The paradox of diversity's influence on the creative teams

Lessons learned from the analysis of 14 editions of "The 24h of innovation" hackathon

Jérémy Legardeur*

Univ. Bordeaux, ESTIA Institute of Technology, 64210 Bidart France
IMS, UMR 5218, Talence, France
E-mail: j.legardeur@estia.fr

Dimitri Masson

Univ. Bordeaux, ESTIA Institute of Technology, 64210 Bidart, France
E-mail: j.legardeur@estia.fr

Mickael Gardoni

ÉTS, 1100, rue Notre-Dame Ouest, Montréal, Quebec, Canada
E-mail: mickael.gardoni@etsmtl.ca

Kusol Pimapunsri

Department of Industrial Engineering - Faculty of Engineering King Mongkut's University of Technology North Bangkok (KMUTNB)
E-mail: kusol.p@eng.kmutnb.ac.th

* Corresponding author

Abstract: The main objective of this paper is to understand the mindset and characteristics of a team in order to foster creative and innovative thinking. Especially, we want to analyse the influence of the diversity of scholar's affiliation within student's team on their performance during early design phase. For that purpose, we focus on one innovative event to foster creativity and design thinking of students during 24 hours design phase. This event is 'The 24h of innovation®" challenge which is an event created by the institute of technology ESTIA in Biarritz since 2007 (http://24h.estia.fr). During the period 2007-2019, we have organized 14 French editions and we collected the data of profile's participants in order to characterise the team's diversity. The paper demonstrates the paradox of the diversity that can increase sometimes positively the average team performance, but also the non-diversity can be a positive factor for the team excellence

Keywords: Creativity, Design Thinking, Innovation, Hackathon, The 24h of innovation, Diversity, Creative teams, Students.

1 Introduction

Motivation

Improving the creativity and innovation skills is a key point for any organizations. It is well known that entrepreneurs and innovators have commonly certain attitudes and characteristics that lead them to success, i.e., curiosity, passion and never giving up attitudes. In the literature we found many factors that influence the team's creativity and cohesiveness. Among them, the team diversity (of participant's profile, or school origin, or country…) is currently a major trend due to the globalization. Most of the companies in the world normally have several different branches in multiple locations. Most people believe that cultural diversity has immense impact on team performance, and it is necessary for teams to become multicultural (Stahl et al. 2007). It seems to be obvious that teams with diversity composed of different profiles and school's origin (engineering, design, marketing…) could be considered as a multiskilled team with a strong advantage to perform creative design task compare to a team composed of people coming from the same education organisation.

However, today there is a big challenge for most of educational institutions to propose multiskilled environment to develop the soft skills of their students (Legardeur et al. 2008). During their teaching program, it's not easy to immerge students to experiment and practice such diversity. Indeed, most of the time, the young people are separate in different schools or university with specific teaching program according to their orientation for engineering, design, marketing, sales, administrative…

Objective et plan

Our main objective in this paper is to contribute to the questions of mindset and characteristics of a team in order to foster creative and innovative thinking. Especially, we want to analyse the influence of the diversity of the stakeholders' profile within student's group on the performance of the team. In our case, the diversity aspect that we analysed here is the number of different schools or university represented in one students' team. The performance of the team is considered here as the results developed by the team during a 24 hours event.

For that purpose, we focus on one example of innovative event supported by ISPIM to foster creative and inventive thinking knowledge of students during design phase. This event is 'The 24h of innovation®" challenge which is an event created by the engineering institute ESTIA in Biarritz since 2007 (www.24h.estia.fr).

The paper is structured as follow: first, we introduce the context of "The 24h of innovation" event and we explain our methodology to code the data collected in order to characterise the diversity in teams and how the performance of the team have been modelled. In section 3, based on the proposed coding, we present the results of 14 editions of "The 24h of innovation" that took place in France during the period 2007-2019. Then in section 4 we will conclude with the main learnings concerning the influence of the diversity of student's origin on the team performance.

