

ANALYSIS OF STUDENTS OPINION ABOUT A CREATIVE DESIGN EXPERIENCE BY MEANS OF VIRTUAL SYNCHRONOUS TEAMS

Elena MULET¹, Nathalie ESCAMILLA¹, Vicente CHULVI¹, Carlos GARCIA-GARCIA²,
Francisco FELIP² and Julia GALÁN²

¹Department of Mechanical Engineering and Construction. Universitat Jaume I, Spain

²Departamento de Ingeniería de Sistemas Industriales y Diseño. Universitat Jaume I, Spain

ABSTRACT

It is very frequent that in engineering design education students work in teams organizing themselves in face-to-face work meetings as well as by means of online applications to share documents and communicate when they are in different physical places. The aim of this work is to analyze the students' opinion about developing creative design tasks by means of virtual teams editing a sketch file synchronously and communicating by chat. An experiment was done in which 21 teams of three students each one generated creative ideas both by face-to-face and virtually. Their opinion has been evaluated by means of a questionnaire.

The results show that the students find that the interface is pleasant and they have enjoyed the experience of using it. They feel satisfied with the amount of information available and the organization of the information in the screen. Design students also think that it is easy to learn to use the IT tool and that it is fine to develop a creative design task in virtual teams. However, students think that the assigned design task is more difficult to do in virtual teams and that it can be solved in a better and faster way in face-to-face teams. A 30% of the students have felt equally satisfied, but a 46% have felt more satisfied in the face-to-face. As a conclusion of the study this kind of creative design tasks are more efficient, in the opinion of the students, in face-to-face teams than in virtual teams using chat.

Keywords: ITs in education, virtual teams in design education, students opinion, creative design, collaborative design

1 INTRODUCTION

It is very frequent that in engineering design education students work in teams organizing themselves in face-to-face work meetings as well as by means of online applications to share documents and communicate when they are in different physical places [1]. Since virtual teams in education are quite frequent it is interesting to know how effective the Information Technologies for collaborative design in education are.

It is usual in product design that the creative phase in the early design step will be driven in groups. In fact, several of the most successful methods for the obtaining of creative solutions are based in how ideas proposed encourage the generation of new ideas, such as brainstorming and other creative techniques, as can be seen in the collections of methods by [2] and [3]. The implementation of these methods into web technologies has demonstrated to be effective in experiences with students within the project-based-learning (PBL) framework [4].

Within the past work related to the university teaching, it must be point the experience performed by Tang et al [5]. Here the differences between creative work in virtual groups and face-to-face groups has been analysed from an experiment involving 20 students working in pairs. The teams must generate a conceptual design of two design problems of similar characteristics by using two different modes of working: traditional sketching environment with a large table space for face-to-face collaboration using pen and paper and the digital environment for collaboration sharing the desktop, using video conferencing and emulating pen-and-paper using Wacom Cintip 21 + Alias Sketches Book Pro. In this experiment the design process and the results were evaluated concluding that both

types of environment did not produce differences in the results, so, the digital environment proposed emulated quite good the traditional environment in terms of design process.

In industrial design teaching it is usual that the students make their design projects in groups. Their tasks combine a part of face-to-face work and a part of no on-site work. When students have the necessity of communicate between them, they commonly use chat-like environment together with web applications in order to share and edit files online and simultaneously.

Another interesting experience in university education compares different communication scenarios for team work which includes face-to-face and wiki plus chat in industrial engineering students solving two exercises. The study concludes that there are no significant differences between the performance between online communication mechanisms on work and the face-to-face work. This study also reveals that students perceive less difficult working face-to-face [6].

If it is true that in a future it would be more easy to use video-conference or, at least, audio-conference, it would be interesting to know up to where the collaborative workspace with chat is useful nowadays to perform group tasks of creative design, since other studies point that chat communication leads to a collaboration that it is experience as more task to task oriented than in face-to-face collaboration [7].

The aim of this work is to analyze the students' opinion about developing creative design tasks by means of virtual teams when those teams share the same virtual workspace for developing their idea and uses a chat for verbal communication. These students' opinion has been collected through a questionnaire based on the Post-Study System Usability Questionnaire (PSSUQ) and the Computer System Usability Questionnaire (CSUQ) of Lewis [8].

