HARNESSING SOCIAL MEDIA AND CLOUD-COMPUTING TECHNOLOGIES FOR CO-DESIGN IN OPEN COLLABORATIVE INNOVATION: THE CASE OF 24 HOURS OF INNOVATION

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Abstract

Designers and industry both agree that new uses of media and cloud computing technologies have had a major impact on the way designers receive and share information and knowledge.
Our research team was interested in examining whether these technologies also directly affect the social dynamics in co-design meetings. In this paper, we describe the dynamics observed during an annual international competition, "24 Hours of Innovation", and at two co-design sessions held at the École de technologie supérieure's INGO Innovation Center in Montreal.
Our aim was to develop a Knowledge Management System that supports the co-design experiences present in an open collaborative innovation process. We analyzed the use of media by participants during four periods of the event: announcement, information, contributions, and polling of projects. We followed 135 teams from more than 20 universities, from 5 continents, which participated in the 5th edition of 24 hours of Innovation in Montreal. This competition also included 14 remote teams that participated in the 6th edition at ESTIA France.

Keywords: Collaborative design, Platform strategies, Design practice, Knowledge management, Open Innovation

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1 INTRODUCTION

The first step of the innovation process is the generation of ideas, and even more important, idea generation "is central to engineering design" (Glier et al., 2011). There is evidence; however, that innovation today requires perspectives from different domains of knowledge to come together, a multidisciplinary approach. In addition to requiring the perspective of different domains of knowledge, companies face additional challenges: first the de-centralization of teams and telework, and second, the need to collaborate beyond the limits of their own company to find new ideas. With these changes in the workplace, collaboration for innovation increasingly occurs in a distributed manner, and companies invest in communication tools to support these collaborations.

Designers and industries all agree that new uses of media and cloud-computing technologies had a major impact on the way that people work and share information and knowledge.

Widespread use of new media provides opportunities for ideation. Collaborative software are applications that enable users to share information and distribute work; tools such as forums, document sharing platforms and wikis are a viable option given their low cost, ease of use and maintenance, and the fact that they don't require specialized technical training for users (Jackson, 2010).

Our research team was interested in whether these technologies also directly affected the social dynamics in co-design meetings. In this paper, we describe the dynamics observed during an annual international competition, "24 Hours of Innovation", and two co-design sessions held at the INGO Innovation Center at the École de technologie supérieure in Montreal.

Our aim is to develop a knowledge sharing platform that supports the co-design experiences in an open collaborative innovation process. We analyzed the use of media by participants during four discrete periods of the contest: announcement, information, contributions, and polling of projects. We followed 135 teams from more of 20 universities distributed across 5 continents that participated in the5th edition of 24 hours, on Montreal. This competition also included 14 remote teams that participated in the 6th edition at France ESTIA.

1.1 Open-Collaborative Innovation definition

Firstly, we would like to introduce the concept of Open collaborative innovation, which the Financial Times Lexicon (2012, p. available online) defines as "to develop projects in which multiple users collaborate and openly share what they develop. Open collaborative innovation projects can be at a larger scale than any single user can undertake alone. Open collaborative innovation is enabled by lower collaboration costs, as people contribute for free, and lower design costs enabled by the Internet and by cost efficient computerised design tools."

This form of user innovation is breaking producers' former monopoly on the design of "big" projects.

For Baldwin and Von Hippel (2010)"*an open collaborative innovation project* involves contributors who *share* the work of generating a design and also reveal the outputs from their individual and collective design efforts openly for anyone to use. The defining properties of this model are twofold: (1) the participants are not rivals with respect to the innovative design (otherwise they would not collaborate) and (2) they do not individually or collectively plan to sell products or services incorporating the innovation or intellectual property rights related to it"(p. 9). Open collaboration implies certain challenges for all actors involved, particularly enterprises, to open their brief of the design and integrate an external team early in the process. For design students it is not easy develop confidence in a process, where there is a high degree of uncertainty about intellectual propriety or role definition in the project. Our research team analysed some social and technological aspects that were put in place to harness the open collaboration in innovative experiences and provide through "24 Hours of Innovation" a cultivated field to train our students in collaborative work with industry and community.

