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**ÉCONOMIE DU DÉVELOPPEMENT DURABLE
ET DE L'ÉNERGIE**

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An assessment of the Learning
Effectiveness of Gaming**

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Janvier 2014

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Teaching Sustainable Development Issues: An Assessment of the Learning Effectiveness of Gaming

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Janvier 2014

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Abstract

The article aims at assessing the effectiveness of a role-play in addressing two concerns: clarifying the concept of sustainable development and teaching sustainable development issues. The effectiveness is gauged by surveying students to reveal how the game matches a set of “significant learning” criteria defined by Fink (2003).

Firstly, our article brings a short overview of how the concept of sustainable development has emerged and spread over time.

Secondly, in order to assess the learning potential of our role-play, we examine how it addresses the six components of Fink’s taxonomy of “significant learning”: (i) foundational knowledge, (ii) application, (iii) integration, (iv) human dimensions, (v) caring and, (vi) learning how to learn. This taxonomy is analysed through a rigorous assessment methodology.

The assessment shows that our role-play is highly praised by the players as it not only brings them foundational knowledge, but also allows them to enhance many skills. Thus, the framework of this role-play contributes to educating *about* sustainable development as well as educating *for* sustainable development.

Introduction

“Sustainable development” was coined for the first time in 1980 (IUCN 1980). Since then, the reference to sustainable development has become commonplace in everyday life and used by the general public, institutions, and private companies. Nevertheless, the concept is often misused and actions aiming at it may divert from what would adequately be qualified as a “sustainable” path.

The 2005-2014 United Nations Decade of Education for Sustainable Development (ESD) is an excellent opportunity for educators to clarify the concept with their students and develop their students' skills so that they become able to adequately address sustainable development issues. On one hand, UNESCO (2009, 2) recalls that "education for sustainable development emphasises creative and critical approaches, long-term thinking, innovation and empowerment for dealing with uncertainty, and for solving complex problems". On the other hand, poor results in terms of learning associated with "usual lecture-recitation teaching pattern" (Joseph 1970, 91) have been well known for decades (Dale 1954, 43). In this context, we have been working for seven years on developing a role-play. Its objective is to deepen the players' knowledge of the concept of sustainable development and develop the skills mentioned by UNESCO. Learners are invited to play the role of an actor officially fully involved in sustainable development and critically examine whether the approaches adopted by the other actors (players) can reasonably be qualified as sustainable.

To be realistic, our role-play reproduces round tables where real organizations confront each other, as in side events which take place in the margins of official inter-governmental meetings (e.g. at Rio + 20 conference). Thus, our tool is not a scripted role-play; it rather embeds co-construction of knowledge and skill development.

Furthermore, as recalled by Torres and Macedo (2000, 120), "Petranek's (1994) second principle of simulation and gaming states that simulation games have icebreaking capacity and open up dynamic participation; thus, simulation games should lessen resistance to accepting novel ideas and stimulate further interest in the new issue by promoting group discussion". The assessment of our role-play tends to prove this assertion.

Our article aims at showing how multifaceted the concept of sustainable development is and explaining how our game helps the audience to grasp the facets of the concept of sustainable development. It is organised in three sections. The first one addresses the definitions of the concept of sustainable development that have been elaborated since the 1970s. We present the three theoretical stylized approaches related to the respective weights of the three intertwined dimensions associated with sustainable development, i.e. economic growth, environmental constraints and social dynamics. The second section of the article focuses on the description of the role-play: its rules, sequencing, and variants. The third section addresses the learning effectiveness of the role-play, based on a rigorous assessment methodology and on the six components of the "significant learning" taxonomy developed by L. Fink (2003).

Three theoretical approaches to address the concept of sustainable development

From surveys of the history and the evolution of the concept of sustainable development (Godard 1994; Nordhaus 1994; Pezzey and Toman 2002), we show in the next subsections that the absence of consensus related to the definition of this semantically unstable concept is directly linked to the process of its generation and dissemination. In fact, the three dimensions associated with sustainable development had long been addressed separately or in pairs in the literature. It is only in the 1970s that they started being addressed holistically.

