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RESEARCH ARTICLE

INNOVATIVE HIGHER EDUCATION FOR CLIMATE: STUDENTS CLUBS AS PEER LEARNING TOOL

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ABSTRACT

Climate change, its consequences and adaptation/mitigation strategies are a complex issue that necessitates inter-disciplinary and trans-disciplinary solutions. Then, educating for climate is a complex task. In this way, Universities could offer a great substrate to launch any societal change. How to cultivate the « *Thinking and Acting ecologically* », a climate awareness and education over youth students community? Dealing with the complex problem of climate change requires creativity, scientific and social competencies and specific communication skills in order to cope with the dynamic change that characterizes its impacts in most facets of society, economy and nature. As a core characteristic of this ''real-world problem'', the cooperation among students, teachers and researchers of the university and the interaction with stakeholders of the region, the state and the globe, is of outstanding importance. For us, in high education, teachers and researchers have to abandon the role paradigm of the teacher as provider of information and the students as ''consumers'' of the provided information. In Morocco, a first approach is conducted in university context through a project called "*L'Effet Papillon* (Butterfly effect)" (COP22, 2016). The project aims to cultivate the ecology awareness and commitment over the student community. For that, we used the inter-disciplinary peer based-education through the students clubs to develop a three steps tool for climate-education: Sensibilizing-Training-Tooling. Student experience and live the process of changing for climate instead of purely memorizing its characteristics and challenges. The process of educating for climate and sustainability and practical applied actions therefore becomes more effective.

INTRODUCTION

Climate change is often a blurry term for a lot of people. Therefore, this paper outlines the concept of climate change and its implications for economy, society and environment. The vagueness, the complexity and the science-based of the concept call for new ways of education that imply the need for a redefinition of teachers', researchers, stakeholders and students' roles. An inter-disciplinary approach based on peer learning is adopted to establish a common basic for the various aspects important to deal with climate challenge and to make it applicable. We will present the concept of climate change and its consequences. In Section 3, we show that educating to climate requires crossing borders between different disciplines and also between science and practice. Then, in Section 3, we present the peer based-education approach, its characteristics and benefits. In section 4, we will introduce our approach to establish a common basis for the various aspects of inter-disciplinarity, trans-disciplinarity and mutual peer based-education in ways to make them applicable in the case of climate education.

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Our project "l'effetpapillon" is an example of practical educational processes and the experiences of students, teachers, researchers, and stakeholders in the process of educating for climate. This paper documents the underlying philosophy, design, organization, and the idiosyncrasies of this educational inter and trans-disciplinary process based on the leading question of how to include climate considerations in our thinking and acting. Finally, conclusions in regard to the question as to how such innovative ways of teaching climate awareness and sustainable development can be applied at the university level and what preconditions need to be fulfilled conclude our paper.

Higher Education for Climate change

Climate change

The problem of climate change (CC) is addressed as one of the most important international issues and consequently this has had a significant effect on the innovation policy area. Climate change refers to meteorological changes over long periods of time. These changes can be gradual over the long term, such as increasing temperatures or decreasing precipitation; or more frequent observation of extreme climatic events such as storms, heat waves or floods.

Climate change is attributed among other things to human activity and its production of greenhouse gases and degradation of the natural heritage. The higher the climate change, the more its impacts are inevitable. The main objective of climate change policy is (1) to mitigate the effects of greenhouse gases (GHG) in the atmosphere and to migrate to a low carbon economy (IPCCC, 2007, 2013) and (2) to adapt through actions designed to reduce the vulnerability facing CC.