1.2 Cloud-computing Technologies and Social Media to support Open Collaboration

Collaboration researchers speak directly about the positive impact of Information and Communication Technologies (ICTs), Cloud-Computing Technologies, and Social Media in collaboration dynamics. Some of basic theories of collaboration are based on new behaviors of sharing information and knowledge such as Web 2.0 or Web 3.0. A constant evolution of tools and applications has transformed the Internet into a fruitful place for collaboration. However, there is a huge difference

between the easy utilisation of ICT technologies for collective work and actual participation in networks, communities of practice, and groupware. Despite the availability of various sharing platforms most companies show little use for development, and their effective participation and collaboration is very low (Hill, Hollan, Wroblewski, & McCandless, 1992; Terveen & Hill, 1998), and isolated (Nielsen, 2006). Nielsen (2006) proposes a "Law of participation inequality"100-90-9 applicable to communities in networks. This law proposes that, for every 100 users, 90 observe, 9 contribute from time to time, and 1 contributes assiduously, generally the owner of the content. The consultant Levan (2009)argues that this law of inequality of participation decreases to 92-7-1ratio , when talking about business networks. The variation between the Internet and intra/extranets can be explained by the requirements of participation established by employers. Why is the participation rate so low? Nielsen (2006) explains that the dilution of collaboration depends on "the size of the group, the familiarity between the members and the interactive or conversational strategies" (ibid), and the organization and the methodology used to tightly knit the community.

These conditions show that if the number of participants is high, it will be more difficult to coordinate their interests. We must therefore create a management structure of knowledge to promote the use of the platform with social strategies for collective sharing, and for training future designers to work in a collaborative mode (Benghozi, Pollet, Trahand, & Vardanega-Lachaud, 2002).

On other hand, the use of ICTs creates another kind of complexity in capturing information distributed across multiple information tools and databases. In our research, we analysed all the tools (in a broad sense) used at the 24H design competition, but we were particularly interested in the use of ICT applications in the co-design experiences and how computer-based Knowledge Management Systems (KMS) (Woo, Clayton, Johnson, Flores, & Ellis, 2004) mediated collective knowledge management (Hasan, 2001).

In the next section, we will present a description of the study and the results obtained.

2 DESCRIPTION OF THE STUDY AND METHODS

In design activities the Workshop is usually implemented as the main work methodology. When viewed as an interactive space, the design workshop allows students and teachers to "recreate" a knowledge space of learning enriched by a reflective discourse. Our research team introduced the Charrette method. "Charette is an intensive, concentrated and deadline-oriented group confrontation and discussion technique applied to identify, analyze, evaluate and solve educational, organizational and community problems and needs" (available online, Bureau Translation Canada, 2011). Charrette as a design activity (Kolko, 2005) encourages teamwork within R&D constraints, time or decision-making, as these elements make the Charrette an effective design strategy.

Charrette is also a potentially effective research method, mainly because it puts participants in a real-world situation, where researchers can observe and test user experience, interfaces, and knowledge management systems during the design process (Clayton, Kunz, & Fischer, 1998). At the end, proposed concepts are also assessed and judged by experts. This confers an ecological validity to the research (Amabile, 1983; Chung, 2009), in the sense that actors are immersed in a professional problem where they test the computational environment or information tools during project development. Another factor is the ecological validation in creative problem-solving that requires a professional consensus when judging the outcomes of teamwork as innovative projects (Amabile, 1983). It is for this reason that our research team identified knowledge acquisition needs and use of ICT technologies in these kinds of design activities while investigating creative teamwork and how ICT tools supported the design teams at the same time.