2 Context and methodology

The 24h of innovation context

"The 24h of innovation®" is a 24 hours nonstop challenge (that can be described as a hackathon) to develop creative and innovative concepts of products (mechanical, electronic, software…) and services. The concept of this event is simple: projects and topics are proposed by companies, labs, association and they are unveiled at the beginning of the competition. Teams are freely composed of a mix of any volunteers (students, researchers, teachers, consultants, free-lances, employees…). After 24 hours of development, teams present their results during an "elevator pitch" of 3 minutes on scene in front of a jury of professionals in the field of innovation. Then the jury must judge the propositions and declare the winning teams that receive the "24h of innovation" awards and prizes offered by the sponsors of the event.

Since 2007, 25 000 participants coming from more than 300 schools & university of 40 different countries have attended one of the 70 editions organized on 4 different continents: European (24h in France, Spain…), American (24h Canada…), Asian (24h Thailand, India…), African (24h Burkina Faso, Morocco…). More than 1000 projects have been developed for 500 companies.

Methodology

During the period 2007-2019, we have organized 14 editions at the engineering institute ESTIA in France and we collected the data of profile's participants in order to characterise the team's diversity.

Our sample is constituted of a total number of 3859 participants that have participated to one of the 14 editions. For the team's constitution during each edition (389 teams in total), the participants have been asked to constitute freely their team by choosing (according to the first arrived/first served rule!) only one project proposed by a company. The only constraint was to respect the maximum number of participants by team (around 7 to 10 according to the year).

We counted the "teams with diversity" with the following rule: any team composed of at least 2 participants coming from different schools or university. The other teams are composed with students coming from the same institution.

To consider the performance of the teams, we compiled the award list of all the editions based on a jury evaluation composed of 4 or 5 experts in the field of innovation. Indeed, during the editions, each jury have been asked to define the 1st, 2nd and 3rd prize and different specific prizes like best prototype, best design, best concept, best creative, best marketing, best presentation…. To help them to converge, we proposed a very simple evaluation matrix to assess all the propositions pitched by the teams based on 3 main criteria: originality, potential, technical and economic feasibility.

For each edition, the table 1 is a first synthesis of the data that we have collected:
- the total number of participants by edition,
- the number of teams that were created during the edition and with all the data available (size of the team, profile of students…),
- the number of teams that received an award during the edition,
- the number of teams with diversity that received an award during the edition

Table 1 Global data by year for the period 2007 – 2019

Year	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2019*
participants	138	176	216	238	243	348	328	334	400	400	444	182	274	138
total teams by edition	20	25	35	25	25	29	26	29	28	26	42	26	36	17
teams with diversity only	6	9	8	17	25	18	19	14	15	22	34	22	30	17
% of teams with diversity	30%	36%	23%	68%	all	62%	73%	48%	54%	85%	81%	85%	83%	all
total awarded teams	9	10	10	11	12	8	8	8	9	9	12	7	11	7
awarded teams only with diversity	3	3	2	8	12	6	8	3	6	8	8	6	9	7
% of awarded teams with diversity / total teams	**33%**	30%	20%	**73%**	n/a	**75%**	**100**	38%	**67%**	**89%**	67%	**86%**	82%	n/a

Nota: 2 editions were organized in March and October 2019.

3 Results about the influence of diversity on teams' performance

Global analysis

In this section we propose a global analysis of the data collected during the 2007-2019 period, in order to check the influence (positive, negative, neutral) of the diversity of student's profiles on the team's performance concerning the generation of creative and innovative solutions in 24 hours.

With the first raw data of table 1, we can compare the global performance of teams with diversity (TwD) and those with no diversity (TnD). In the table, the percentage of awarded TwD are in bold when it is more important compare to the percentage of TwD with the total number of teams in global. As we can notice in table 1, the probability to be awarded with a team composed of different profiles (TwD) is more important for 7 editions among 12 (58%), and less important for 5 editions among 12 (42%). There are 2 editions (in 2011 and the second one in 2019) where all the teams were composed with diversity so we can exclude these two columns from the analysis.

We can also calculate the percentage by category of teams in table 2. For example, in 2007, 3 TwD on 6 corresponding to 50% were awarded whereas 6 TnD on 14 corresponding to 43% were awarded. There is a correlation between the results of the table 1 and 2.