The turning point of the 1970s: the birth of the concept of sustainable development

The 1970s, named the “second decade of development”, by the United Nations General Assembly can be considered as a turning point. First, the Club of Rome’s report “The Limits to Growth” (Meadows et al. 1972) questioned and denounced the economic growth process and concluded that all growth scenarios (simulated by the “World3” model) would lead to the collapse of the global system. Even though its alarmist conclusions were criticized, it triggered the debate on the possibility of sustainable (economic) growth.

The same year, at the Stockholm Conference on Human Environment, M. Strong (Secretary-General of the conference) presented the concept of “ecodevelopment”. It was then promoted by the United Nations Environment Program (UNEP) and by the United Nations Conference on Trade and Development (UNCTAD) as follows: “conditions should be created for people to learn by themselves through practice how to make the best possible use of the specific resources of the ecosystem in which they live, how to design appropriate technologies, how to organize and educate themselves to this end” (UNEP-UNCTAD 1974, 11).

Slowly, this concept disappeared, as it was deemed radical by the international community. The semantic shift from ecodevelopment to sustainable development is considered by O. Godard (1994) as an institutional withdrawal: sustainable development does not involve the paradigmatic disruption that underlies ecodevelopment

The first official reference to sustainable development was made by the International Union for Conservation of Nature (IUCN) in 1980. In 1983, the UN General Assembly created the World Commission on Environment and Development chaired by G. H. Brundtland to tackle the issue of the deterioration of the environment and the depletion of natural resources and their consequences on economic and social development. In 1987, the Brundtland Report coined sustainable development as: “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED 1987, 43). Thus: “sustainable development is a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations” (WCED 1987, 46). The economic, social, and environmental spheres, which have become the three pillars of sustainable development, appeared in filigree. Furthermore, the report emphasized the need for equity in two complementary ways: intergenerational equity and intragenerational equity, without precisely specifying how to deal with it.

Three theoretical stylized approaches to sustainable development

From a theoretical standpoint, three main approaches address sustainable development differently, depending on the sphere to which more emphasis is given. A first approach focuses on the economic sphere; we could thus depict it as “econocentric” (Gowdy and O’Hara 1997, 240). It is related to the neoclassical theory of equilibrium and growth. In brief, authors defending this approach consider environmental problems as externalities due to failures in the allocation system. They identify conditions for an economically optimal exploitation of resources and its implication for the evolution of well being (Solow 1974; Nordhaus 1994). Sustainability means “non declining utility” (Pezzey 1992, 14). This is close to the definition of income brought by Hicks when he identified the conditions for a long term

wealth increase: income is “the amount which they [people] can consume without impoverishing themselves” (Hicks 2001 [1939], 172).

The second theoretical school brings a “biocentric” vision focused on the supremacy of the environmental sphere. The proponents of “ecological economics” and “bioeconomics” reject the vision of an economic sphere “disembedded” from the two others. As early as in the 1960s, K. E. Boulding (1966) opposed a “close economy” to the prevailing “open economy” (which he identified as a “cowboy economy”) and developed an analogy to represent the earth as a spaceship with limited reservoirs of resources and limited carrying capacity of pollution. Nicholas Georgescu-Roegen (1971) defends the alienation of the economic process to thermodynamic rules such as the “entropy law”. Using various concepts developed in natural sciences, ecological economists argue that the social and economic spheres are conditioned by the environmental one (Daly 1990; Daly 2006).

On top of the central place given to the market to allocate resources or to solve externality problems, another major difference between the neoclassical school and ecological economics lies in the substitutability between different kinds of capital. According to the first school, natural capital and man-made reproducible capital are substitutable, whereas ecological economists view them as complementary rather than substitutable (Daly 1996). These different views have led to referring respectively to weak versus strong sustainability.

