

The impact of multimodal learning environments on the development of creativity

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This paper seeks insight into the impact of multimodal learning environments on the development of creativity. It draws on a case study of a three-day workshop 'Creativity and Innovation' held with first year Master's students at the Graduate School of Management of Grenoble Alpes University. The goal of the workshop was to accompany students, through the use of Creative Problem Solving (CPS) techniques, in finding creative and innovative solutions in a real-life problem-solving task: to come up with an idea of an efficient system that would allow a long-term cooperation between students and the Sustainable Planning Office (SPO) for enhancing the sustainable planning of the campus. To this end, students were placed in a multimodal learning environment: designed with a wide range of multimodal practices (individual and team-work in small and large groups; rotation of group members; collective intelligence games; brainstorming; role-play; story-telling, etc.); working in multidisciplinary groups (students majoring in different fields); and were asked to provide multimodal productions (posters; oral presentations; 'product boxes', etc.). Participants were explicitly asked to use written language in their productions the least possible. Drawing on the analyses of the learning environment and learners' multimodal productions, the study aims at contributing to the understanding of the impact of multimodal learning environments on the development of learner creativity.

KEYWORDS

Multimodal learning environments; situated multimodal practice; multimodal productions; creative problem solving (CPS); development of creativity

1. Introduction

Although multimodality research has been gaining ground only over the past few decades, 'it addresses a phenomenon which is as old as representation itself and crucial to an under-

standing of almost all forms of communication' (Stöckl 2004: 9). Indeed, human communication and representation have always been multimodal by nature and the recent interest in multimodality is seen as the late discovery of the obvious (cf. Kress and Van Leeuwen 2001; Ventola et al. 2004; Stöckl 2004; Iedema 2003). Stöckl (2004:10) accounts for the focus on language as the standard and dominant form of communication by the lack of adequate models for the analysis of other modes and puts forward two models of multimodal analysis for printed as well as TV and film media.

Considering that with the development of new technologies multimodality has taken an even greater place in everyday communication, 'the multimodal literacy needs of students are stretching the ability of teachers to support them' (Ventola et al. 2004: 2). Thus along with the domains of media and communication, multimodality is increasingly prevalent in education. Guo (2004: 215), for instance, suggests that 'teachers and researchers need to take seriously the multimodal nature of meaning making in academic apprenticeship and professional life and refocus our research and teaching agenda to better prepare our students for their current and future academic and professional life'. While discussing the new multimodal opportunities for language teaching, Kaltenbacher points to the:

growing pressure on teachers at all types of educational institutions to make extensive use of IT and the new media in their classrooms. This is due both to the IT industry's lobbying of governmental and educational authorities to spend more money on training pupils and students on computer-based products, as well as the wide-spread public belief that if something is 'multimedia', it is also automatically good. (2004: 120)

In a study on the impact of new media and information technologies on learning and teaching (2004), he warns against delivering multimodality in education in a way that actually disrupts learning. The findings of his study point to the need for carefully designing multimodal experiences for learners that are based on deliberate thought or on a didactic concept, rather than on chance. While the author quite rightly questions the efficacy of the massive use of the new media in classrooms, he also brings up a common ambiguity linked with the idea of multimodality.

When it comes to educational practices, more often than not multimodality is associated with and sometimes even equated to technology-mediated learning (cf. Sankey et. al 2010). However, although the notion of multimodality goes hand in hand with that of multimediality, one should be careful not to reduce the former to the latter. In a similar stance, Shipka (2011) has critiqued the way multimodality is conflated with digitality. Indeed, in view of the relatively recent development of multimodality research, the terms mode and modality still lack precision.

The notion of modality is often reduced to sensory modes. Thus, while referring to multimodal learning environments, Sankey states: 'multimodal learning environments allow in-

structional elements to be presented in more than one sensory mode (visual, aural, written).’ (Sankey et al. 2010: 853)

The conventional notion of mode governing linguistic communication is grounded on the idea of mode as a way in which language is used and therefore implies speaking, listening, reading and writing. The term ‘mode’ is also used to conflate with different channels of oral and written communication (telephone, face-to-face, fax, email, letters, etc.). This approach is based on tools and technology-mediated channels involved in communicative acts. Furthermore, formats of communication (e.g. presentation as opposed to conversation or interview) can also be considered as a mode of communication. Kress and Van Leeuwen (2001: 21-22) define modes as ‘semiotic resources’ that ‘can be realized in more than one production medium’. In a more socio-cultural view, Kress (2010: 79) defines mode as ‘socially shaped and culturally given semiotic resource for making meaning’.

However, as Prior (2005) argues, while addressing the notion of multimodality Kress’s focus on artifacts rather than practices is problematic. In line with Prior’s view, the present study endeavors to explore multimodality in education in a wider sense, as referring to ‘communicative artefacts and processes which combine various sign systems (modes) and whose production and reception calls upon the communicators to semantically and formally interrelate all sign repertoires present’. (Stöckl 2004: 9)

As pointed out by Prior (2013: 523) ‘A striking feature of [...] multimodality studies in general, is the almost exclusive focus on texts and other semiotic objects. Multimodality studies rarely involve close attention to how people make, distribute, or use multimodal texts and objects.’ Indeed, multimodal meaning-making practices as such have still not received sufficient attention in the field of multimodality research. This paper advocates the need for such studies and attempts to contribute to the field by placing multimodal practice at its core and refocusing multimodality research attention to situations of use and the complex dynamics of situated semiotic activity. On a similar vein, practice-oriented approaches to multimodality research and discourse analysis are noted in Norris (2004), Scollon (2008) and Johns (1998).

Furthermore, while most studies on multimodal learning environments focus on the input, that is to say, on the content material as well as the design and delivery of teaching (what and how to teach) (cf. Baldry 2000; Jochems, van Merriënboer and Koper 2005), the present study adopts a shift in perspective and enquires into learning and not teaching practices, though the two are intimately linked. The focus of the present study is the learners’ experience of multimodal practices, as well as the learning outcome (multimodal productions), i.e. what and how students learn in a multimodal environment.

Finally, while multimodality has mainly been treated as an approach to analysis (resulting in Multimodal Discourse Analysis), this paper addresses the issue as an approach to learning. Multimodality as an approach to learning is a relatively new issue and is therefore fairly under-researched. For this reason, the present study attempts to contribute to understanding

how situated multimodal practices can open up new opportunities for learners to actively and naturally engage in learning-processes, and thereby enhance their motivation and develop skills, such as creativity and multimodal literacy.

After presenting the research method and the framework of analysis in the opening sections, we will proceed with presenting the research tools that served for data collection. Some qualitative findings will be discussed in section five that falls into two sub-sections: the first focuses on the multimodal practices comprising the learning environment, while the second – on learners' multimodal productions. The limitations of the present study as well as some directions for further research will be considered in the concluding part.

2. Research Context

Grenoble Alpes University ranks first in France and the eighth in Europe² in terms of campus layout. Situated in the French city of Grenoble, the university sits adjacent to the French Alps and counts three mountain ranges as part of its campus. With its complex layout and onsite management system it is truly a city within a city. A special unit was thus created to deal with these involved tasks. It is the Sustainable Planning Office (SPO) that operates with in-house staff members and a number of external service providers. However, the SPO has been confronted with a real problem that of motivating students to commit to participating in the sustainable management of their campus. The SPO thus asked the participants of a creativity workshop to come up with innovative and creative solutions as to how to motivate students to commit.