Table 2 Percentage of awarded teams by category for the period 2007 – 2019

Year	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2019*
% of awarded TwD	**50%**	33%	25%	**47%**	100	**33%**	**42%**	21%	**40%**	**36%**	24%	**27%**	30%	100
% of awarded (TnD)	43%	**44%**	**30%**	38%	0	18%	0%	**33%**	23%	25%	**50%**	25%	**33%**	0

Nota: 2 editions were organized in March and October 2019.

From this global analysis we can conclude that we observe a moderate positive effect of the diversity of the team performance. From our point of view, we thought that this trend would have been more important and demonstrated with more difference of percentage.

We decided to go further in the detailed analysis of data by using an advanced coding of the 389 teams' characteristics. Our main objective was to be more accurate in the characterisation of the diversity of the teams to challenge our global analysis based on a binary distinction (TwD vs TnD).

Detailed analysis

In order to go deeper in our analysis, we detailed the teams' composition by calculating an index of team diversity specific to all the 389 teams. We proposed to define this Index of Team Diversity - ITD according to the following formula:

ITD (Index of team diversity) = 100 x (Number of different schools in the team / Total number of students in the team)

This ITD give a percentage of diversity of students' school affiliation within a team. For example, a team composed of 8 students coming from 4 different schools or university has an ITD of 50% (see examples in Table 3).

We gathered all the data for the 389 teams and compare the ranking of this ITD index with the team's performance evaluated by the jury members of each edition. In order to have more detailed results on this last point, we made the distinction between:

- the awarded teams that received specific prizes "Spe P" (i.e. best prototype, design, concept, mock-up, presentation…)
- and the winning teams of each edition who were awarded by the higher honours (i.e. 1st, 2nd or 3rd prizes).

We ranked all the 389 teams according to their ITD index and awards (see table 4). From this list we extracted the ITD average (= 28,46875) in order to compare the performance of the teams above the average (i.e. with more diversity) and bellow the average (i.e. with less diversity).

Table 3 Example of detailed data for the period 2007 – 2019

Award	Team's name	Index of team diversity (%)	Total number of students in the team	Number of different schools in the team
No award	#24h	**12,5**	8	1
Specific Prize	24our BIKE	**25**	8	2
3rd Prize	**BasoTerrible**	**20**	10	2
2nd Prize	**20centimes**	**30**	10	3
1st Prize	Gaz Guys	**50**	8	4

Table 4 ITD index and awards of all teams for the period 2007 – 2019

Award	Idx	St	Sch	Award	Idx	St	Sch	Award	Idx	St	Sch	Award	Idx	St	Sch
	100	2	2		50	6	3		43	7	3	Spe P	38	8	3
Spe P	86	7	6		50	6	3		43	7	3	2nd	38	8	3
	80	5	4	2nd	50	8	4		43	7	3		38	8	3
	75	8	6		50	8	4		43	7	3		38	8	3
	71	7	5	1st	50	8	4	2nd	43	7	3	Spe P	38	8	3
	71	7	5		50	2	1		43	7	3		33	6	2
Spe P	70	10	7		50	4	2		43	7	3	Spe P	33	6	2
3rd	67	3	2		50	6	3	Spe P	43	7	3		33	9	3
	67	3	2		50	6	3		43	7	3		33	12	4
	63	8	5		50	2	1		43	7	3		33	3	1
Spe P	63	8	5		50	8	4		43	7	3	2nd	33	9	3
	60	5	3		50	8	4	Spe P	43	7	3	Spe P	33	12	4
Spe P	60	5	3		50	6	3		43	7	3		33	9	3
	60	5	3		50	4	2	Spe P	40	5	2		33	6	2
	57	7	4		50	4	2		40	5	2		33	6	2
	57	7	4	Spe P	50	8	4		40	10	4		33	9	3
	57	7	4		50	2	1	Spe P	40	10	4		33	3	1
Spe P	57	7	4		44	9	4		40	5	2	1st	33	6	2
	57	7	4		44	9	4		40	10	4	3rd	33	9	3
Spe P	57	7	4		43	7	3	Spe P	40	5	2		33	6	2
	57	7	4	Spe P	43	7	3		40	10	4		33	3	1
	57	7	4		43	7	3	Spe P	40	5	2		33	3	1
	57	7	4		43	7	3		40	10	4		33	6	2
	57	7	4		43	7	3		40	10	4		33	9	3
	56	9	5		43	7	3		38	8	3		33	6	2
Spe P	56	9	5	Spe P	43	7	3		38	8	3	Spe P	33	9	3
	50	8	4	Spe P	43	7	3		38	8	3		33	6	2
	50	4	2		43	7	3		38	8	3	2nd	30	10	3
3rd	50	8	4		43	7	3		38	8	3		30	10	3
	50	6	3		43	7	3		38	8	3		30	10	3
2nd	50	10	5		43	7	3		38	8	3		30	10	3
	50	10	5		43	7	3		38	8	3		30	10	3