The third theoretical school, the ecodevelopment’s approach introduced above, is “anthropocentric”: it insists on the supremacy of the social sphere over the environmental sphere and, finally, the economic sphere. Theoretically explored by I. Sachs (1980), ecodevelopment can be defined as a programmatic progress and, above all, as the willingness to reconcile economic development, environment preservation and social progress. To him, the following conditions are central: (i) the satisfaction of basic needs of the poor, especially in developing countries; (ii) the adoption of lifestyles and technologies compatible with each “ecozone” and the autonomy in decision making; (iii) ecological wisdom; (iv) citizen participation; (v) planning at the level of human communities.

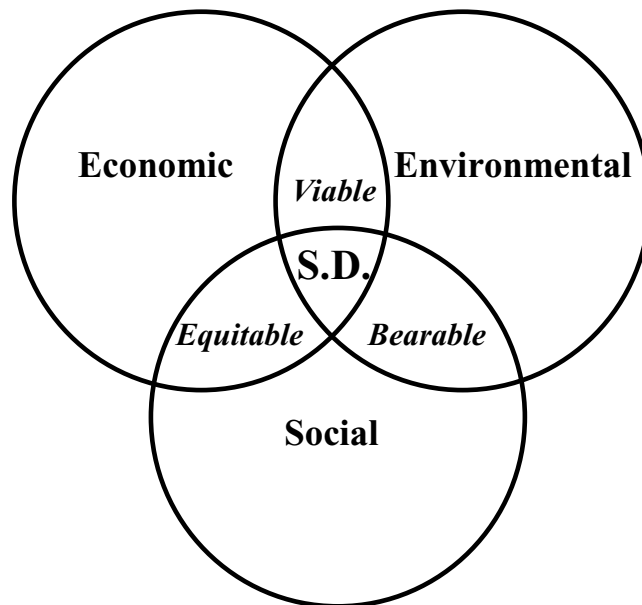
In addition to the debates within the research community, the reference to sustainable development has become common place in institutional meetings as well as within the civil society: it is presently part of collective rhetoric. When reviewing the various definitions of sustainable development, the US National Research Council (1999, 23) noted that its proponents put different emphasis on “(i) what is to be sustained, (ii) what is to be developed, (iii) the types of links that should hold between the entities to be sustained and the entities to be developed, and (iv) the extent of the future envisioned”.

The concept of sustainable development is obviously equivocal, protean and not universally understood (Nordhaus 1994) while it is overused. This is why we believe that the first step towards designing Education for Sustainable Development should entail understanding its polysemy. The game that we have created is meant to reach this goal (Buchs and Blanchard 2011).

Role-playing description

The synthetic view of sustainable development presented in figure 1, though very restrictive and open to criticism, physically shapes the role-play. The three dimensions, economic, social and environmental, are intertwined.

Figure 1: a synthetic representation of the three spheres of sustainable development