This paper presents the findings of a case study carried out within the framework of this workshop organized by the Graduate School of Management of Grenoble Alpes University. The workshop aims at training learners to use creative problem solving (CPS) techniques in finding innovative solutions to real-life problems. It is organized yearly within a very brief but intense period of time, i.e. three seven-hour days. Participants are given a research problem on the first day and need to come up with an innovative solution on the second day. A material representation (poster, video, product box, etc.) of the proposed solution along with an oral presentation of it are to be made by the end of the third day.

A wide range of learning practices deriving from the theory of CPS are used in the workshop to accompany students in acquiring tools and techniques, and accomplishing tangible learning outcomes. There are more than a hundred participants that work in small groups of four to five students majoring in different fields, and each teacher is in charge of three to four of such groups. The present case study concerns fourteen participants that worked in three groups. In what follows, the research focus and methodology are presented.

3. Aim and Methodology

The paper reports on a case study designed to gain insight into the impact of multimodal learning environments on the development of creativity. As mentioned, it conceives of a multimodal learning environment as being comprised of both multimodal practices and multimodal productions. As for the idea of creativity, its use in the present study is twofold: it refers both to the creative and innovative nature of the proposed solutions and the choice and combination of semiotic resources used to construct multimodal representations in order to communicate about the given solutions.

In the perspective of establishing a connecting relationship between a multimodal learning environment and the development of learners' creativity, the following research question was addressed: does a multimodal learning environment involving multimodal communicative practices and multimodal assignments positively affect learners' creativity?

The multimodal learning environment was analyzed through learner evaluations of its different aspects, while learners' creativity was explored through the analysis of their multimodal productions. Such method of analysis was determined by the fact that learner-centeredness was key to the design of the present research.

In an exploratory approach, a case study was carried out with fourteen participants. This could seem as a rather limited sample in order to be considered as representative, however, the study was conceived adopting a qualitative, exploratory approach and to compensate for this limitation its findings were put to test in two further case studies with eight and ten participants respectively. By adopting this method, we were looking for qualitative insights into our research question.

4. Research data and interpretative framework

The research draws on two sets of data: learner evaluations in a questionnaire survey and multimodal artifacts produced in specific pedagogical assignments.

The questionnaire survey was submitted to learners at the end of the workshop and sought to elicit learner evaluations of different components of the learning environment. Taking into account highly disparate levels of English of the participants and the fact that the workshop was carried out in French, the questionnaire was also conceived in French. It was comprised of questions pertaining to different aspects of the design of the learning environment. These constitute the analytical categories under which the results of the questionnaire are discussed in the first part of section five. In particular, communicative practices directly and explicitly linked with the solution of the problem (individual vs. small and large group work; rotation of group members; brainstorming; learning-by-doing) and those indirectly and implicitly affect-

ing the problem-solving process (collective intelligence games; working in multidisciplinary groups and audio-visual stimuli used to enrich the learning environment).

The use of a questionnaire survey to evaluate the learning environment derived quite naturally from the overall learner-centeredness of the study. Furthermore, this method, with its underlying self-reflecting processes, was aimed at helping learners enhance their overall multimodal literacy by (a) developing awareness of meaning-making processes in a multimodal perspective and (b) understanding the significance of multimodal practices. As Kress (2003: 24) argues in meaning-making processes it is vital to understand 'the meaning-potentials of the resources as precisely and as explicitly as we can' in order to be able to choose consciously the most appropriate semiotic resource to make and represent meaning.

Similarly, in order to be able to make the utmost use of the semiotic potential of each mode and develop one's creativity in combining them to represent meaning, learners need to be aware of the meaning-making potential of each semiotic mode. Such awareness is believed to develop their creativity.

The feedback on learners' experience collected through the questionnaire survey was then confronted with our observation of classroom interactions. By adopting the observational analysis of situated semiotic practices, the paper aims at contributing to the theory of multimodal communication. For as Prior argues:

Although multimodality studies [has] argued for attention to practice, analyses have focused attention almost exclusively on texts, screens, and semiotic objects. Where practices are mentioned, they are almost always inferred from, or imagined off, the pages, screens, and three-dimensional objects under analysis as opposed to being described through observational and ethnographic attention to the dynamics of situated semiotic activity. (2013: 524)

Multimodal artifacts, constituting the second set of data, were learner productions conceived in specific pedagogical assignments throughout the workshop. To evaluate the development of the learners' capacity to creatively combine different semiotic resources in meaning-making processes and in constructing multimodal representations, two sets of artifacts were chosen for analysis, those produced at the very first and final stages of the workshop and which were labeled respectively as 'initial' and 'final' productions.

These were analyzed within the interpretative framework as suggested by Stöckl (2004). The specific framework of analysis was chosen as it draws on the idea of mode and modality as advocated in this paper, that is, integrating views on mode as a sensory channel (visual, auditory, etc.) and a semiotic resource (verbal and non verbal). Furthermore, it offers the possibility of a detailed analysis integrating criteria, such as medial variants of semiotic modes (static and moving images, spoken and written language); peripheral modes (typography, layout); sub-modes (font, type size; color; composition, perspective, etc.) and features (differentiation hue, contrast, etc.).

Section five below presents some qualitative findings focusing first on the results of the questionnaire survey and then on learners' multimodal productions.

5. Findings and Discussion

The results of the questionnaire survey are presented below based on the analytical categories as explained above.

5.1. Multimodal learning environment: results of the questionnaire survey

Design as described by Kress and Van Leeuwen (2001: 45) stands for 'a deliberateness about choosing the modes for representation'. Similarly, design of learning environments implies a thoughtful and deliberate choice of the modes of communication between the learner and teacher, as well as among learners or groups of learners. The questionnaire that was submitted to learners comprised questions relative to multimodal practices included in the design of the workshop. Learners were offered opportunities to engage in situated multimodal practices to experience different learning modalities, which extensively involved social interaction. In what follows, the results of the survey are presented under subsections pertaining to different multimodal practices that learners were brought to experience throughout the workshop.

Individual vs. small and large group work

Learners were brought to work individually and subsequently in small and large groups. The switch between learning modalities enabled them to share and exchange ideas efficiently. An efficient cross-fertilization of ideas was made possible due to the fact that group members who had their own, often fixed ideas, while discussing with each other, were able to bounce ideas off each other and build on each other's ideas to ultimately come up with a completely new idea. In this sense, the diversity of learning modalities entailed a diversity of modes of thinking.

The work in small groups was felt as interactive. It helped establish confidence among group members and facilitated communication. Learners were more disposed to open-up and share ideas with their group-mates, before presenting them in front of a larger group.

In large groups, while each sub-group presented their own solution, the other sub-groups provided feedback, highlighting the positive and negative aspects of the proposed solution. Ideas were exposed to helpful and constructive criticism of peers. Strengths and weakness of an idea or solution were identified, which allowed improvement.

Rotation of group members

Once each sub-group came up with a solution, there was a rotation of group members.