The challenge of Climate-education

We start from the results of a study carried out among our students on the state of their knowledge about climate change. It was clear that our young people know nothing about CC, its consequences, solutions or strategies to deal with it. With this in mind, we decided that it was necessary to lay the foundations for climate-education. We define the latter as "the capacity of a person to mobilize knowledge around the Climate in order to implement eco-actions". Universitiescouldallow us to put in place a climateeducation. It's the ideal place to launchanysocietal change, its the place to innovate, disrupt and transform. The students are the target but shouldbealso the tool. To includeclimate in the everyday life and reasoning of students, whatwe call climate-education, there are several challenges, that are in the same time the characteristics of the climatebased-problem:

Inter-disciplinarity: It calls for cooperation across different subjects and disciplines. The IFCC (4^{th} report 21.3.2.3) emphasized that a wide variety of competences are needed to develop a holistic concept of climate change (its consequences, over society and economy) and to be able to contribute to a system change towards sustainable and eco-actions. Hence, higher education for climate needs to be interdisciplinary. This approach facilitates real cross-disciplinary thinking, translating, reconciling and integrating disparate discourses, traditions and methodologies. The borders between the humanities (''alpha-sciences''), natural sciences (''beta-sciences'') and social sciences (''gamma-sciences'') are crossed in order to solve a common real-world problem (Steiner and Posch, 2006).

Trans-disciplinarity: It involves intense interaction between academics and practitioners in order to promote a mutual learning process between them. It is important to change the configuration between science and society to bring the first to the latter. As a real-problem, CC needs an approach embedded in real practice. With this interaction, the stakeholders in the specific organization or region are confronted with new ideas and insights. This helps them to develop new orientations towards sustainable development and to better understand the options available for innovative activities. For academia, it helps them to benefit from the practical knowledge and experience and to think about relevant problems. By combining analytical knowledge and systems understanding with practical observation and experience, and linking these to society's risk perception and demands, a joint problem-solving process amongst science, technology and society can be achieved (Steiner and Posch, 2006). Trans-disciplinary for climate includes the aspect of mutual learning. The result of an integrated process of knowledge production amongst scientists and practitioners will be knowledge that is socially more robust (Gibbons and Nowotny, 2001).

Socialization: itisneeded to have an effective inter- and trans-disciplinarity. How could the agents, stakeholders, teachers, students, policymakers etc. cooperate and exchange if thereis no socialization and networking processheld ? Socializationis the processthroughwhichwelearn to appropriatebehavior to become effective members (Louis, 1980). How welearn the values, norms, beliefs, and behaviors of society, organizations or groups. It is important to break the icesbetween the different disciplines and spheres (academia vs practionners). Constributing to the success of a cooperative effort requiresinterpersonal and small group skills. Placingsociallyunskilledindividuals in a group and tellingthem to cooperatedoes not guaranteethattheywillbe able to do soeffectively. Persons must betaught the leadership, decision-making, trust-building, communication networking and conflict-management skills as purposefully and precisely as academicskills (Johnson and Johnson, 1997).

Self-regulated learning: as climate-education could not be included as module or a specific program. We suggest that student learning should be a Self-regulated learning. There are a variety of definitions of self-regulated learning. Zimmerman (2001) proposed an interesting one. It means that learners are meta-cognitively, motivationally and behaviorally active participants in their own learning process and self-generate thoughts, feelings and actions to attain their learning goals. It's required as the climate-education is not a diploma in the university. The students, and not the teachers, have the most active role. Being intrinsically motivated, the students are required to find the relevant information for themselves. Teachers merely play the role of facilitators and not of authorities and the main sources of information. This emphasis on higher-order learning, focusing on thinking that involves the whole spectrum of activity, from analysis and synthesis to arriving at conclusions, encourages the use of a broad range of knowledge, skills and abilities as well as the development of critical thinking. The main focus lies on self-regulated gaining 'climate competences'. Supported by animators (professors and student trainers), the students learn to integrate knowledge from different sources and to distinguish between important and less relevant data for coping with climate problems and challenges.

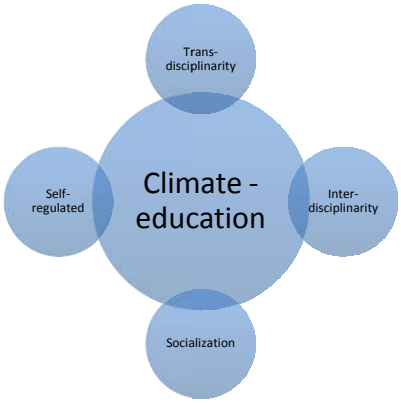

Figure 1. Characteristics for a climate education

Nevertheless, where to start? How to implement all this? Peer based-education could match all these challenges.