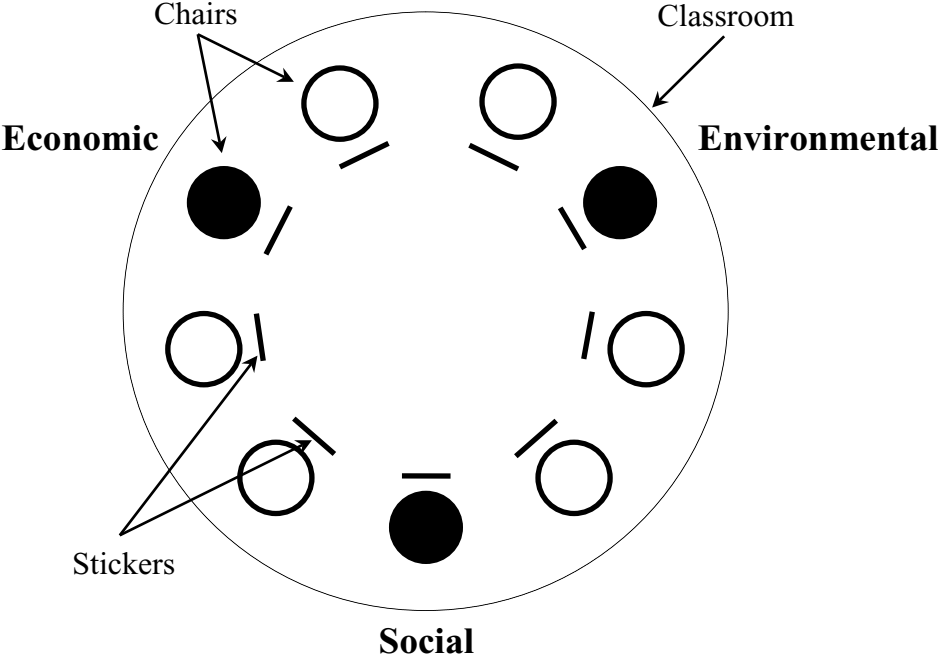
Role-play description and sequencing

The role-play's target is graduate students who have previously been taught about the concept of sustainable development, and have attended classes on related topics. However, variants of the role-play make it accessible to other audiences, from middle-school students to adults. The ideal number of players is 12 but the role-play is relevant between 9 and 18 participants. The whole session lasts between two and three hours, depending on the number of players.

Before playing, students are required to work individually for about a month, while the class on topics relating to sustainable development unfolds. They have to retrieve information concerning an organization that has been randomly assigned to them and is undisclosed to other players. At that time, they do not know anything about the role-play. At the end of this preliminary phase, they have to hand in a four-page assignment, which comprises three parts: (i) the organization's official view / discourse / strategy on sustainable development issues, (ii) a short review of a concept that is related to sustainable development and the organization that has been assigned to them (iii) a critical assessment of the information collected. Studying a specific concept associated with sustainable development deepens the students' knowledge around sustainable development issues. The four-page document does not reflect the work load associated with the information gathering and analysis tasks. Instead, it only acts as a memo that has to be clear and concise. Such an exercise is designed both to develop the students' synthesis skills, and to help them in the perspective of the role-play.

Before the role-play starts, the teacher prepares the classroom to materialise the three dimensions of sustainable development with chairs and stickers that are posted on the floor (figure 2). There should be a chair for each participant.

Figure 2: classroom setting of the role-play



Each sticker signals two dimensions: the major sphere is indicated in capital letters, while the minor sphere appears in lower cases (e.g. ECONOMIC-social, SOCIAL-environmental, etc). The major sphere relates to the organization’s core activities, the minor sphere reflects the main area affected by the organization’s sustainable development strategy. The stickers frame a circle covering all the possible MAJOR-minor spheres combinations. Table 1 shows examples of organizations that have been assigned to students over the years, the spheres that the organization is expected to illustrate, and one of the associated concepts that students have explored.

Table 1: Examples of organizations represented in the role-play

Organization	Core activity	Suggested MAJOR-minor spheres	Suggested associated concept
<i>BP</i>	International oil and gas company, petrochemicals manufacturer	ECO-eco	Corporate social responsibility
<i>Grameen Bank</i>	Bank offering financial services to the poor, to help them fight poverty, remaining profitable	ECO-soc	Micro-credit
<i>Mobility Car Sharing</i>	Car-sharing company	ECO-env	Energy efficiency
<i>WWF (World Wide Fund for Nature)</i>	International environmental organization	ENV-env	Grassroot movement
<i>The Carbon Neutral Company</i>	Company providing carbon reduction solutions to companies	ENV-eco	Carbon offsets
<i>World Resources Institute</i>	NGO aiming at protecting the earth, promoting development, and advancing social equity	ENV-soc	Climate justice
<i>Human Rights Watch</i>	International organization defending and protecting human rights	SOC-soc	Human rights
<i>Oxfam</i>	Confederation of organizations aiming at ending poverty and injustice	SOC-eco	Food security
<i>Bard Center for Environmental Policy</i>	Graduate studies program at Bard College, NY, USA, offering a degree in environmental policy or climate science and policy	SOC-env	Environmental education

Note: Students may well choose other concepts than the ones suggested in the table. But they must get an agreement from the instructor about the relevance of their concept.

Source: Authors.