2 RESEARCH METHODOLOGY

In this work an experience is described in which 21 teams of tree design students each one were assigned a creative problem which consisted of designing a new product and developing a sketch of the solution. The students had not work together in a team task before.

Each team performed two situations: one in which they worked face-to-face in the same room; and the other one in which each member were located in a different room simulating a virtual team. For each situation the team tackled a different design problem. An experiment design was prepared so that each one of the two design problems were solved half of the times by a virtual team and the other half by a face-to-face team.

In the face-to-face situation, the participants employed paper and colours and in the virtual situation the students used track pads (devices that translate pressure in pointer movements) together with Google Docs, which is a free-use Web-based programme to create online documents in a collaborative way (Figure 1). The Paint application was also used to share the same file and visualize every change simultaneously and in real time. This way, the tools provided very similar possibilities to represent the sketches in both type of teams.

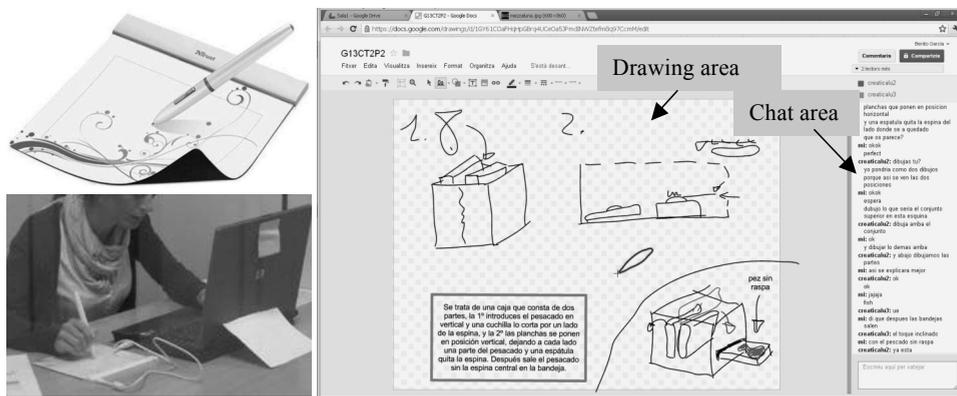


Figure 1. Track pad interface device and a screen capture of the Paint with chat in GoogleDocs

Students' opinion about the experience has been evaluated by means of a questionnaire based on the (PSSUQ) and the CSUQ of Lewis [6] to know the opinion about the usability of ITs in a creative design task in comparison to when the same task is conducted by students in the same physical space. The final questionnaire is shown in Table 1. Questions from 1 to 7 ask about the differences between generating creative ideas in virtual teams and face-to-face; while questions from 8 to 14 ask directly about the usability and suitability of the proposed system for virtual teams.

Table 1. PSSUQ and CSUQ-based questionnaire

Questionnaire instructions:									
The following questions refer to how you have been feeling using ITs to virtual team work in comparison to face-to-face. The position 4 means that you have feel equally in both working scenarios.									
1. How easy it has been to work in teams with ITs in comparison to working face to face?									
Much easier	1	2	3	4	5	6	7	Much more difficult	
2. How simple it has been to work in teams using ITs in comparison to working face to face?									
Much simpler	1	2	3	4	5	6	7	Much more complex	
3. How correctly have you been able to complete the work using ITs in comparison to working face to face?									
Much more correct	1	2	3	4	5	6	7	Much less correct	
4. How quickly have you been able to complete the work using ITs in comparison to working face to face?									
Much quicker	1	2	3	4	5	6	7	Much slower	
5. How efficiently did you completed the task using ITs in comparison to face to face?									
Much more efficient	1	2	3	4	5	6	7	Much less efficient	
6. How comfortable have you felt using ITs in comparison to working face to face?									
Much more comfortable	1	2	3	4	5	6	7	Much more uncomfortable	
7. Overall, to generate creative ideas in teams, How satisfactory have you felt using ITs in comparison to face-to-face?									
Much more satisfied	1	2	3	4	5	6	7	Much less satisfied	
8. It has been easy to learn to use this system									
Strongly agree	1	2	3	4	5	6	7	Strongly disagree	
9. I believe I could become productive quickly using this system									
Strongly agree	1	2	3	4	5	6	7	Strongly disagree	
10. I has been easy to find the information I needed									
Strongly agree	1	2	3	4	5	6	7	Strongly disagree	
11. The information provided by the system was easy to understand									
Strongly agree	1	2	3	4	5	6	7	Strongly disagree	
12. The organization of information on the system screens was clear									
Strongly agree	1	2	3	4	5	6	7	Strongly disagree	
13. The interface of this system (screen, flexible tablet and tactile pen) were pleasant									
Strongly agree	1	2	3	4	5	6	7	Strongly disagree	
14. I have liked using the interface of this system									
Strongly agree	1	2	3	4	5	6	7	Strongly disagree	
If you have any other comment, please, insert it here (volunteer)									