Peer learning for climate education

Peer learning and cooperative learning are of the most remarkable and fertile areas of theory, research, and practice in

education. There are over 900 research studies validating the effectiveness of cooperative over competitive and individualistic efforts, but the practical implementation is yet not mastered (Boud, Cohen and Sampton, 1999). Our experience is a tentative to propose a methodology applicable for climate education and sustainability.

Characteristics

Cooperative learning exists when students work together to accomplish shared learning goals (Johnson and Johnson, 1999). Each student can then achieve his or her learning goal if and only if the other group members achieve theirs. The Peer learning is a cognitive educational approach that consists in making the learner a partner in learning. It redefines the relationship between the triangle "Teacher-student-knowledge" to extend the concept of student to "student-trainer". "It is a method that consists of a series of activities that allow student participants to share their experiences, vision and knowledge about a climate challenge and then mobilize, involve and disseminate through a network of students-trainers. It presents some interesting characteristics:

Legitimacy of the peer-trainer for learners; - equality in learning through a collaboration of knowledge and between peers ; - solidarity in learning "together" rather than "alone".
The main educational theories are enthusiastic about the educational benefits of peer interaction, even they differ somewhat in their view on how peer interaction contributes to development (Damon, 1984). The Piagetian view stresses the socio-cognitive conflicts generated in peer discourse and debate. The Vygotskian view stresses the internalization of intellectual processes like verification, spontaneous generation, and criticism, all of which flourish during peer communications. The Sullivanian view, aligned partially (but in different ways) with both Piaget's and Vygotsky's views, stresses the co-construction of new ideas that occurs during peer collaboration.

Theoretical Benefits

There are many reasons that favor peer-based instruction in universities. Our review has suggested several:

- Collaboration between peers can provide a forum for discovery learning and can encourage creative thinking. The collaborative forms of peer exchange can foster discovery learning of basic concepts. Peer interaction can introduce students to the process of generating ideas and solutions with equals in an atmosphere of mutual respect. This in turn can foster an orientation toward kindness and fairness in interpersonal relationships. Through mutual feedback and debate, peers motivate one another to abandon misconceptions and search for better solutions.
- Peer learning can help underachieving groups of students overcome their motivational deficits. It consolidates and builds socio-motivational relationships, improves communication and leadership skills.
- Peer instruction favors student's personal skills by improving their attitudes toward others, enhancing their self-esteem, and providing them with constructive social experiences. The experience of peer communication can help mastering social processes, such as participation and argumentation, and cognitive processes, such as verification and criticism.
- It can aid teachers' efforts to provide individualized learning experiences for their students.
- Promoting the emergence of informal knowledge such as non-formalized knowledge, tacit knowledge.
- But, how peerlearning as educationalapproachescould help to build a collective knowledge, an ecological culture and promote pro-climate actions over the studentcommunity ?

« Students clubs » as peerlearningtool

In the following section, we discuss how the peer based-education approach throughout students organizations can serve as a ''vehicle'' towards climate awareness and culture: This approach can be seen as a ''vassal'' that brings together the appropriate forms of the interdisciplinarity, transdisciplinarity, mutual self-responsible learning, and communication in order to handle the complex problem of climate change from a teaching and research perspective as well.

« L'effet papillon » : an inter-trans-disciplinary project

'L'effetpapillon' (The butterfly effect) is a project that goal is socio-behavioral change, favoring the reintegration of the ecological dimension into our daily attitudes. We are building around the climate change and its impacts, ecology and its economies, a capacity and knowledge to understand and to act for climate and its adaptation/mitigation strategies. "L'effetpapillon" project combines research with pedagogy to promote climate culture and education. The approach aims to relocate Morocco's National Determined Contribution (NDC) in terms of mitigation and adaptation to climate change at the local and individual levels. The university IbnZohr is the biggest one in Morocco with 120000 students and covering 40% of the Moroccan territory. These characteristics give our experience a great credit.