The participants, acting as decision makers, have to prepare a five-minute speech emphasizing how their organization is addressing sustainable development issues and including the related concept that they have previously selected. They are not allowed to dig into the article they have handed in, so as to make their speech spontaneous and creative. Then they have to choose the chair that faces the sticker that best matches their view of the organization’s sustainable development approach, according to the content of the speech they intend to deliver. They are allowed to move chairs if they think that it is relevant.

When all the students are seated, a first round of the role-play may start. The instructor selects the student who will start role-playing e.g. the student representing the most famous organization of the panel, or the student with the best communication skills. Students are invited in turn to deliver the speech that they have prepared. They must address the previous participants’ speech, so as to make the role-play livelier (e.g. build a partnership between Oxfam and Grameen Bank). At the end of their speech, they must justify their sticker positioning. Furthermore, while a student is role-playing, other students may ask short questions or very briefly react. Finally, the student who is sitting opposite in the circle must silently analyze whether the speech delivered is consistent with the place the speaking student has chosen, i.e. consistent with the indications on the sticker.

This feedback is used as an introduction to the second round of the role-play. After listening to the feedback of the student sitting opposite to them, participants have to address the criticisms about their positioning as well as the verbal attacks that may have been expressed against their organization in the first round.

The teacher does not intervene at all in the two rounds, except to make sure that the time limits are respected. The last sequence of the session is devoted to wrapping up what the students have learned about the concept of sustainable development as well as its related concepts. The teacher may tackle questions in the concluding phase, so as to raise the students' awareness of some points that they might have overlooked otherwise.

The stickers are a pedagogical tool of the role-play, as the students have to role-play according to the position (MAJOR SPHERE-minor sphere) that they have adopted, and justify their positioning. Depending on the students' presentation of the sustainable development strategy of their organization, it may well happen for example that a multinational firm such as BP be positioned in the ECONOMIC-social or ECONOMIC-environmental spheres. Although initially the instructor has purposely not proposed to the students that they can sit in the middle, at the intersection of the three spheres, some students may spontaneously decide to do so, deeming that their organization's sustainable development strategy covers the three spheres. As a consequence, students may want to move some of the chairs that have initially been positioned by the instructor around the circle. Some positions may be "congested" while some others deserted. The (ir)relevance of the students' position choices raises fruitful debates during the role-play.

A role-play to assess or to explore the concept of sustainable development

The game has been designed for students in social sciences, in the context of a course that addresses environmental economics and policies. Nevertheless, the role-play can be used as groundwork for a novice audience.

Several variants of the role-play may be considered, depending on the audience and its prior awareness of the concept of sustainable development. For example, the role-play may be performed as an introduction to a course on sustainable development. The goal is fourfold: raising the students' interest in class content; showing the students the diversity of organizations that claim aiming at sustainable development although their strategy and actions do not focus on the three pillars of sustainable development; sharpening the critical and debating skills of the participants; giving the teacher an overview of the students' awareness and knowledge about the concept. In this variant, students do not prepare any work before the role-play and do not explore concepts relating to the organizations. At the beginning of the role-play session, they are randomly assigned an organization and given a short note about its core activities. The organizations selected by the teacher are well-known, so that the students may have some prior knowledge about them. Students have 15 minutes to prepare their arguments and build their role.

Learning effectiveness of the role-play

As M. Sutcliffe (2002) recalls it, many studies have shown that role-plays contribute to a positive change in classroom dynamics. In addition, they are fruitful tools to teach (and, thus, to learn) economics in general (Gremmen and Potters 1997) and sustainable development in particular (Dieleman and Huisingsh 2006). In order to assess the learning potential of our role-play, we analyze below how it addresses the six components of Fink's taxonomy of "significant learning": (i) foundational knowledge, (ii) application, (iii) integration, (iv) human dimensions, (v) caring and, (vi) learning how to learn.

Assessment process

The learning effectiveness of the role-play was evaluated through an anonymous online questionnaire assessing the impact of the role-play. For each question, four impact levels were suggested: (1) No/poor impact; (2) Small/fair impact; (3) Significant/satisfactory impact; (4) Large/excellent impact.