Over 20 institutions participated in the 5th International 24H innovation Competition at Ecole de technologies superieure at ETS- Montreal. There were 135 teams and about 782 participants (more information about the teams and countries is available at www.innokiz.com). 15 institutions participated in the 6th edition of ESTIA-Bidart in France with about 193 participants (information available at www.24h.estia.fr and www.innokiz.com). The Montreal competition took place during the Creativity & Commerce Conference (C2MTL) in Montreal. The research study consisted of an empirical study that analyzed the teamwork carried out by teams during the 24H competition. We studied four periods of time during the contest: announcement, information, contributions, and poll assessment of the projects. We followed the use of media by participants and looked at three variables linked to the experiential process during computer-mediated interactions:

1. Communication tools used during team formation and knowledge sharing stages.
2. Visualization of the representation of ideas during the three stages of knowledge acquisition: identification, conceptualization and codification, proposed by Dalkir(2012);
3. Information sources (cognitive and knowledge exchanged) used effectively by the teams for idea exchange (project proposals) or teamwork among team members and external experts, partners or sponsors.

Our research explored these three topics related to the co-design experience in an experimental platform of collaboration: www.innokiz.com, as well as ICT and social media used to support design teams of 24H, as it will be explained in the third section.

2.1 Utilisation of Social Media

The 24H teams were able to develop complex interactions through the knowledge they acquired to solve problems as well as the knowledge that was shared to develop new products. In addition they needed support to develop their activities during the rapid Charette process. These strategies involved a co-localization of participants, but the teams also needed to exchange digital information among their members as well as with the organization staff and industrial partners. In the early design stage, 24H teams searched for information in order to understand the context of the new product. This information delimits the design problem and defines the goal/task to draft the new product concept. At this early design stage, information is dispersed mainly throughout the Internet and in distributed experts.

In the first part of our study, we defined the utilisation of media in order to be informed about the competition and the kind of communication used by each team member to gather this information. The analysis of information sharing was followed with the use of ICTs during the competition. The initial project request was presented using the ETS license from the Cisco WebEx Meeting Center by Mickaël Gardoni. He then presented the industrial and academic proposals for new product or service development during 20 minutes. All the information and exchanges were supported at www.innokiz.com, a collaborative platform developed by ETS. Using ICT applications, every design team worked remotely from their host institution. The organisations presented over 40 creative challenges and design teams then freely selected one to work on, given members' experience, knowledge and/or interests. During the competition, all participants were encouraged to question, discuss, and work remotely with academics, professional experts and companies in Canada, Uruguay, and France. Webex™ was also used for meetings between industrial personnel and participants, and in the last period of the competition, international teams presented their projects remotely to the jury, using a video of 3 minutes at www.youtube.com. A jury convened from industry members and academics assessed the videos, and the community was also invited to select the most innovative project.

2.2 Task Analysis

In Task analysis, a researcher analyses the specific steps involved in achieving a task. It is a detailed description that includes cognitive and psychomotor actions performed by a person as they carry out the task. Some of the details include: sequence of steps, duration, frequency, task allocation, complexity, environmental conditions, necessary prerequisites (e.g. tools). Task analysis is a form of applied behavior analysis and it is used to derive a job description, to recruit and select employees, to develop training for that task, to design support tools and environments, to document procedures (e.g. produce a manual or checklist) and to automate tasks (Crandall, Klein, & Hoffman, 2006). The results of as task analysis are often presented in the form of a model, typically a hierarchy, with the overall goal of the task on top and the lower-level steps on the bottom as proposed by Kirwan and Ainsworth (1992).

During the competition, we sent out online forms to all registered students who had agreed to participate in the research. This was an introductory questionnaire with some biographical information and teamwork experience, open-ended questions every three hours about which design process stage they were at, and what knowledge and tools they had needed and used. There were a total of ten forms participants had to submit if they worked in that three-hour period. They then completed and submitted a final user satisfaction questionnaire at the end of the 24H competition.

3 DATA ANALYSIS

3.1 Social Media utilisation for 24H Information

Data was obtained from participants in the Montreal and Bidart 6th edition competitions. Of about 193 total participants, 65 participants completed questions about the use of media and ICT tools they used to be informed about the 24H Competition. As shown in Figure 1, 38% obtained information from informal networks composed of friends and classmates, 35% from their professor, 8% from the information posted in InnoKiz,7% from Facebook, and 4% institutional sources (of the host University) such as email etc.