It is a question of concretely cultivating the ecological culture in the daily life of the students, to implicate them effectively in actions designed by them and for them. It is also a question of redefining and operationalizing the role of universities in the debate and climate action through two axes:

- Strengthening students' capacities, by adding the "climate" component to their panel of skills. Universities cannot overshadow the climate challenge and must equip their laureates with appropriate knowledge and tools to contribute to mitigation / adaptation strategies. All students are concerned whatever their specialty and background. Climate Smart Education is based on educational tools adapted to the nature of the problem and to this new generation of students.
- Joining research results and findings to actions undertaken in the field by the other stakeholders. This includes, for instance, understanding the motivations and barriers to ecological involvement and pro-environmental behavior to help policy makers, corporations to launch effective campaigns.

These objectives require an inter-disciplinary approach by opening up the different institutions constituting the university and trans-disciplinary including the different stakeholders: politicians, civil society, university, companies, international community.

Figure 2. « L'effet papillon logo »

« Students clubs » to operationalize peer learning

It is up to the university teachers and researchers to be organized in a way that leads to constructive learning situations for the students based on the given complexity of the overall problem. This implies the teachers and researchers are responsible for:

- Providing the students with the information and competencies needed to have an appropriate basis for working on potential scenarios for the development of the considered case, but in extension also for;
- Supervising the students in the process of working on the case together with stakeholders by specializing and simultaneously synthesizing (How can the problem be divided into sub-problems, so that the students can handle them?

Students community is well established and well organized within the university throughout their clubs and associations. The idea here is to use these organizations, their network and their relationships to implement our butterfly effect.

Our pedagogic approach is declined in three stages (see *figure 3*):

- *Sensibilization (awareness) to climate (and CC impacts) and ecology* through organizing special events like the celebration of the earth day, environment day, inviting the different stakeholders: policy makers, scientists and researchers from different backgrounds, films projections, launching competitions (smart phone pic for climate, recycling competition etc.)
- *Training by mobilizing the student-trainer:* we chose leaders and main members from the different clubs (inter-disciplinarity) of the whole university and different specialties and different concern (social clubs, cultural, sportive, high tech, etc.) and we empower them using brainstorming technic, giving them some kit-tools to introduce the climate consideration in their objectives and mission. The aim is to spread and diffuse the
- *Tooling by setting up tools and practical knowledge to develop daily actions and attitudes.* We are launching some tools by student's active participation like: the charter for ecological student, the butterfly game and "Eurêka" competition for student green entrepreneurship.

Our project includes also Networking/clustering within university and between universities to create the necessary substrate to develop "competencies and resources network" related to climate. This positive "noise" is capital to initiate and launch projects (Daadaoui, Saoud and Mahani, project purpose for the prestigious Academy Hassan II for Sciences and Technics).

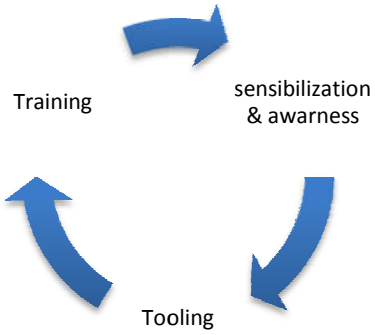

Figure 3. A threestepapproach for climateeducation

Evidences from our experience

During our two years of existence, we managed to engage a hundred students in our approach by strengthening their capacity to be student-trainers for their classmates. On the awareness component, we were able to reach several students from different institutions through the organization of events and awareness campaigns. Finally, in tooling, we made it possible to generate several ideas that gave birth to ongoing projects.From this experience, we might formulate some (1) practical contributions of peer-based education in climate context (2) guidelines for implementing this approach.

Practical contributions of peer based-education

In the specific context of climate education, the peer based-education had had several contributions in terms of cognitive benefits, commitment and affect, and new tools and methods for developing the climate skill (Table 1).

