Collaborative Creativity: A Computational Approach

Raw Shaping Form Finding in Higher Education Domain

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***Abstract*— This paper examines the conceptual synthesis processes in conjunction with assistive computational support for individual and collaborative interaction. We present findings from two educational design interaction experiments in product creation processing (PCP). We focus on metacognitive aspects of interaction, externalization and, representation to obtain better performance, shorter ideation time and enhance creativity. Self-regulated learning (SRL) and collaborative computer supported reflective learning (CSRL) have strong links with our research on hybrid computational design tools.**

Keywords - intuition; creativity; design; hybrid design tools; collaborative interaction.

I. Introduction

Our hypothesis is that we can use the machine as an active participative partner in creativity and processing, but to what extend and how much control is handed to the machine is a user-choice and decision. Our approach is to have the user involved as much as possible, in such the tool (machine) [1] is like any other tool a mere extension to facilitate and aid in a specific task. The proposed holistic framework encompasses mixed realities with tangible exploration transferring another perspective on usability, processing and interaction scenarios within HCI and user-centered experiences in the creative domain. In Expt. 1, we show method and results from sixty-six heuristic shape ideation tasks combined with three-dimensional scanning and hybrid morphing techniques. In Expt. 2, the sixty participants were equally divided in thirty analogue- and thirty hybrid synthesizers and they worked in paired and triad groups on the same design task. The participants were undergraduate design engineering students.

II. Experiment I

In Expt. 1 sixty-six participants were presented the following self-regulated learning (SRL) [2] design task: choose a common tool; select the tool intent; and create iterations by a variety of tool-actions, haptic interactions and manipulations and manifest these in a moldable material (e.g. clay, wet sand). Cast the various patterns or shapes in plaster or resin. Choose the most interesting shape or form and make a three-dimensional scan of the artifact (-s) as illustrated in Fig.1. With the point-cloud data of the object make different virtual models and create a product or artifact representation. Combine the analogue and virtual ideation processes to make a final visualization and presentation of the design process as shown in Fig. 2. The initial fuzzy-frontend of a design process where forethought on the process takes place; followed by iteratively performing the ideation process, is enhanced by a hybrid mix in tools and technologies. Doing-in-action, thinking-on-your-feet and, reflection-on-action stimulate learning, foster knowledge acquisition and skills [3, 4, 5]. Table I shows the preliminary results of this experiment. Total duration to execute the design task was two weeks, in support of incubation and reflection.

Figure 1. Iterative ideation process, scans, morphing and representation

Figure 2. Setup and scans from sixty-six participants.

TABLE I. PERFORMANCE SCORE AND TASK SUCCES EXPT. I

Experiment I :	
Number of students	66
Total nr. of 3d scans	112
Total nr. of tangible models	158
Total nr. of virtual models	115
Total nr. of end products	73%
Total nr. of artifacts	16%
Total nr. unidentified	1%
Total task success	84%
Total completion	90%

978-0-7695-5009-1/13 $26.00 © 2013 IEEE
DOI 10.1109/ICALT.2013.51

IEEE computer society

III. EXPERIMENT II

The design task of Expt. 2 is to design and create a Farm Stand. The sixty participants were equally divided in analogue design synthesizers (ASD) and hybrid design synthesizers (HDS), subsequently arranged in nine paired and four triple groups. After the design brief the twenty-six groups had to collaboratively generate and externalize ideas by association and abstraction followed by an iterative ideation process to make representations. The ASD groups were supported with traditional design tools, for the HDS groups were added a hybrid design tool (HDT) [4] as shown in Fig. 3. For a full account on interactive processing with the HDT we refer to its primary documentation [1,6,7]. Duration of the design task was ten minutes, five minutes for brainstorming and five for iterative ideation interaction (Fig. 4). Four expert facilitators supported the groups during the duration of the experiment. The aim was to generate as much iterations as possible in five minutes ideation time. In Fig. 4 we show paired and triple groups during interaction and ideation in reflective negotiation with tangible and intangible content. Fig. 5 illustrates the hybrid tool interaction were participants mediate between modalities and mixed realities. Intermediate solutions and end results of physical- and virtual models are presented in Fig. 6. We analyzed and evaluated by comparing the results from analogue and hybrid representation and presentation in solving the design task. In Table II we show preliminary findings and results indicating quantitative scores in proportion to the actual interaction time.