Overall 179 students (9 classes) have been invited over two years to assess the impact of the role-play. All of them were graduate students in economics, 95 % aged between 22 and 30 years. The questions addressed issues relating to knowledge content, critical thinking development, self-assertiveness development, and behavioural change relative to the use of the concept of sustainable development. Comments were elicited. 72 students, i.e. 40 % of the targeted population, have responded over the two years. It is quite a good rate, as the students had no other incentive to fill in the questionnaire than giving feedback to the instructors so that the game could be improved over the following years.

Results

The results of the anonymous online questionnaire are summarized in table 2. For each item of Fink's taxonomy we present the related questions of the questionnaire and the results as percentages.

Foundational knowledge "refers to students' ability to understand and remember specific information and ideas". It provides the key understanding that is necessary for other kind of learning (Fink 2002, 32). We consider this item as the most crucial one. Two questions of our questionnaire assess the learning potential of the role-play in terms of foundational knowledge. They deal with the general content of the role-play compared to the rest of the syllabus and with the specific knowledge on the concept of sustainable development. Results show that both are considered beneficial. If we group answers by two, considering on the one hand, answers 1 and 2 (poor impact/fair impact) and on the other hand, answers 3 and 4 (significant impact/large impact), results show that students assess the role-play as a useful tool to enhance foundational knowledge: 86 % emphasize that the game brought additional content to the semester course and 59 % mention that the game helped them to deepen the concept of sustainable development.

The comments that students have freely added to the closed questions show that they benefit in multiple ways from the work they have carried out prior to the role-play, as they get a vision of the organization that has been assigned to them and of the main issues relating to the field in which it is acting. They also deepen their knowledge of the concept of sustainable development as they have to compare the approach adopted by their organization to what they have already heard about sustainable development in previous classes: they often realize that the dimensions associated with sustainable development spread beyond the basic economic, environmental and social tripod, into cultural and ethical spheres. Moreover, they get further knowledge from what the other participants bring up during the role-play, including from the discussion in the wrap-up session. Our tool therefore teaches a few theoretical snapshots, practical concepts, and key issues related to sustainable development, in addition to the

expected basic knowledge acquisition. In all these respects, our role-play is a contribution to education *about* sustainable development.

Fink's second item, application, refers to the process of learning how to engage in different kinds of thinking and to the development of different skills (Fink 2002, 32). When role-playing, students use many skills: creativity (their presentations should be lively and spur reactions); communication (their messages should be clearly enunciated and understood); remaining focused (when listening to the others) and critical thinking (fruitful interactions with the others).

Considering this item, the role-play appears to be ambivalent. It clearly helps in developing critical thinking: 54% consider the impact of the role-play as satisfactory and significant (up to 79% grouping answers 3 and 4). Nevertheless, in terms of development of the skills directly linked to expression and to the way to communicate, the role-play is estimated to have a small impact (40% grouping answers 3 and 4). As the game session is short and each student takes the floor for a limited time, we reckon that students cannot much improve their communication skills.

Table 2: Assessment of the role-play by students

Items of Fink's taxonomy	Questions	Answers (%)			
		1	2	3	4
<i>Foundational knowledge</i>	General content with regards to the class	1.4	12.5	70.8	15.3
	Specific knowledge about the concept of sustainable development	4.1	36.7	38.8	20.4
<i>Application</i>	Development of critical thinking	2.8	18.1	54.2	25
	Improvement of your expression and way to communicate	9.7	50	29.2	11.1
<i>Integration</i>	Group cohesion	16.3	38.8	38.8	6.1
<i>Human dimensions</i>	Your capacity to consider others' opinions	5.6	34.7	50	9.7
	Enhancing your assertiveness	5.6	43.1	44.4	6.9
	Your capacity to convince	11.1	38.9	41.7	8.3
<i>Caring</i>	Your future behaviour with regards to the concept of sustainable development	0	8.7	52.2	39.1
<i>Learning how to learn</i>	The relevance of the game sequence (from survey to role-play) as a learning method	6.1	18.4	42.9	32.7

Note: grey cells indicate the highest score.