The questionnaire was answered by 51 from the 63 participants of the experiment, thus, the number of answers is more than the 80% of the population and the results are representative enough. In addition to the questionnaire responses, an analysis of the students' rationale has also been done by means of personal interviews after the experiment. The Toulmin model has been applied to represent the reasons of their opinions. In this model several elements are identified [9]:

- Data: The facts or evidence used to prove the argument
- Claim: The statement being argued (a thesis)
- Warrants: The logical statements that serve as bridges between the claim and the data.
- Qualifiers: Statements that limit the strength of the argument.
- Rebuttals: Counter-arguments indicating when the general argument does not hold true.
- Backing: Statements that serve to support the warrants

3 RESULTS

Frequency of the answers to each question has been calculated from the collection of the questionnaire answers. First of all, results of questions 1 to 7 have been analysed, since they compare the opinions between the two modes of working used in the experiment. Lately, results of questions 8 to 14 have been analysed. These questions are related to specific opinions of the work system for virtual groups.

3.1 Comparison between the two modes of working

Table 2 resumes the answer percentages for questions 1 to 7. As it can be seen, more than the half of the survey respondents found the task a bit more or quite more difficult by using technologies regarding to face-to-face working. Nonetheless, a respectable percentage of the 30% of the students has found it easier. That is, although the percentage of people that finds more difficult working with ITs is higher, there are also an important percentage of the students that has found it easier.

Table 2. Comparison of virtual and face-to-face experience

How it has been working with virtual teams in comparison to face to face?							
	1	2	3	4	5	6	7
	Easy	Simple	Correct	Quick	Efficient	Comfortable	Satisfactory
Much more	0%	0%	2%	4%	2%	14%	2%
Quite more	12%	16%	18%	14%	16%	14%	12%
A little bit more	20%	12%	18%	20%	27%	8%	10%
Equally	2%	16%	18%	12%	22%	18%	29%
A little bit less	39%	37%	20%	25%	24%	33%	24%
Quite less	22%	16%	20%	16%	6%	8%	16%
Much less	6%	4%	6%	10%	4%	6%	8%

When asking about the simplicity of the system, the variety of the responses increases, even though the 37% of them considers that it is complex to use the proposed system for creative group working. In Table 2 can be seen that answers to questions 3 and 4, related to the opinion about the grade of correction and speed on performing tasks, are very distributed. So, the mode of working, virtual or face-to-face, doesn't seem to make influence in the grade of correction, and, despite the low differences found, the system used in the experiment for virtual groups working appears to be a bit slower than face-to-face working.

The analysed answers show as a result that the use of technologies results a bit less comfortable than working face-to-face. Moreover, almost the 14% of the surveyed feels quite more or much more uncomfortable working in virtual teams. Considering that the participants are young people used to use technologies both to communicate and in their studies, these opinions should be analysed deeper. Regarding to the efficiency of the system, few differences are shown between the two work systems, although the use of technologies appears to be a little more efficient.

Finally, regarding to the satisfaction degree when working in virtual teams, the 29% of the students consider that both working modes are equally satisfactory, an close to that opinion is the 24% of them that think that the virtual working is a little bit less satisfactory than the face-to-face working.