In a short exercise (fifteen to twenty minutes), learners changed groups every five minutes so that each learner had the chance to participate in discussions in each of the sub-groups. This learning modality involved time constraint (which was felt as efficient for generating ideas) and multimodal communication. As learners changed groups, participants provided explanations to new members of the group orally and through graphical representations (writing, drawings, etc.). The new members were encouraged to complete the drawings and suggest new ideas.

Rotation of group members proved to be productive as it ensured continuous improvement of the creative process, fueling the initial solution with new ideas. The advantages of this mode of communication are double-sided. On the one hand, for the members who leave their group and join new groups and thereby new research questions: this allows learners to take a step back on their own problem and come back to it with a new perspective. Furthermore, learners discover the research tools and methods adopted by other groups and get the chance to apply those to their own problem.

On the other hand, for the team who welcomes new members: firstly, this provides an opportunity of explaining how the issue was understood and addressed, present and justify the methods and tools that were used and possibly the obtained results. This communicative practice brings an undeniable cognitive benefit, that of enhanced clarity, for in the process of explanation and the search for clarity in order to make the problem and the adopted approach comprehensible for the others, these become clearer for those who explain. Secondly, when sharing one's ideas, there is a real questioning and the possibility of exposing oneself to criticism. Then comes the need to find arguments to back one's viewpoint or modify it in case convincing arguments couldn't be found. And finally, this particular communicative practice offers new perspectives and allows for external viewpoints to be integrated in the problem solving process. Hence the possibilities of harnessing ideas are amplified and participants are given the chance to tap into each other's ideas, skills and knowledge so as to come up with innovative and creative solutions to their problem.

Brainstorming through post-it notes

One of the communicative practices broadly used among learners within the framework of this workshop was ideation and brainstorming using post-it notes. Participants were asked to produce as many ideas as possible, writing only one idea per post-it note. First, each learner wrote their own ideas individually, without showing them to the others, in order not to influence their group-mates. Then, each participant shared their ideas with the group, orally explaining each idea and displaying it on a board. The use of post-it notes, that was implemented to stimulate the brainstorming process, was largely commented by learners as having a positive impact on their creativity.

The post-it based activity rendered learning particularly dynamic. Participants were encouraged to produce as many ideas as possible, which gave them little time to judge their own

ideas and therefore censure them in the belief that the others could judge their ideas. In this multimodal communicative practice, new ideas were often born by combining and establishing links between two different ideas, which constitutes the very basis of innovation. In this process ideas took shape, were materialized and became tangible. To put them down on a piece of paper meant these could be thrown away easily as well. So participants did not really attach much importance to their own ideas, and didn't judge them. As will be demonstrated further this point is of particular importance for the development of what Kelley (2013: 9-10) calls 'creativity confidence' which lies at the very heart of one's capacity to be creative.

One undeniable drawback of this communicative practice is of course its failure to meet the environmental concerns by using so many post-it notes (one post-it note per idea, instead of writing several ideas on a single post-it note). But this process helps organize and reorganize ideas easily. Once all the ideas are displayed on the board, participants can see different categories emerge and organize or re-organize their thought and problem-solving process as many times as necessary. One possible argument for this multimodal learning practice could be the idea that post-it notes can and should be recycled at the end of the workshop.

Learning-by-Doing

After being given a brief theoretical background on the CPS techniques, learners were brought to practice them through learning-by-doing method. When it came to evaluating this learning modality, some frustration was said to have been experienced by the participants in the beginning because of a lack of confidence in their skills and the capacity to fulfill the task on their own. However, once the participants managed to tap into their own resources to accomplish a task, they regained confidence in themselves and considered this mode of learning as the most efficient for it enabled them to see a project take shape through a step-by-step process in a tangible manner.

Adopting the learning-by-doing approach, participants tested a number of processes and learnt how to use different multimodal communicative practices to diversify their methodology of work, stay focused and be productive within very short periods of time.

What was particularly appreciated in learning-by-doing was that it enabled participants to actively engage in the learning process, which became more interactive and playful. The feeling of being able to work in complete autonomy that was developed by the participants in this learning modality was perceived as rewarding and learner empowering.

Collective intelligence games

Collective games such as icebreakers and energizers were extensively used in the design of the workshop. These are complex multimodal communicative practices in that they involve gesture, posture, body language, oral language, but they can also involve writing and drawing. These learning modalities do not concern the problem to be solved directly and explicitly,

however, they are important in that they allow learning more about individual participants within a group, finding out their character traits, their attitudes and certain behavior patterns as well as the way each member operates (e.g. whether or not one is more efficient when put under pressure, time or other constraints, etc.). This knowledge, which might seem to be irrelevant, proves to be precious when used in the process of addressing the research question, as it allows participants to collaborate more efficiently and make each member of the group bring utmost contribution to the work accomplished.

These games also help develop self-confidence of members, as regardless of individual backgrounds (age, profession, exam results, etc.) each member of the group is treated equally in these games. This facilitates the sharing of ideas later on within smaller groups, as participants are more confident and are not afraid to be judged.

These games also serve as 'playful breaks' that stimulate and entertain learners and help them relax, take a step back from their research question, get positive energy before getting back to their problem-solving tasks more focused and thereby more productive. It could therefore be concluded that including collective games in the design of multimodal learning environments improves learner concentration by making the learning process more dynamic and engaging.

Furthermore, collective games serve as team-building tools. These are used within the framework of the present workshop to help develop group cohesion and establish a positive working environment (conviviality). It goes without saying that the cross fertilization of ideas takes place more easily and efficiently within a group in which members feel confident and share a feeling of belongingness. The common objective of the group, i.e. to find an innovative solution to a problem, is then shared more easily; members identify with this common goal and feel fully concerned with its efficient accomplishment.

Working in multidisciplinary groups

As mentioned earlier, participants were put in multidisciplinary groups. Each group was comprised of participants from a wide range of disciplines, such as marketing, production and purchasing management, logistics, management of IT systems and HR. In the questionnaire survey, participants were asked to evaluate the impact of the multidisciplinary environment on their learning process and outcome. They felt that while working in multidisciplinary groups, they were confronted with different ways of addressing a problem specific to each discipline. Interestingly, the idea of culture, specific to each discipline, similar to corporate culture, came up. The culture of a given discipline as the manner in which a question was addressed, research tools and methods were chosen and used.

Each member of the group was complementary and had an active role in the process of working. Everyone was engaged in the activities and contributed according to their expertise, skills and knowledge. This made the work more dynamic, and the participants were more mo-

tivated and focused. The feeling of being useful to one's team further developed their self-esteem and thereby self-confidence and contributed to a better group cohesion. This resulted in more ideas in terms of both quantity and quality.

Integrating multidisciplinary in the design of the learning environment allowed the participants to adopt different viewpoints while addressing a research question and thereby have an overview of the problem from different angles and treat it in a more comprehensive manner. The participants' multidisciplinary skills and knowledge were called upon, which was key to broadening the spectrum of possibilities as to the methodology adopted and the solutions developed. Thus multidisciplinary entailed enhanced multimodality in terms of adopted communicative practices.

Beyond the very process of learning, participants felt that the multidisciplinary nature of their groups had a strong impact on the final result: the proposed solution was better than it could have possibly been, were the group made of members from one and the same discipline. Not only they were given the opportunity to take advantage of an expert view, but also that of a novice, equally valuable, as the latter had an unbiased view on the problem. This allowed establishing new links between phenomena and coming up with more innovative ideas.