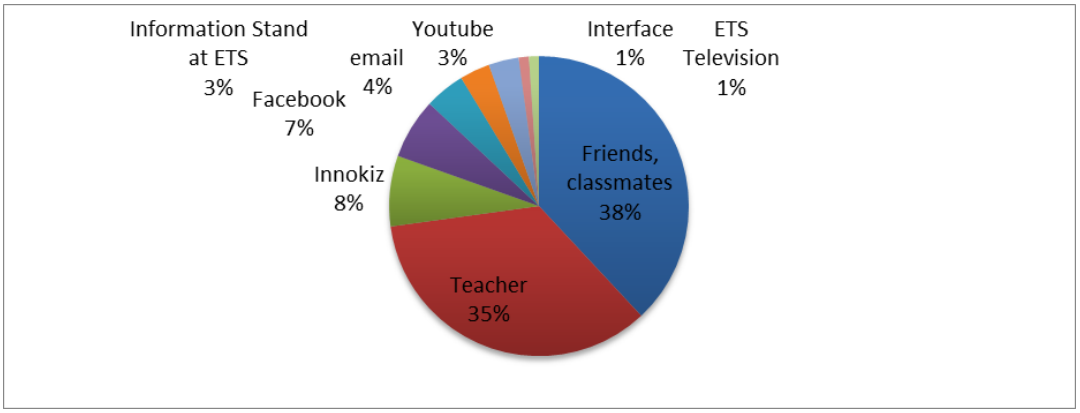


Figure 1. Communication channels used to obtain information about 24H

We asked participants which communication channel was more useful in informing them about 24H. Figure 2 explains the impact of communication channel on event visibility. We see a constituted network had more impact in the announcement of the event. Social media such as Facebook and InnoKiz had an impact on the visibility of the event.