Source: Authors' data, gathered through anonymous online questionnaires.

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Integration comes from the interactions between students during the role-play. Since the organizations that have been carefully selected by the teacher are complementary, interactions are easily fostered. Still the impact of the game on integration is gauged positively only by 45 % of the respondents, as the students have known each other for several weeks before the game: the three-hour role-play does not bring much extra group cohesion. When using the role-play as an introduction (as in the variant presented above), we experienced that it becomes an effective ice-breaking tool (e.g. some students are nicknamed according to their role in the role-play for the rest of the semester).

Human dimensions are enhanced during the role-play. L. Fink (2002, 32-33) states that: "when students learn something important about themselves or about others, it enables them to function and interact more effectively". Human dimensions are related to the "human significance" of what they are learning.

When delivering their speech, students learn about themselves: they may realize that they are good orators, persuasive, creative, or conversely poor in these respects. Students also learn about the other participants: they may discover them in ways that they had not perceived so far. This complex item is hard to assess quantitatively. Nevertheless, results show that the role-play is relatively fruitful for enhancing social and personal aptitudes. When asked about the improvement of the capacity to consider others' opinions, 60% evaluate the contribution of the role-play as significant (considering answers 3 and 4). Similarly, 51% declare that the

role-play contributes to increasing their assertiveness and 50 % think that the role-play helps them to enhance their capacity to convince. These relatively low scores can be linked to the short duration- and “one shot-” dimensions of the game.

Caring “may be reflected in the form of new feelings, interests, or values. Any of these changes means students now care about something to a greater degree than they did before, or in a different way” (Fink 2002, 33). Here, we want to appreciate the potential changes in students’ behaviour with regards to the concept of sustainable development. Grouping answers 3 and 4, 91% consider the role-play as significant to make them change. The respondents pledge that they will endeavour to refer to the concept of “sustainable development” adequately, not across the board. They also state that they will keep a critical eye on how “sustainable development” is used –and misused- in everyday life as well as in academic or professional arenas.

As far as learning to learn strategies are concerned, 76 % of the respondents find that the game contributes positively. In their comments, students report that they appreciate the integrated learning process that spans from studying numerous information sources and documents over a few weeks, to synthesizing information in the written assessment, to preparing relevant arguments to defend their position during their speech, and to critically examining the others’ position. They wish that the learning process of more courses encompass all those learning dimensions.

Conclusion

Historically, the concept of sustainable development was built in the 1980s, and born from debates on economic growth, the nature of development, and the use of natural resources. The term has spread rapidly and is now common place in multiple arenas. However, its meaning varies widely depending on who uses it and on which of the three basic economic, environmental and social spheres primary emphasis is put. This semantic instability makes it difficult for students and the general public to grasp the stakes behind the concept. In this context, the simulation game that we have created aims at deepening the knowledge of the concept of sustainable development and other related notions, i.e. at educating *about* sustainable development. Meanwhile, the participants are given the opportunity to develop many skills, to interact with the other players, learn about themselves, become more responsible citizens, and learn to learn: the role-play also aims at educating *for* sustainable development (Karatzoglou 2013). Results show that its contribution to the improvement of human skills is limited. This is mainly due to the fact that the game is a one-shot event that lasts only three hours.

This role-play provides substantial added value in terms of knowledge gain and teaching method because it enables students to understand the concept of sustainable development in a less normative format. It may also contribute to develop the players’ personal skills. The relevance of this role-play is less linked to its innovative gaming architecture than to the way it offers an incremental method to clarify concepts, and deepen the players’ knowledge around sustainable development issues.

Gaming obviously offers a relevant way to cope with the concept of sustainable development. Indeed, as stated by Ahamer (2013, 294), who addresses the role of gaming to cope with climate change, “coevolution of facts and the values for assessment of facts create shifting

fundamentals and moving targets that hamper the approaches of traditional science”. Our role-play reinforces this statement as it lies on co-construction of knowledge. It complements other teaching approaches to learning about and for sustainable development such as the ones developed by Raufflet et al. (2009).

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