Audio-visual stimuli

In the course of the three-day workshop, participants were exposed to music and a highly colorful environment to reinforce the audio-visual dimension of their learning setting. Two different playlists developed by Scott Doorley, the Creative Director at the d.school of Stanford University were used for the purposes of enriching the learning experience with audio stimuli. The first list, called 'active' was bouncy and upbeat, and was designed to support making and physical activity, whereas the second 'reflective' list, featuring quiet tunes, acted as background music for small group discussions or individual work.

Participants were asked to evaluate the impact of the audio-visual stimuli on their way of thinking and working. When confronted with this question, the participants were first surprised and admitted not having thought of these stimuli explicitly. However, with hindsight, they thought the abundance of colors in their learning environment could have influenced their work and motivation in a positive though subconscious way. To better understand the role of color in their work, they imaged if they were to use only the black color while drawing and representing visually the research problem, it would have been sad and much more simplistic, devoid of any intricacy and detail, they concluded. So the colorful environment was said to have influenced positively their way of representing ideas. Furthermore, along with music, color was described as having triggered positive emotional responses and thereby more motivation to engage in the proposed activities. Studies in cognitive sciences have demonstrated that emotions do affect learning (cf. Sylwester 1994). Also the word 'active' was often cited to demonstrate the idea that learners felt as active participants of the learning process, which

was considered to be more engaging and fun. 'Such an environment makes you want to work', a learner pointed out.

The abundance of colorful stationery put at the participants' disposal was felt as having called for more creativity. Even though the workshop was organized as part of their academic curriculum, one of the learners wrote: 'while working in this kind of environment, my feeling was that I was working more in a company than at a university'. It could be inferred that the work that was being accomplished was felt as real-life and relevant and not as purely theoretical. Also, as the task was felt as useful and realistic, learners felt more motivated to commit and come up with innovative and feasible solutions.

The added value of multimodal learning environments

The diversity of the modes of communication, chosen for the design of the learning environment, was a much-appreciated aspect of the workshop and the participants described their multimodal learning experience as rewarding and enriching.

The wide range of learning modalities was also thought to have enhanced their motivation. Even though the word 'motivation' didn't appear explicitly in the way the question was formulated in the survey, as it didn't constitute the focus of our study, it came up very often in the participants' tokens. The dynamics created by the diversity of communicative practices contributed to learners feeling more engaged in the learning process and being more productive. Furthermore, it developed flexibility and adaptability, and created a playful and interactive working environment.

Also, some of the participants felt that their argumentation skills were enhanced, as they were brought to explain their ideas and back their solutions while presenting those to others.

Furthermore, learners were able to work autonomously and in small and large groups, which developed their team-playing skills. The opportunity to work in small teams and express oneself in different modes developed the participants' self-confidence. They felt more at ease with sharing their ideas. The legendary psychologist and Stanford professor Albert Bandura has shown that self-confidence is a key factor in developing creativity. He referred to this type of confidence as 'self-efficacy':

Individuals who come to believe that they can effect change are more likely to accomplish what they set out to do. [...] People with self-efficacy set their sights higher, try harder, persevere longer, and show more resilience in the face of failure. (Kelley 2013: 9-10)

Furthermore, CPS is a process in which participants learn to accept a certain degree of ambiguity as to the outcome of learning processes. When confronted with a task, they are taught to jump in and accomplish it, to experience the process without questioning it much. As a result, they accept to let control go and unleash their creative potential. As Kelley puts it:

When people transcend the fears that block their creativity, all sorts of new possibilities emerge. Instead of being paralyzed by the prospect of failure, they see every experience as an opportunity they can learn from. The need for control keeps some people stuck at the planning stage of a project. With creative confidence, they become comfortable with uncertainty and are able to leap into action. (2013:10)

As for multimodal assignments, one of the participants wrote: 'Drawings enable us to go to the point directly. These are efficient tools, which help avoid wasting time on trying to find the perfect wording to explain one's point.' The possibility to express oneself multimodally was clearly experienced by the participants as an advantage, which unleashed their creativity. One of the participants mentioned:

It is difficult to explain everything in mere words. The possibility to visualize the proposed solution, for instance, through drawings, is a real asset as it helps shed light into the issue and clarify it by visualizing its different aspects and furnishing a tangible reference for the ideas developed.

Learners were able to visualize the problem and its possible solutions and thereby get a multidimensional picture of the issue to be addressed. The possibility to use drawings or other means of representation was felt as innovative in that it fostered learning in a more playful and informal environment. Therefore, the participants stated to be more motivated to accomplish the task.

Interestingly, one of the participants compared the opportunity that was given to them to express themselves tapping into a wide range of semiotic resources to 'gaining more space' to express oneself and to create. As if they shifted from a two-dimensional space, that of representing by a pen and paper (or a keyboard and a screen) to a richer and multidimensional space. The opportunity that the learners were granted to use multimodal means of communication in their productions gave free rein to their imagination.

More importantly, in such multimodal environments where learners were encouraged to use the least possible language and tap into other semiotic resources instead, participants felt that their skills to express themselves differently, multimodally developed. Participants, who affirmed in the beginning not being able to draw, ended up using drawings extensively to illustrate their ideas.

To conclude, in their questionnaire responses, when asked about the impact of the multimodal learning environment on the development of their creativity, all the participants mentioned that their creativity and imagination were definitely stimulated and developed in such environments.

Having discussed the results of the questionnaire survey on different multimodal practices constituting the learning environment, in what follows, we will proceed with the analysis of our second set of data, i.e. learners' multimodal productions, using the interpretative framework as developed by Stöckl (2004).

5.2 Multimodal productions: tracing the development of learners' creativity

As mentioned above, learners were taught the CPS techniques through learning-by-doing method. That is, after being given some theoretical explanations on different stages constituting the creative process, as well as the tools and techniques to be used, they were given a real-life problem and were asked to address it by implementing the CPS process.

In stage one of the CPS process, which consists in clarifying the problem to be addressed, participants were given an exercise to practice the visualization technique. In particular, they were asked to address the following question: how are holiday plans decided in a large family (many kids and/or blended family)? The answer had to be represented graphically using language the least possible. They were given fifteen minutes and all sorts of stationery supplies (color pencils, markers, post-it notes, scissors, etc.).

The groups were to explore the question by featuring the following elements: purpose, stakes, stakeholders (parents, children of different age groups), the notions involved (family, holidays), constraints (financial and other), available resources and possible solutions.

In the course of the workshop the participants were asked to design a number of multimodal productions: first, to enhance their skills in visually representing a research problem and then, at the final stage, to represent their proposed solutions. Accordingly, participants' multimodal productions are analyzed in two sub-categories: 'initial productions', that served to practice multimodal communication while representing a research problem (holiday plans in a large family), and 'final productions' representing proposed solutions (SPO problem on campus management).

Initial multimodal productions

The above picture (see Figure 1) can be read from top to bottom (vertically) and from left to right (horizontally). First, on the top left corner, we can see a drawing of the family, united as one and sharing a common goal – their future (summer) holidays, represented on the right side of the poster. Far from being a coincidence, such spatial distribution, namely drawing the family on the left and their goal, on the right, bears a strong semiotic potential, that of conveying temporal signification through spatial organization. The past is represented on the left, while the future on the right. This temporal signification is confirmed by similar designs occurring in other multimodal productions discussed further. As for the vertical design, learners tend to represent the research question as a departure point above the suggested solution, as if conveying the sequence of events occurring one before the other.