From results over the comparative opinion of the two work systems, it can be seen that in general terms the students are a bit more satisfied working in face-to-face mode than in virtual mode with the tools provided in present experiment. They consider the proposed system a few more complexes and difficult for elaborating a first graphical solution presented as a sketch.

3.2 Results on the usability of the working system for virtual teams

The second part of the survey refers to the opinion about the level of usability of the used system for virtual team working. The frequency graphs of the answers are shown in Table 3. More than a 60% of the surveyed are strongly agree or closer with the question relative to the easiness of learning to use the system (question 8). Moreover, they perceived that they can be more productive with it (question 9) and they like the interface employed (questions 13 and 14). It has also to be noticed that around the 10% of the surveyed opine that it has been difficult to learn to use the system (q8) and a 12% thinks that, even with practice, the system used in the experiment wouldn't be enough productive for creative team tasks (q9).

Table 3. Opinion about system usability for virtual teams

	8	9	10	11	12	13	14
	Easy to learn	Productivity	Finding information	Information easy to understand	Clear organization	Pleasant interface	Like using interface
Strongly agree	43%	39%	29%	29%	29%	41%	41%
	31%	25%	24%	33%	18%	18%	18%
	10%	10%	22%	16%	20%	20%	18%
Indifferent	4%	12%	14%	8%	12%	8%	14%
	10%	8%	8%	10%	10%	12%	10%
	2%	4%	4%	2%	8%	2%	0%
Strongly disagree	0%	2%	0%	2%	4%	0%	0%

Regarding to the information provided by the system, the opinion has been less positive than in case of the interface. In question 10, the most chosen option has been that they are totally agree in that it has been easy to find the information they needed, and the 75% of the surveyed were some, quite or strongly agree with that. The question 11, about the easiness of understanding the information provided by the system, the most selected option was “quite agree”, with a 33% of the answers, closely followed by “strongly agree” with the 29% of the answers. The agreement has been lower in question 12, about the clearness of the organization of the information on the system screens. Here the answer selection was more dispersed. Despite the fact that the 29% were strongly agreed with the clearness of the information’s organization, the 22% are disagreed in some level.

3.3 Commentaries of the students about the design creative experience with virtual teams

Twelve of the 51 received responses include an optional commentary of the surveyed. The most of them were referent to the disturbance of having to type to communicate with the rest of the team members, and that if the technologies make easier the communication they see positive solving creative tasks in virtual groups. There are also commentaries about the few possibilities of the Paint tool employed in the experiment, but they also believe that they will be able to get more profit with more practice. Moreover, two students mention that face-to-face work would be better always, no matter which technology will be used. Figure 2 summarizes the most common students’ rationale about their opinion on this experience, based on the model of Toulmin [9]:

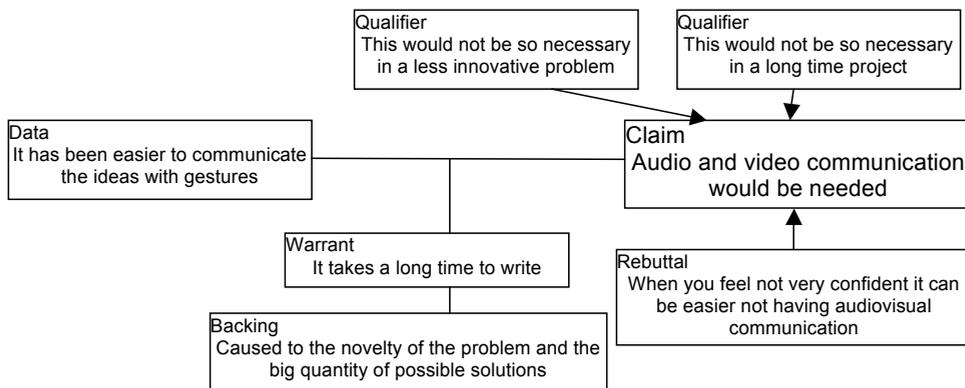


Figure 2. Students’ arguments about the collaborative system used

4 CONCLUSIONS

This paper shows the opinion of 51 university students about the use of a virtual environment for group creative design using chat. The results show that the students find that the interface is pleasant (60% of totally or quite agreement) and they have enjoyed the experience of using it (60% of totally or quite agreement). A 78% and a 67% feel satisfied with the amount of information available and the