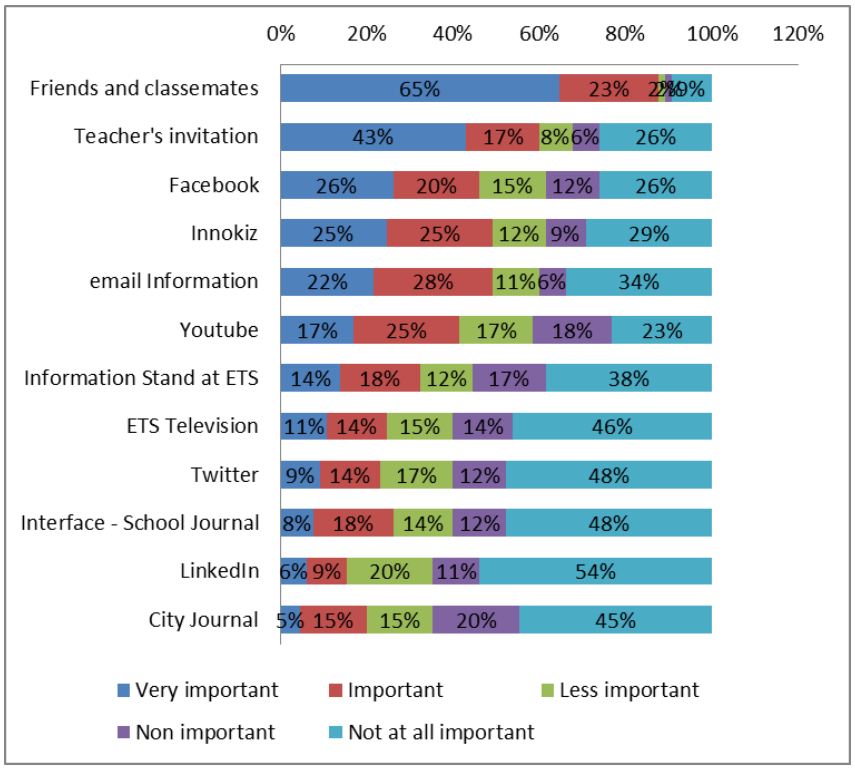
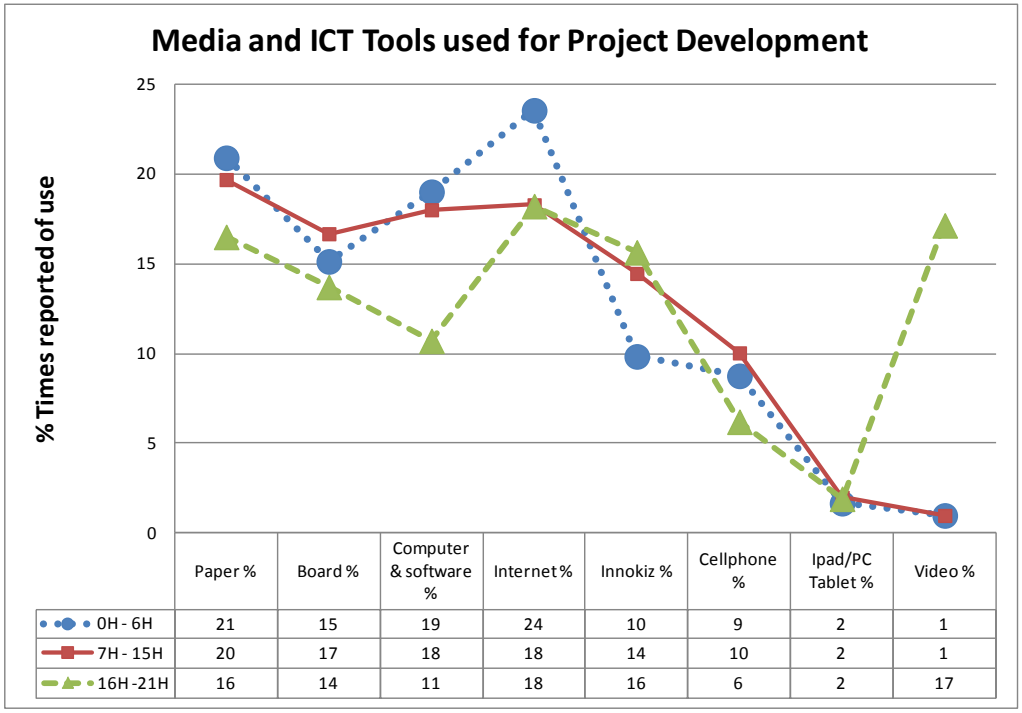


Figure 2. Social media and other communication tools used for information on 24H

This data validates the question on whether participants invited friends and classmates where 65% responded that friend' invitation was more important.