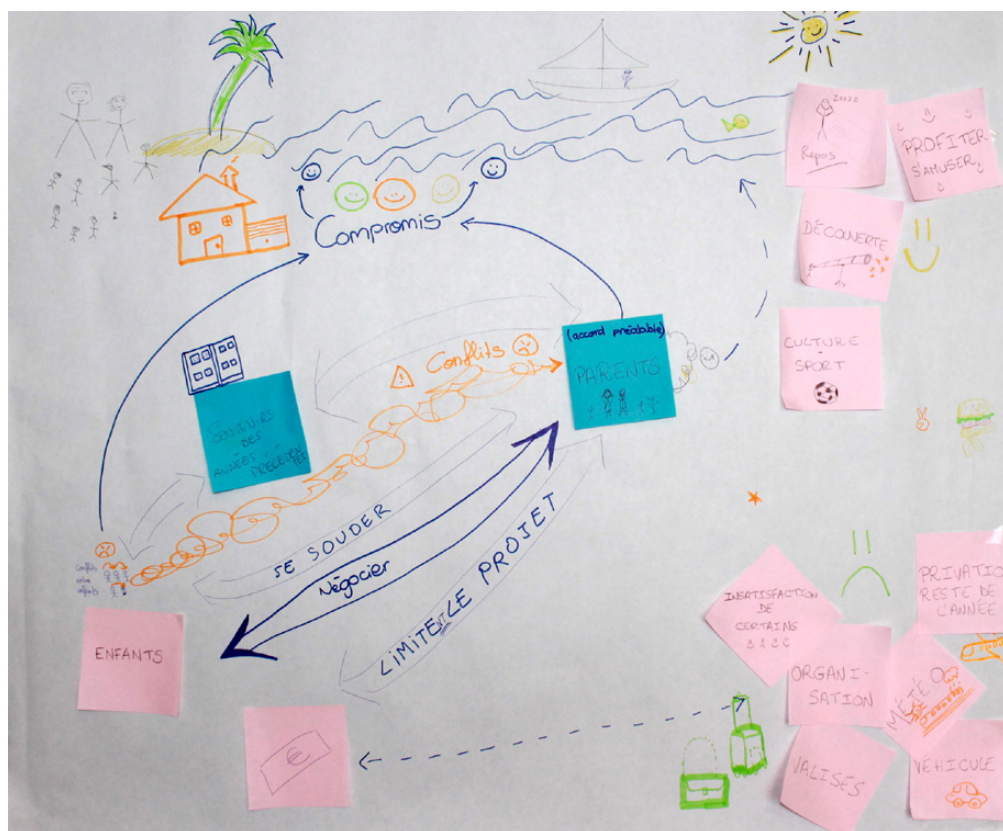


Figure 1. Clarifying the problem. Multimodal production of group one

Four pink post-it notes are used to clarify what is meant by holidays, namely – sleep and rest (a man sleeping with the letters ‘zzzzz’ next to him and the word ‘rest’ [repos³]), enjoying and having fun (happy smileys), discovering new things while on holidays (someone looking through a telescope with the writing ‘discovery’ [découverte]) and finally sports and cultural activities (a soccer ball). Decision-making that involves different factors and stakeholders is represented as a circular process through the use of pointed curved arrows. Group one, put the children (‘children’ [enfants] written on the left-hand side) and parents (drawn on a post-it note) in opposite positions, using different color post-it notes and then united them in the same process using a double-sided arrow that reads ‘negotiate’ [négocier]. Happy and sad smileys are used to represent tensions, conflicts and satisfaction. One of the factors that is taken into account in the decision-making process is the souvenirs of past holidays represented though a photo-album, next to the words ‘past year souvenirs’ [souvenirs des années précédentes]. Various constraints impacting the decision-making process are represented at the bottom of the poster – on the one hand, financial constraints (a banknote with the symbol of the euro drawn on it) and on the other, all the other types of constraints, such as weather, luggage,

savings, organizational and time-table constraints, transportation (if they were to leave in a car, plane or ferry). Finally, thirty words are used to accompany the visual representations. To get back to the initial question, for group one, the decision-making process is a negotiation between parents and children in which an agreement can be reached through compromise.

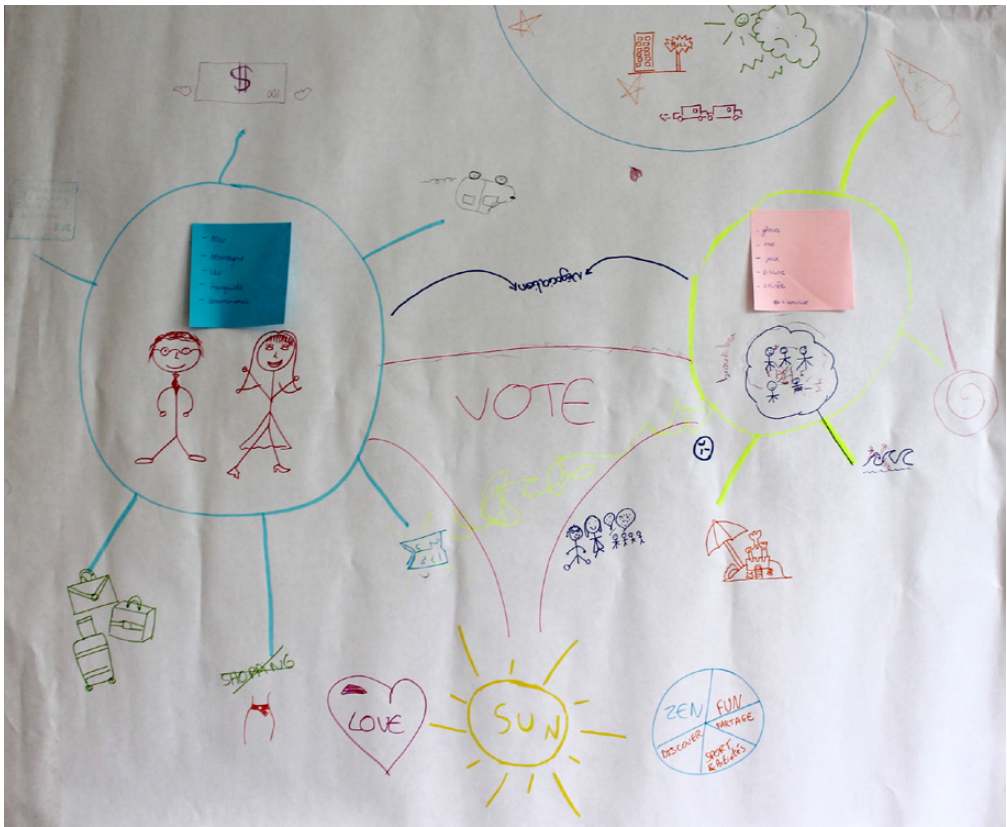


Figure 2. Clarifying the problem. Multimodal production of group two

Similar to the multimodal narrative of group one, that of group two can also be submitted to a top to bottom reading. At the very top of the poster we can see the current situation (city life, buildings, pollution, capricious weather), the decision-making process in the middle, and finally the solution, successful holidays, at the bottom. Drawings take a central place on the poster. We find the same stakeholders involved in the decision-making process (parents and children), drawn within opposed circles, using different colors, as if to separate them physically in two different zones and to demonstrate clearly that they have distinct interests, constraints and desires in the negotiation process. Desires of the parents (sea, mountains, skiing, calm and gastronomy) and those of the children (ice-cream, sea, games, swimming pool, partying, having fun) are written on a blue and pink post-it notes correspondingly and stuck above them.