	30	10	3
	30	10	3
Spe P	30	10	3
	30	10	3
Spe P	30	10	3
Spe P	30	10	3
3rd	30	10	3
Spe P	30	10	3
	30	10	3
	30	10	3
	30	10	3
3rd	30	10	3
	30	10	3
	30	10	3
Spe P	30	10	3
Spe P	30	10	3
Spe P	30	10	3
2nd	30	10	3
Spe P	30	10	3
Spe P	29	7	2
	29	7	2
	29	7	2
2nd	29	7	2
	29	7	2
	29	7	2
	29	7	2
	29	7	2
	29	7	2
2nd	29	7	2
	29	7	2
Spe P	29	7	2
1st	29	7	2
	29	7	2
Spe P	29	7	2
Spe P	29	7	2
	29	7	2
	29	7	2
	29	7	2
	29	7	2
Spe P	29	7	2
	29	7	2
Spe P	29	7	2
	29	7	2

	29	7	2
3rd	29	7	2
Spe P	29	7	2
	29	7	2
	29	7	2
3rd	29	7	2
3rd	29	7	2
	29	7	2
Spe P	29	7	2
	29	7	2
	29	7	2
	29	7	2
	29	7	2
1st	29	7	2
	29	7	2
Spe P	29	7	2
	29	7	2
	29	7	2
	29	7	2
	29	7	2
	29	7	2
Spe P	29	7	2
	29	7	2

Average = 28,46875

Spe P	27	11	3
Spe P	25	8	2
	25	8	2
	25	8	2
Spe P	25	4	1
Spe P	25	8	2
	25	8	2
	25	8	2
	25	8	2
Spe P	25	8	2
	25	8	2
Spe P	25	8	2
	25	4	1
	25	4	1
Spe P	25	4	1
Spe P	25	8	2
	25	8	2
	25	8	2
	25	4	1
2nd	25	8	2

	25	8	2
	25	8	2
	25	4	1
	25	8	2
	25	4	1
Spe P	25	8	2
	25	4	1
	25	8	2
Spe P	22	9	2
Spe P	22	9	2
	22	9	2
Spe P	22	9	2
	22	9	2
	22	9	2
	22	9	2
	22	9	2
Spe P	22	9	2
Spe P	22	9	2
	22	9	2
1st	22	9	2
	22	9	2
	22	9	2
Spe P	20	5	1
	20	10	2
3rd	20	10	2
	20	5	1
	20	10	2
	20	10	2
	20	10	2
	20	5	1
	20	10	2
Spe P	20	10	2
	20	5	1
	20	5	1
	20	10	2
1st	20	10	2
Spe P	20	5	1
Spe P	20	10	2
Spe P	20	10	2
Spe P	20	10	2
	20	10	2
	20	10	2
2nd	20	10	2
	20	10	2