3.2 InnoKiz Collaborative Platform and other ICT technologies

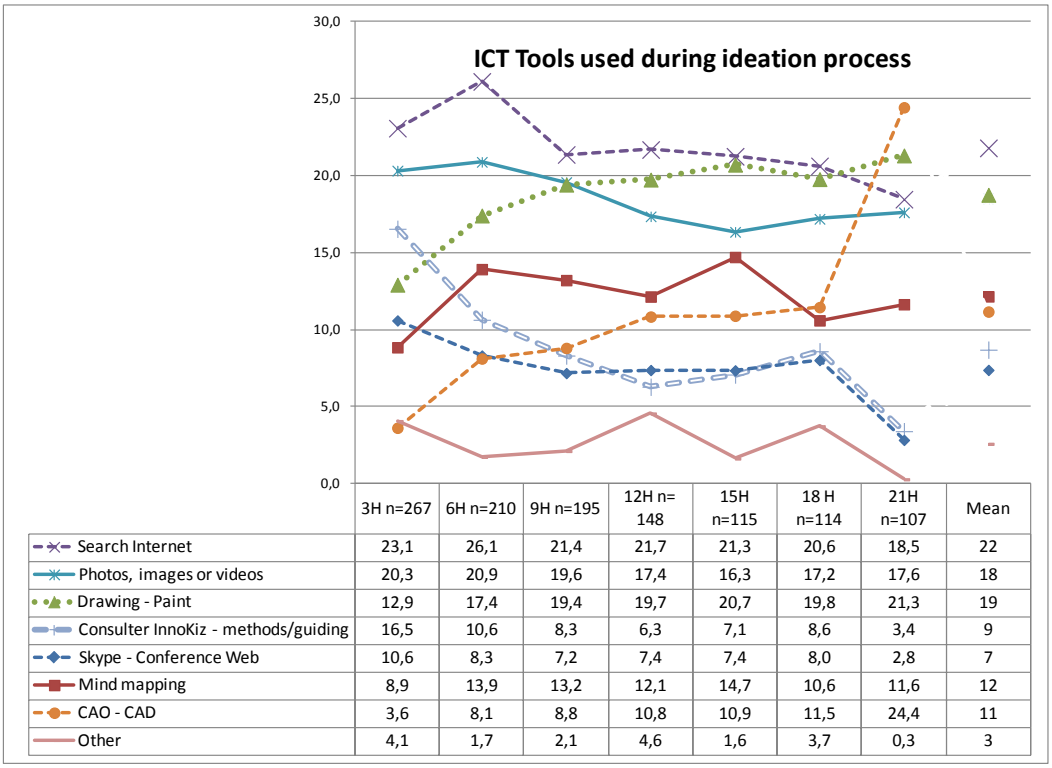
From a total of about 820 students who participated in the 24H, 267 agreed to take part in this research. They completed an on-line form every 3 hours. Figure 3 summarizes the use of ICT technologies during the first 6 hour-period, followed by periods between 6 to 15 hours and from 15 to 21 hours. Participants expressed the number of times they worked using a specific media tool. During first 6 hours there was the most intensive use of ICT and social media tools: Internet 24%, Paper 21%, Computers and Software 19%, and Boards 15%. In a second period, from 7 hours to 15 hours, participants used: Paper 20%,Computers 18%, Internet 18%, and Boards 17%. For the last period between 16 hours and 21 hours, the use of Internet was18%, Video 17% and Paper 16%. As we see, the use of Internet was constant during all period of project development. We observed that InnoKiz use was relatively constant during the competition: 10%, 14%, and 16%. The use of InnoKiz is a little more intensive at the end of competition due to a requirement to publish the results. The use of the cell phone was 9%, 10% and 6%. Tablets or Ipad use were scare as they were used only 2% of the time.



	Paper %	Board %	Computer & software %	Internet %	Innokiz %	Cellphone %	Ipad/PC Tablet %	Video %
0H - 6H	21	15	19	24	10	9	2	1
7H - 15H	20	17	18	18	14	10	2	1
16H -21H	16	14	11	18	16	6	2	17

Figure 3. Media used during 21 hours (%)

Figure 4 presents a most detailed description of the activities performed using ICT Tools. We tracked the use of the Internet as a Search Engine and Database as a main activity addressed by the teams, for each 3-hour period. At first it was 24% and then 18%. This data was confirmed by the use of ICT Tools analysed in Figure 3. Next we found the use of paper (21%) and Computer and Software (19%). The detailed use of computer and software is presented in Figure 4. The browsing activity is present during the entire 21 hours, as is the use of graphical software for image processing and video processing. Participants browsed InnoKiz as a source of information/guidelines more intensively in the first 6 hours, and it then decreased during the rest of the competition. This was similar to the use of the Videoconferencing or eRooms. Grapical software such as AutoCAD, Catia, or SolidWorks were used more at 18 hours. Mind-mapping was a support activity that remained constant during the entire 21 hours.