Similarly, constraints of each sub-group are represented in a circular movement around them: timetables, money, transportation, luggage and savings (the word shopping is crossed out) for the parents on the one hand, and no constraints but further representations of desired things (ice cream, candy) and activities (building a sandcastle on the beach, surfing) for the children, on the other hand. The sub-groups are joined through a vote in the form of a funnel that leads to love, sun and pleasant activities. Interestingly, the latter are represented diagrammatically using a pie chart to show the amount of each activity (zen, fun, discovery and sports) and thereby signify balance among the activities to be chosen. As in the previous case, writing (twenty-one words in this case) is used to support drawings.

It is surprising to see that even though the participants were explicitly asked to use language the least possible, it was used even when it did not seem to be absolutely necessary. To represent love and sun in this poster, the participants used drawings (a purple heart and a yellow sun) and then, whilst there was no ambiguity, they used writing to clarify their drawings and added the words 'love' and 'sun', as if to reinforce the visual message. Instead of choosing either of the two modes (writing or drawing), a preference was given to combining the two modes. So for this group, the best way of deciding on holidays is through a vote that would take place after a negotiation between the parents and children.

Finally, when it comes to the multimodal production of group three (see Figure 3 below), what strikes the viewer is the amount of writing used, which is greater than in the previous two cases.

In total, forty-six words were used (as compared to thirty and twenty-one words for groups one and two respectively). For this group of learners, there are four stakeholders involved in the decision-making process: namely, the mother, the father, the mother's children and the father's children. Parents, however, are united as one group through a symbol of heart. When we look at the poster from left to right, we can see the 'initial suggestion' [proposition initiale] written within a rectangular form as a departure point for negotiations, and on the right 'final decision' [décision finale] in a circle, to represent the ultimate goal. The use of rectangular and circular forms to signify departure point and target goal respectively are interesting. The shift from left to right is represented through an arrow that has some irregular lines in the middle. Those stand for discussion and compromise between parents, represented on the bottom (along with their constraints) and the children, represented on the top, with theirs.

Next to the final decision, another drawing of heart can be seen with the word 'compromise' [compromis] to suggest that love and compromise are necessary to reach a final common decision, with symbols of '-' and '+' to represent the advantages and disadvantages of such a compromise. The details of the final decision (e.g. elder kids take care of the youngest ones) are enlisted below the 'final decision'. After having a discussion, and taking into account the constraints and future rewards, everyone proceeds with a vote, like in the previous case. As the drawing of parents and children in weighing scales suggests, the children's vote weighs heavier and the final decision is taken, which leads to sunny holidays at the beach.

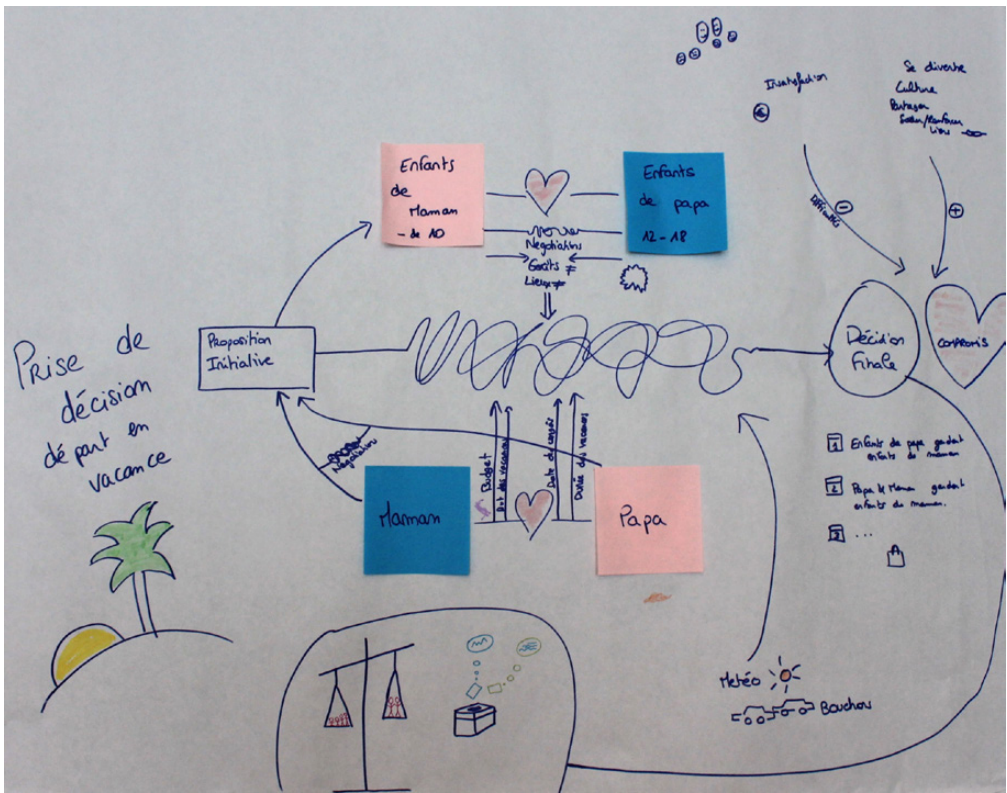


Figure 3. Clarifying the problem. Multimodal production of group three

As could be noticed, to represent holidays, all the three groups portrayed summer holidays at the beach. To do so, group one and three portrayed the sun and a palm tree, while group two used drawings to make a further distinction between different activities for different age groups as leisure time at the beach. In particular, building sandcastle for the youngest children as opposed to surfing for the elder ones. This is where the richness of a multimodal representation comes in and shows its efficacy.

As can be seen in figures one, two and three, all the three groups, though working in physically distant workspaces, represented the main stakeholders, i.e. parents and children, as two distinct groups and considered them as having contrary interests. They were opposed and the decision making process was represented as negotiation.

Final multimodal productions

In what follows, we will analyze the final multimodal productions of learners, which were used to represent their proposed solutions to the real-life problem submitted by the Sustainable Planning Office.