	20	10	2
1st	20	10	2
	20	5	1
Spe P	20	10	2
	20	10	2
	20	5	1
	20	10	2
	20	10	2
	20	10	2
3rd	20	10	2
	20	10	2
	20	10	2
3rd	20	10	2
	20	10	2
	20	10	2
	20	5	1
Spe P	20	10	2
Spe P	18	11	2
	17	6	1
	17	6	1
	17	6	1
1st	17	6	1
Spe P	17	6	1
Spe P	17	6	1
	17	6	1
	17	6	1
Spe P	17	6	1
	17	6	1
Spe P	17	6	1
Spe P	14	7	1
	14	7	1
	14	7	1
	14	7	1
	14	7	1
	14	7	1
Spe P	14	7	1
Spe P	14	7	1
	14	7	1
1st	14	7	1
	14	7	1
	14	7	1

Spe P	14	7	1	1st	13	8	1	1st	11	9	1		10	10	1
	14	7	1	2nd	13	8	1	Spe P	11	9	1		10	10	1
	14	7	1	Spe P	13	8	1		11	9	1		10	10	1
	14	7	1		13	8	1		11	9	1		10	10	1
Spe P	14	7	1		13	8	1	Spe P	11	9	1		10	10	1
	14	7	1		11	9	1		11	9	1		10	10	1
Spe P	14	7	1		11	9	1		10	10	1		10	10	1
	14	7	1		11	9	1		10	10	1	2nd	10	10	1
	13	8	1		11	9	1		10	10	1		10	10	1
	13	8	1		11	9	1		10	10	1	Spe P	10	10	1
Spe P	13	8	1	Spe P	11	9	1		10	10	1		10	10	1
	13	8	1		11	9	1		10	10	1	Spe P	10	10	1
Spe P	13	8	1	Spe P	11	9	1		10	10	1	1st	10	10	1
	13	8	1		11	9	1	Spe P	10	10	1	2nd	10	10	1
Spe P	13	8	1	3rd	11	9	1		10	10	1		10	10	1
	13	8	1		11	9	1		10	10	1		9	11	1
	13	8	1		11	9	1	1st	10	10	1	Spe P	9	11	1
	13	8	1		11	9	1		10	10	1	1st	9	11	1
	13	8	1		11	9	1		10	10	1				
	13	8	1	Spe P	11	9	1		10	10	1				
	13	8	1	Spe P	11	9	1	Spe P	10	10	1				

The detailed set of data is available online:
https://docs.google.com/spreadsheets/d/1OISuUFbwP_OOY4R0QG88zA-FMvcaReHI4Rfn6b5meLE/edit?usp=sharing

The results presented in the table 5 and table 6 provide new insights concerning the influence of diversity on the performance of the team. The table 5 shows that the performance of teams with less diversity (according to the ITD average) is a little higher compared to the team with more diversity. The most significant difference is the number of 1st prize which is most important for teams with less diversity. These results of our detailed analysis are surprising but also interesting because they are in opposition with the results of the global analysis based on the same data.

Table 5 Performance of teams classified according to ITD average for the period 2007 – 2019

	Teams above the ITD average = Teams with more diversity of 28%	Teams below the ITD average = Teams with less diversity of 28%
Number of awarded teams with Spe. Prize	42	**49**
Number of awarded teams with 3rd Prize	**8**	**4**
Number of awarded teams with 2nd Prize	**9**	5
Number of awarded teams with 1st Prize	4	**10**
Total	63	**68**

Table 6 Performance of teams (with diversity or not) for the period 2007 – 2019

	Teams with diversity	*Teams without diversity*
Number of awarded teams with Spe. Prize	**59**	32
Number of awarded teams with 3rd Prize	**11**	1
Number of awarded teams with 2nd Prize	**11**	3
Number of awarded teams with 1st Prize	7	7
Total	**88**	43