	3H n=267	6H n=210	9H n=195	12H n= 148	15H n=115	18 H n=114	21H n=107	Mean
Search Internet	23,1	26,1	21,4	21,7	21,3	20,6	18,5	22
Photos, images or videos	20,3	20,9	19,6	17,4	16,3	17,2	17,6	18
Drawing - Paint	12,9	17,4	19,4	19,7	20,7	19,8	21,3	19
Consulter InnoKiz - methods/guiding	16,5	10,6	8,3	6,3	7,1	8,6	3,4	9
Skype - Conference Web	10,6	8,3	7,2	7,4	7,4	8,0	2,8	7
Mind mapping	8,9	13,9	13,2	12,1	14,7	10,6	11,6	12
CAO - CAD	3,6	8,1	8,8	10,8	10,9	11,5	24,4	11
Other	4,1	1,7	2,1	4,6	1,6	3,7	0,3	3

Figure 4. ICT Tools used during 3 hour-periods (%)

3.3 Poll Consensus and Public Participation through InnoKiz

In the online forms to participants, we asked them about the InnoKiz functionalities that were effectively used.We then estimated an average of the results for each teammate. Later, we compared these data with the record of the Web Administrator, as shown in Table 1. TeamKiz (team on-line space of collaborative work) or IdeaBox (on-line space for sharing ideas) was used by the teams 19% for co-localized teams and 30% for remote teams. The use of a platform among co-localized teams seems to be influenced by the discipline of their participants: 50% (n=9) were computer science students, and the other professions were mechanical and industrial designers. In the case of remote teams, the sample was not enough to demonstrate the reasons of use of Innokiz.

Table 1.Use of Ideabox for co-localized and remote teams

	Total n teams = 135	**n teams Innokiz use**	**% Use**	**Discipline**
Colocalized team	123	23	19%	Computer science (n=8), Informatics, Mechanical and Industrial (n=4) Design, Industrial Engineering (n=4)
Remote teams (Virtual)	12	4	30%	Engineering (2), Design, Agriculture science (n=1), Food Engineering (n=1)

During the competition, about 820 participants used InnoKiz; of these, 91% used the platform to be informed and to participate in the competition. All of them worked in co-localized way, while only 9% worked inside InnoKiz (using others functionalities of the platform). Table 2 shows the ratio of utilisation of the platform by virtual and co-localized teams.

Table 2 shows that virtual teams are twice as ready to publish ideas in the IdeaBox as co-localized teams. InnoKiz allows the use of an idea evaluation tool, to send messages among teammates and to win prizes. However, the virtual teams do not have public votes, so their social external interaction is limited.

In Table 3 and Figure 5 we observed the distribution of comments: the main topics were explanations of the subject 25% when sponsors or coaches gave more information about their problem. Also, 24%

of the comments were about creativity cues that some participants from the organization board provided to give some clues to the teams.

Table 2.Use of Ideabox for co-localized and remote teams

	All	Colocalized	%	Virtual	%	Proportion Colocalized	Proportion Virtual	Ratio Colocalized	Ratio Virtual
# Participant	820	750	91	70	9				
Internal Messages	47	40	85	7	15	8,81	4,70	1:9	1:5
Messages community	249	223	90	26	10	8,37	6,70	1:9	1:7
Public participation	34	34	100	0	0	7,50	0,00	1:7	1:0
Prizes	53	46	87	7	13	8,64	5,30	1:9	1:5

Some participants involved with the competition used the platform for coaching, encouraging, explaining, commenting or answering some question from the team. Those comments were sent to the team using the comments tab of the public space.
The data obtained from comments of public participation and the effective uses of this function for the teams were then analyzed.

Table 3.Public messages to the team

Number	Categories	%	Description	n=messages
1	Encouraging teams	15	Notes about team achievement	5
2	Subject explanation	25	Questions about challenge	8
3	Organisation greeting	15	Messages from organisation board	5
4	Creativity cues	24	Give to teams	8
5	Sponsor contact	21	Sponsor message in public	7
	Total	100%	Total	33

This interaction was present for the co-localized teams, as observed in Table 2, where the ratio of public participation was 7:1 while delocalized teams had a ratio of 1:0. We observed that this interaction could be easier for the co-localized team. These teams have a social support that is easier to establish than it is for virtual teams. The social contact and the ongoing support produced an effect that is visualized in the platform.