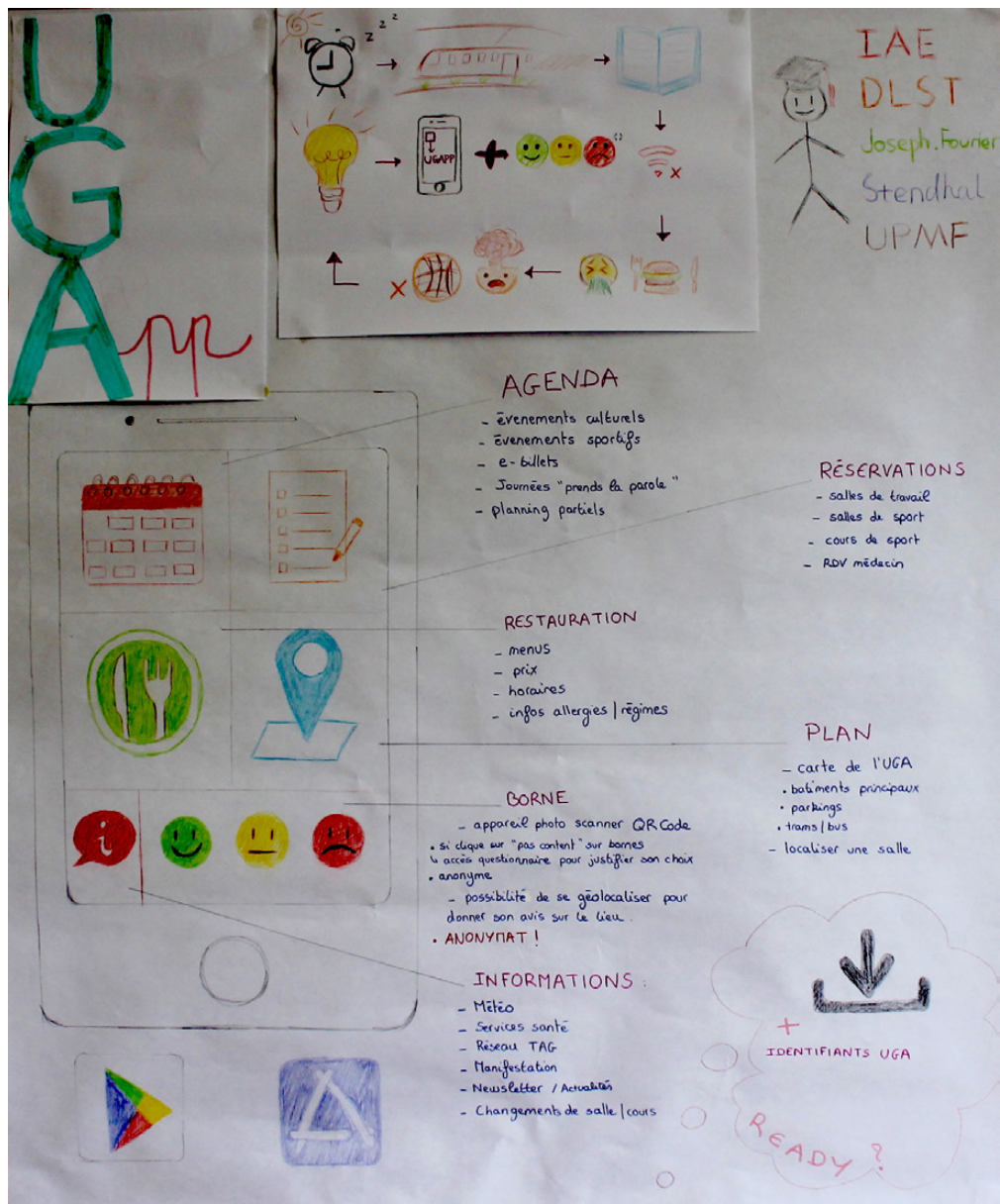


Figure 4. Multimodal representation of the proposed solution of group one

Group one (see Figure 4) came up with a mobile application solution (UGApp) which students can use to evaluate different campus sites and services and thereby contribute to the sustainable management of the campus. To encourage students to download and use this app, the latter integrates essential information for students (such as course and exam timetables, cultural and sports events, campus map, etc.).

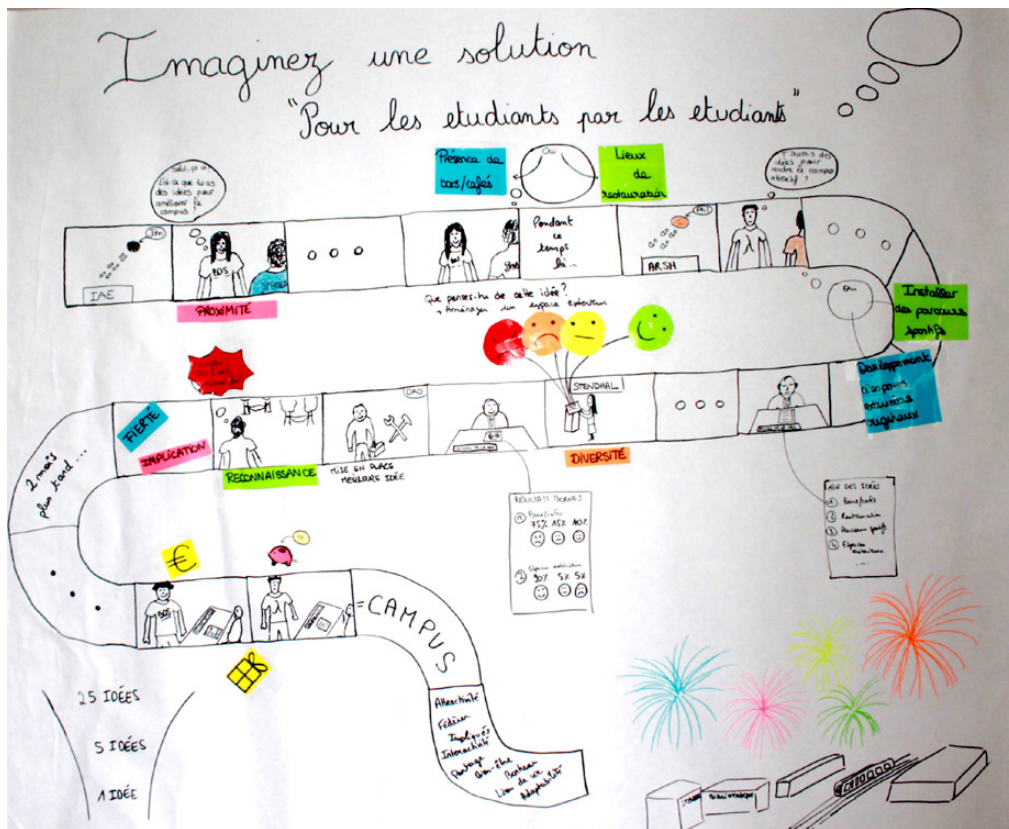


Figure 5. Multimodal representation of the proposed solution of group two

Group two (see Figure 5) imagined different channels of communication that students would use to provide SPO with feedback on campus equipment; a shortlist would then be made by the latter to prioritize and address students' concerns.

Finally, group three (see Figure 6) suggested using different cultural events to gain students' feedback. Should we compare learners' initial and final multimodal productions, we would notice that the graphic representations in the latter are of a higher density and quality. Furthermore, in final productions diagrammatic representation (in particular the use of arrows and the spatial composition of representations) takes a central place.

Drawing on Stöckl's model (2004: 12), which served as reference for our analysis, it could be stated that as far as the sensory channel is concerned, all the productions fall within the visual sensory channel. Two core modes are involved – image and language, with their medial variants – static image and writing, respectively. As far as typography and layout are concerned, apart from group three, learners used capital letters to facilitate reading, and writing was accomplished in different directions in line with the way the narrative unfolded. There was

a wide use of sub-modes, such as color, vectors and perspective. Lines, arrows and forms were used to make diagrammatic representations.