4 Conclusions and lessons learned

From a practical point of view, the goal of the 24h of innovation is to foster the socio-technical practices (Subrahmanian et al. 2001) of the students that are involved in a short but intensive collaborative period with the use of creativity and design tools, marketing and communication methods... We think that this kind of event helps the young generation to be more creative and more easily integrated in the socio-professional networks. In this paper, we propose some insights concerning the influence of diversity on collective and creative design process. From a theorical point of view, our results are complementary with others scientific experimentations performed during the 24h of innovation (Legardeur et al. 2009), (Legardeur et al. 2010), (Jimenez et al. 2010), and show the influence of the team diversity on the generation of creative concepts by students under time pressure. Our study shows that the diversity of affiliation within students' teams can be defined as a paradox with a positive and negative influence on their performance during a 24 hours contest. The most surprising new learning of our work is concerning the results obtained by the teams with low level of diversity. In our case studies, we demonstrate that the winning teams of the 1st prize award are most of the times composed of students with low diversity (10 teams with less than 22% of diversity were awarded with the 1st prize compared to the total number of 14). After investigation, we noticed that most of the winning teams of the 1st prize were mainly composed with a core of students with stronger relationships: i.e. they were friends, members of associations, roommate… Our results are questioning some previous work in the literature on the influence of the diversity of ethnic (Watson et al 2002). We think that the ability to work together, the relationship between students created during their scholarship within a school or university could be influences more important to succeed during hackathon-like event. To sum up our scientific contributions, the main learning is concerning the paradox of diversity's influence on teams:

"If the team is composed of students with different affiliations, the diversity can increase positively the average performance (i.e. the probability to be awarded by one of the different prizes in our case study). At the opposite, if the team is mainly composed by students from the same affiliation, the non-diversity can sometimes increase positively the excellence performance (i.e. the probability to be awarded by the 1st prize in our case study)"

References

Landy, Frank J.; Conte, Jeffrey M. (2009-09-08). Work in the 21st Century: An Introduction to Industrial and Organizational Psychology. John Wiley & Sons. ISBN 9781405190251.

Forsyth, D. R. (2010). Group dynamics. Belmont, CA: Wadsworth. pp. 358–359

Jimenez-Narvaez L.M., Choulier D., Legardeur J., M. Gardoni, « Creative Teamwork in Quick Projects Development QPD, 24 Hours of Innovation », in the proceedings of the 18th International Conference on Engineering Design, pp. 214-223, ICED'11, Copenhagen, August, 2011.

Jimenez-Narvaez L.M., M. Gardoni, Reflections on Creative and Collaborative Teamwork in Charrettes, 24 Hours of Innovation, Proceedings of IDMME - Virtual Concept 2010, Bordeaux, France, October 20 – 22, 2010

Legardeur J., Zephir O., Minel S. « How to analyse collaborative practices of engineering students? », in the proceedings of the 10th Engineering and Product Design Education, E&PDE08, Vol 2, pp 541-546, Barcelona, September, 2008. ISBN 1-904670-04-0

Legardeur J., Choulier D., Savoie E. « The 24h of innovation®: an event to stimulate new product concepts in the sports technology », in the proceedings of the Asian Pacific Congress on Sport Technology, APCST 2009, Honolulu, Hawaii, USA, September, 2009.

Legardeur J., Monnier B., Choulier D. « New projects evaluation method for the 24h of innovation® », in Towards new challenges for Innovative management practices - ERIMA 2010, Vol.3, n°1, pp. 177-186, June, Wiesbaden, 2010

Legardeur J., Choulier D., Monnier B., « How to evaluate creative and innovative concepts during the contest of the 24h of innovation® », International journal of Projectics, Vol. 2. n°5, pp. 105-118, De Boeck Edition, 2010. ISBN 978-2-8041-6130-9

Stahl, Günter K., et al. Unraveling the Diversity-Performance Link in Multicultural Teams: Meta-analysis of Studies on the Impact of Cultural Diversity in Teams. France: INSEAD Working Paper Series, 2007.

Subrahmanian E., Westerber A., Talukdar S., Garrett J., Jacobson A., Paredis C., Amon C. Integrating Social Aspects and Group Work Aspects in Engineering Design Education", in the proceedings of the Workshop on Social Dimensions of Engineering Design, pp. 117-126, 17–19 May. 2001

Watson W. E., Johnson L, Zgouridesc G.D., The influence of ethnic diversity on leadership, group process, and performance: an examination of learning teams. International Journal of Intercultural Relations, Vol 26, Issue 1, pp 1-16, February 2002