me a lot. In my current employment I can now work perfectly with people from different areas" (Former Student 1). The interviewees also said they had improved their communication skills: "Having to make presentations in front of several people helped me a lot because it is now easier for me to share my knowledge with headmasters, teachers and parents" (Former Student 2). The interviewees highlighted the importance of paying attention to local actors: "I mostly learned to listen to them" (Former Student 2); however, they have also learned how to discriminate between the experiences that are actually related to the academic field and the residents' claims: "[Our work] must be very thorough" (Former Student 1).

Figure 9: Summary of the validation field trip: urban reconnaissance walks, exhibition, presentation and delivery of contributions, Mayor of Chepén and work table. Source: teaching team, 2017.

The course professors and guest professors used specific rubrics to evaluate the students' skills for multi-interdisciplinary team work and the application of participatory methodologies. Their assessment was positive and coincides with the opinions of the municipal officials and former students. Additionally, it must be noted that there was an improvement in the following attitudinal features that contribute to collaborative work: exchange of information, solidarity among students of different specialties, ability to listen to each other, negotiation skills to reach agreements in the complementary solutions and in actual contexts, punctuality, accountability, and respect for their peers and the local actors.

The ability of the students to communicate and disseminate the results of their work has been demonstrated in the presentations carried out during the validation workshop and in the event CONSTRUCTECNIA 2017, organized on August 25-29, 2017 at the PUCP, to which the students were invited as speakers.

Conclusions and recommendations

The improvements achieved on the students' skills show that the redesign of the risk management course (approaches, methodology, and objectives) was appropriate. The pedagogical and cross-cutting nature of the participatory workshops provides an enabling environment for the teaching of skills for multi-interdisciplinary and participatory work to students of the Civil Engineering and Architecture and Urban Planning specialties through projects in actual contexts.

The pedagogical innovations applied in the redesign of the course allowed the students to acquire and improve in the following skills: the ability to interact with city officials and authorities and a wide range of local actors, and the ability to synthesize, substantiate and present their ideas and projects. In addition, they enhanced their attitude towards team work with specialists from other disciplines after acknowledging the scale of their contributions to the project and the effort put into them. It is very likely that these skills and attitudinal approaches will be used by students when they graduate and pursue their professional careers.

With regard to the impact on the population, there are some important aspects to be considered. From their interaction with city officials and authorities in a constructive space of respect supported by an academic structure, residents became aware of the complexity of urban problems. City officials, for their part, improved their skills to develop risk management plans with a collaborative approach and realized the value of systematizing their information. However, a weakness was detected in the population, related to non-structural measures such as their day to day behavior and land use, which in some cases have a negative influence in the quality of their lives.

Based on the positive results of this innovation experience, the aim of this project is to adjust, systematize and disseminate the methodology applied in the course for the teaching of multi-interdisciplinary and participatory work, placing a greater emphasis on raising awareness on good citizen practices. This participatory experience will allow the interdisciplinary methodology DRM to spread in other higher education courses and in local risk management.

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