4 ANALYSIS OF RESULTS

We observed the parallel use of the platform with other ICT tools, specifically the Internet browser as a search engine as a main activity reported. The InnoKiz platform was used by local and virtual teams in a very similar way in order to register for the competition and to post the results in an embedded Youtube video link. Also, the platform enhanced all the information needed to be aware of the competition. Some important design activities were conveniently supported by ICTs, and used by delocalized teams, especially the sharing idea space. This was because there was a need to enhance the information, ideas and knowledge obtained in a digital way for those teams. However, the delocalized teams were isolated from virtual social interaction with the Public in an open-collaborative innovation context.

5 MODELING THEUSE OF ICTS AND SOCIAL MEDIA FOR OPEN-COLLABORATION IN CO-DESIGN

ICTs such as cloud-computing technologies reveal the social dynamic that exists among designer communities. A model of open-collaborative innovation should reflect these social interactions with ICT technologies used by the design community. Social media adds some elements that facilitate the

communication to call upon designer communities to respond to the 24 H call; however social media are effective only if the community is well established.

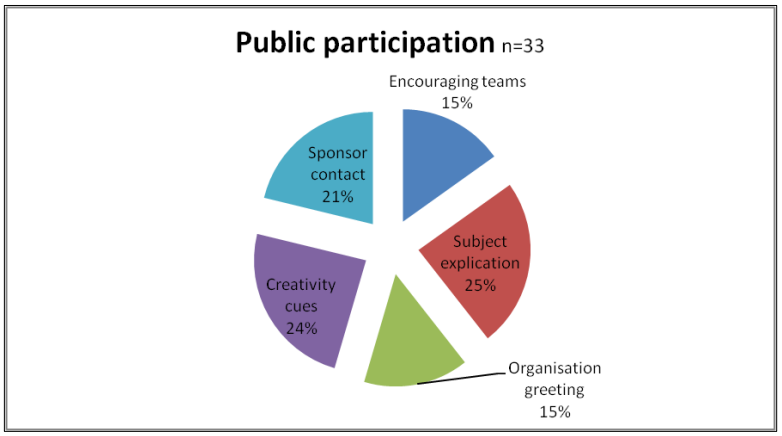


Figure 5. % of received messages from the public to teams during 24H

As seen in Figure 6, in order to generate an effective innovation platform using social media and ICT tools, the participants must have social interconnection that is based on personal acquaintances such as between classmates and teachers. This model was also observed for the public participation, with contributions (questions, greetings and ideas) of the external participants to co-localized teams.

Figure 6. Modeling uses of ICT and social media for open-collaborative innovation. Image adapted from: http://franco.ca/internet/index.cfm?voir=blogue&id=10711&M=599&item=1500, with permission of the author: Sylvio Franco. (Accessed December, 2013)

6 CONCLUSIONS

Results show that design teams preferred being invited by personal acquaintances and professors and most worked in teams that had few external expert interventions. Co-localized teams had more opportunity to receive external advice and contributions than de-localized teams did. Social media that are often useful to contact and inform participants were not utilised during the co-design process.

In our research we explored three topics related to the co-design experience in an Open Collaborative innovation platform (www.innokiz.com), and the ICT and social media support used by design teams.
Several factors must be considered when implementing a collaborative platform to support open-collaborative innovation. While the implementation of groupware or Web-based tools to enhance virtual teams is fairly straightforward, there are some social factors to develop as well such as: training in the use of those technologies, fostering new aptitudes to collaborate among students, and new methods of collaborative work in co-design. This study demonstrates that both co-localized and delocalized teams need tools for collaborative interaction, which few systems can provide.
Apart from technological issues, others aspects also directly affect the success of collaborative interaction. In particular, some amount of training time must be set aside for the use of the main functions of a new platform such as www.innokiz.com .Training is also needed for the preparation of a protocol or convention for asking questions, and for the preparation of related materials and strategies for presenting co-design results. Our future research will focus on these topics and we would like to extend to an invitation to participate in our reflective activities on open-collaboration

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