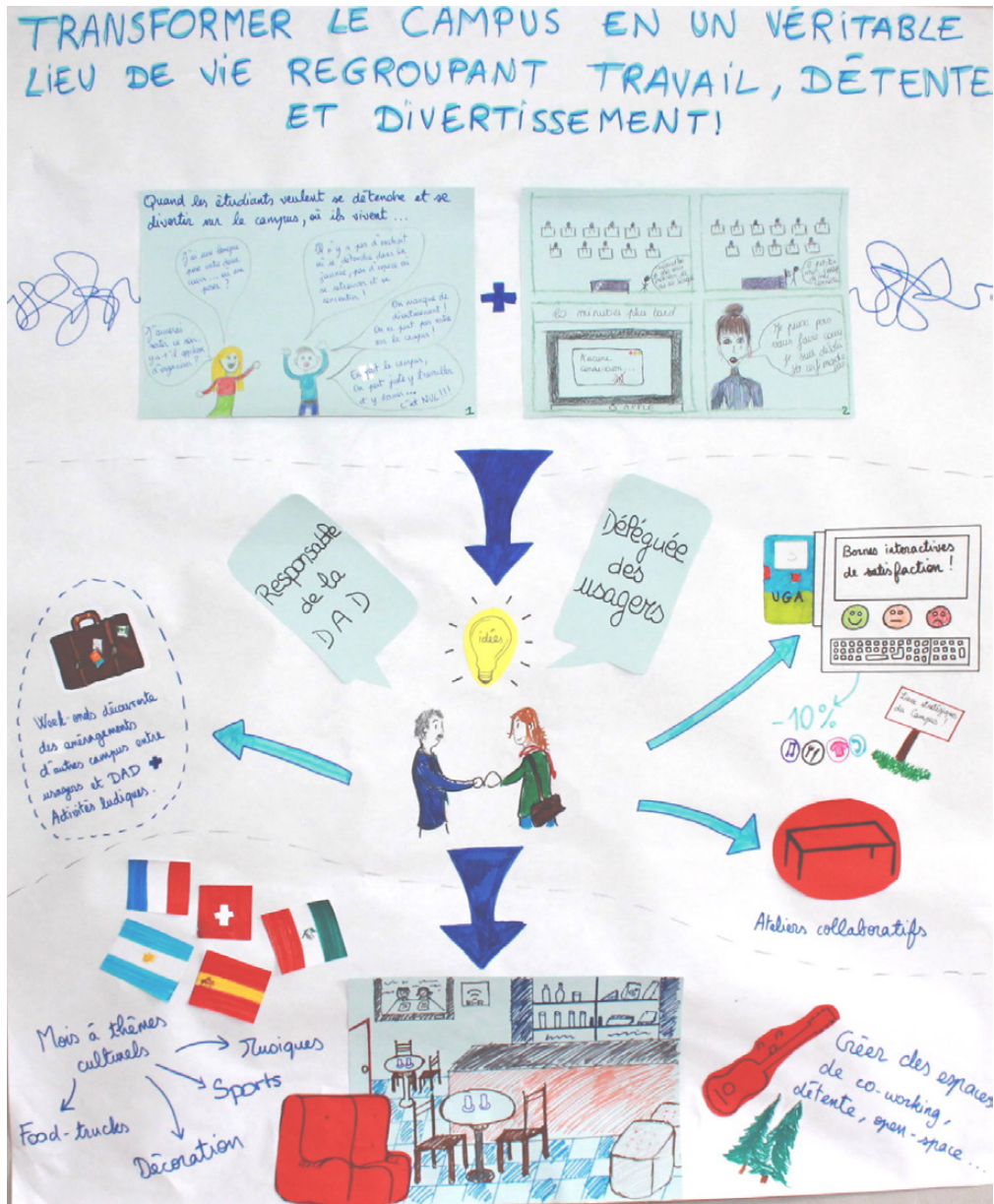


Figure 6. Multimodal representation of the proposed solution of group three

Apart from diagrammatic representation, a second element that was heavily tapped into was symbolic representation. Various symbols were used, such as the symbols of dollar, euro,

heart, not equal to, thought bubble, plus and minus for advantages and disadvantages, crossing out a word to signify the absence of what it represents. Symbols and diagrams are powerful means of efficient communication, but what is interesting for diagrams is that apart from being a means of communication, they constitute a key mechanism of reasoning. So if multimodal practice encourages the use of diagrams, it thereby develops reasoning and analytical skills.

Having analyzed learners' multimodal productions designed at the first and the final stages of the workshop, it could be concluded that learners' final productions can be characterized with the greater creativity. At the end of the three-day workshop, not only learners were more confident in their visual representation skills and motivated to produce multimodal artifacts, they also developed their creative confidence.

6. Concluding remarks

The multimodal learning environment of our case study was comprised of two basic elements – multimodal learning practices and multimodal productions. The different multimodal practices used in the design of the learning environment were complementary and cannot be classified hierarchically. Their diversity helped keep the participants focused and motivated. Furthermore, multimodal communicative practices used at different stages of the CPS process fostered learners' capacity to express themselves multimodally and represent their ideas more creatively.

Multimodal representation enhanced understanding and improved learners' capacity to grasp the complexity of an issue in its finest subtleties. Learners' multimodal productions further resulted in enhanced motivation and fostered their willingness to engage in interactive multimodal practices. Multimodal productions encouraged the simultaneous use of different semiotic modes and helped stimulate innovative and creative thought. Learners' ability to design increasingly multimodal artifacts showed a positive impact of the multimodal learning environment on their capacity to creatively choose and combine a wide range of semiotic resources to make, negotiate and represent meaning in a multimodal perspective. Thus the findings of our research suggest that carefully designed multimodal environments affect positively learner motivation and the development of creativity.

To put to test the findings of the present study and compensate its limitations in terms of the small number of participants, further research could be carried out adopting a quantitative approach. Also, a further study can envisage to record and analyze oral presentations of learners while explaining their multimodal productions; and also include a control group in which participants will work in environments with the least possible multimodality.

The study advocates the need for revisiting traditional learning practices and suggests that multimodal learning environments can positively impact learner motivation; develop crea-

tivity and foster multimodal literacy provided that learners' awareness of multimodal meaning-making practices is raised through self-reflective processes. Finally, the study highlights the significance of investigating multimodality practice for the field of multimodality research.

Acknowledgements

This research was carried out following a training in CPS provided to teachers by Promising¹, a state financed research project launched at the University of Grenoble Alpes (UGA) in 2012, whose purpose is to foster creative and innovative teaching practices in Human and Social Sciences. The impetus for this paper was a multidisciplinary workshop on creativity and innovation 'IAE Starter' which is organized yearly by the Graduate School of Management of Grenoble Alpes University.

NOTES

1 Promising is one of France's IDEFI projects: the acronym stands for 'initiatives d'excellence en formations innovantes', a competitive national project to encourage high-quality, innovative teaching and learning. It benefits from the financial support of the French Government, through National Agency for Research (ANR), ANR-11-IDEFI-0031.

2 The 10 most beautiful universities in Europe', The World University Rankings, January 22, 2018. Available from: <https://www.timeshighereducation.com/student/best-universities/10-most-beautiful-universities-europe>. [Accessed December 11, 2018]

3 Hereafter, the original words in French as they appear in learner productions will be given in square brackets, preceded by their English translations in inverted commas.

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