organization of the information in the screen respectively. Design students also think that it is easy to learn to use the IT tool (84%) and that it is fine to develop a creative design task in virtual teams. However, students think that the assigned design task is more difficult to do in virtual teams (67%) and that it can be solved in a better (46%) and faster (51%) way in face-to-face teams, concluding that creative design tasks are more efficient in face-to-face teams. A 29% think that both systems are equally satisfactory, but a 48% feel more satisfied with face-to-face working.

The reasons why they believe that face-to-face is better are the need of typing the information through chat, which can be easily solvable by using other technologies, and the limitations of the drawing tool. This can be caused to several reasons, as the fact that communication is more fluid or the fact that previously they have normally worked in face-to-face creative design groups. Thus, in case that the virtual system would have allowed for audio-visual communication probably the questionnaire results would have been different. Nonetheless, it is also interesting that they are open to the use of technologies for this kind of tasks, and that they have been capable of performing the task in the same time conditions. Anyway, they think that for this kind of tasks, these limitations can be overcome through practice.

From an educational point of view in subjects in which creative solutions from team working are needed, students show a preference for face-to-face creative work sessions in comparison to chatting and drawing in a virtual context. So, the most satisfactory for students will be organizing the sessions in the time in which all students can be present in space. Contrarily to this statement, students have also claimed that the virtual system presents the advantage of encouraging the proposal of crazy ideas, which is not easy to do in a face to face communication if they don't feel confident enough.

Indeed, for longer projects which comprise more tasks than the creative generation of ideas, if a virtual system like the one analysed in this research is used the students would appreciate the possibility to join virtually for working on the project since this would allow for more frequent contact between the team.

ACKNOWLEDGEMENTS

This work has been possible thanks to the project P11B2010-51, "Estimulación y evaluación de la creatividad en el diseño de productos en equipos de diseño distribuidos", funded by the Universitat Jaume I.

REFERENCES

- [1] Magal-Royo T, Jorda-Albiñana B, Gonzalez del Río J, Ampuero Canellas O, Giménez-López JL. Online Collaborative Environments in the Creative Process of Product Development for Engineering Students. *Procedia - Social and Behavioural Sciences*. Volume 51, 2012, Pages 677–681.
- [2] Jones JC 1970 *Design Methods: Seeds of Human Futures* New York Wiley-Interscience.
- [3] VanGundy AB 1988 *Techniques of Structured Problem Solving* New York Van Nostrand Reinhold.
- [4] Ardaiz-Villanueva O, Nicuesa-Chacon X; Brene-Artazcoz O; Sanz de Acedo Lizarraga ML; Sanz de Acedo Baquedano, MT. Evaluation of computer tools for idea generation and team formation in project-based learning. *Computers & Education*, 56, 3, 700-711 (2011).
- [5] Tang, H.H., Lee, Y.Y. and Gero, J.S. Comparing collaborative co-located and distributed design processes in digital and traditional sketching environments: A protocol study using the function-behaviour-structure coding scheme. *Design Studies*, 2011, 32, (1), 1-29.
- [6] Rodríguez-Donaire S; Barodzich I. The Influence of Online Communication and Web-Based Collaboration Environments on Group Collaboration and Performance. *Procedia - Social and Behavioural Sciences*, Volume 46, 2012, Pages 935-943.
- [7] Lantz Ann. Meetings in a distributed group of experts: Comparing face-to-face, chat and collaborative virtual environments. *Behaviour & Information Technology*. 20,2 (2001).
- [8] Lewis JR. IBM Computer Usability Satisfaction Questionnaires: Psychometric Evaluation and Instructions for Use. Technical Report 54.786 (1993).
- [9] Toulmin S, *The Uses of Argument* (1958) 2nd edition (2003).