Cognitive benefits

Peer interactions are sources of cognitive development but it gives rise to socio-cognitive conflicts, as it introduces a confrontation between divergent conceptions. This confrontation, which is not necessarily "violent", is very present in Peer based-education when they bring together participants from different backgrounds and cultures. This confrontation will generate a first "inter-individual" imbalance within the working group by confronting each participant with different points of view.
What could happen concerning the definition of climate change, its consequences and the solutions. Each one thus becomes aware of his own thought, that he can, in a second

time, reconsider and evolve taking into account what the others bring him. The resolution therefore implies a relocation of the subject and a reconsideration of his own point of view through the use of arguments and communication between learners. The interaction between peers thus makes it possible to become aware of one's way of thinking and put in place tools or methods, towards climate and sustainability for instance. By becoming aware of this, the participants acquire a better knowledge of their own functioning and their singularity, its strengths and dysfunctions. But in a learning process, it is an asset to become aware of its "difference" and its capabilities because it is precisely these that will feed the process. It is also important in a peer-to-peer exchange that everyone be aware of their abilities in a particular area so that they can share them at best.

Commitment, soft skills and affect

Peer communication and exchange build on individuals' strengths and mobilize them as active participants in the climate debate - this is true for us as well as students-. Not only do helpers learn the subject better and deeper, but they also learn ethos and climate philosophy. Peer based-education has simultaneously generated learning and communication skills such as improved self-esteem and a better knowledge of one's own system, or even a taste for partnership (Stevens and Slavin, 1995). Peer exchanges and learning thus favor an improvement of self-esteem, since they develop awareness during the exchange of the singularities and skills of each while recognizing that everyone has their skills and "weak points" on which others can help. Moreover, by soliciting, "jointly the processes of transmission, appropriation and reinvestment of knowledge" (Barnier 2001 cited by Launay, 2015), peer based-education had beneficial effects on the communication skills of those who are learning but also of those who explain because it is the fact of having to structure one's thinking, reorganize one's knowledge that allows one to progress.

Guidelines for future experiences

In order to introduce peer-based education, a number of guidelines could be followed. They must be modified according to the specific nature of the subject, the context and the culture. Students are embedded within particular universities, and these latters within particular social and cultural contexts.

A number of principles have emerged from our experience to guide future development:

- All students should be encouraged to assume both the role of tutor (where they have a special competence) and the role of tutee (where they can benefit from extra instruction).
- Peer exchange should be done on a one-to-one basis.
- The same tutor and tutee should be paired together over a sustained period of time so that a personal relationship can develop between them. This is why we choose the students clubs as an operational configuration: they know each other and tight links exist already.
- The students should be from different background but have the approximately the same intellectual abilities.
- Collaboration groups may vary in size from one to five students.
- Groups should be reformed, so that different students have a chance to work together.
- The role of the supervisor in a peer collaboration group should be first to keep the student focused on the task on the topic and review with them what they have learned after the task is completed.
- Intellectual conflict between students in a collaboration group should be kept to a moderate degree: Too much or too little debate is unfavorable to progress. The supervisor here plays an important role to balance the exchange and to maintain the positive cooperation.
- Adult teachers should encourage students in collaboration groups to express verbal justifications for their disagreements with one another.
- In collaboration groups, all students should be constantly encouraged to offer solutions and express their opinions. No student should be allowed to acquire an expert status that discourages the active participation of other students in the group.

Conclusion

Educational innovations must be shaped accordingly across diverse educational contexts and subjects. Peer based-education was an ideal approach for encouraging our students to wrestle with intellectual challenges of climate change. Learning to communicate accurately through written and spoken language, grasping the logic behind scientific knowledge, joined to and realizing the political rationale underlying a societal governance system can all be fostered in a collaborative peer interaction context. Such intellectual accomplishments stretch the boundaries of university classrooms. Consequently, they flourish best under conditions of highly motivated discovery, the free exchange: of ideas, and reciprocal feedback between mutually respected equals. Inter and trans disciplinary exchange activities can be integrated in a way that leads to a self-regulated mutual learning process between the actors concerned. Students, researchers and practitioners from the project work together closely in order to find an appropriate action to the leading question of the adaptation/mitigation to climate change.

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