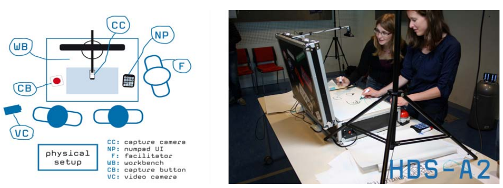

Figure 3. Setup and hybrid design tool interaction.

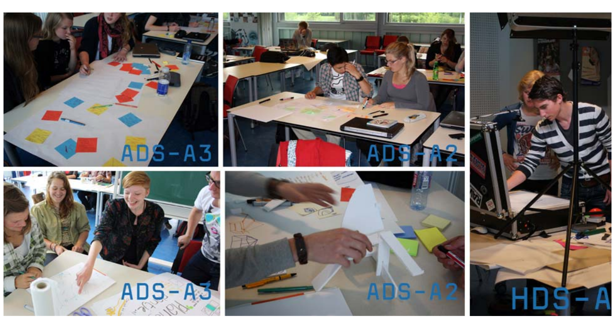

Figure 4. Collaborative mindmapping and brainstorm sessions.

Figure 5. Hybrid design interaction with tool

Figure 6. Physical and virtual models

TABLE II. QUANTITATIVE SCORES TIMED EXPT. II

Experiment II	Duo Coll.	Trio Coll.	Duo Coll.	Trio Coll.
Total groups	9 x A2	4 x A3	9 x H2	4 x H3
Number of students	18	12	18	12
Total ideation time in min.	45	20	-	-
Total interaction time in min.	-	-	43	24
Average iter./min.	1,2	1,2	0,7	0,8
Total abstract representations	30	15	31	15
Total tangible models	8	2	6	2
Total VR models	0	0	24	13
Total iterative representations	38	17	61	30

IV. SUMMARY AND CONCLUSION

In this article we presented two experiments in concept linked with self-regulated learning (CRL) and computer supported reflective learning (CSRL). We showed a multi-modal creativity approach to PCP assisted with a hybrid design tool. The findings and results are preliminary and are part of our ongoing research and exploration. The hybrid tool shows promise in intuitive human computer interaction (HCI), speed and collaboration to externalize a multitude of ideas. The combination of making tangible and virtual iterations evokes pleasure, feedback and reflective negotiations to manifest solution-driven results. We intend to further explore and research this work in the domain of technology enhanced learning (TEL). In conclusion, Planck (1949) stated that the creative scientist 'must have a vivid intuitive imagination, for new ideas are not generated by deduction, but by an artistically creative imagination' [8].

ACKNOWLEDGMENT

We like to thank all the participating design students of the University of Twente in the Netherlands.

REFERENCES

[1] R.E. Wendrich, "Design Tools, Hybridization Eploring Intuitive Interaction," Proc. of the JVRC Conference of EuroVR, T.Kuhlen, S.Coquillart, and V.Interrante (Ed.), Stuttgart, 2010, pp. 37 -42.

[2] B. Zimmerman, "Becoming a self-regulated learner: An overview," *Theory Into Practice*, vol. 41, May. 2002, pp. 64-70

[3] D. Schön, The Reflective Practitioner, Basic Books Inc.,New York NY USA, 1983.

[4] M. McCullough, Abstracting Craft: The Practiced Digital Hand, the MIT Press, 1998.

[5] M. Polanyi, The Tacit Dimension, Doubleday & Company Inc. USA, 1983. *(references)*

[6] R.E. Wendrich, "Multimodal Interaction, Collaboration, and Synthesis in Design and Engineering Processing'" in Marjanovic D., Storga M., Pavkovic N., and, Bojcetic N. (eds), 12^{th} International Design Conference-DESIGN2012, Dubrovnik, 2012, pp. 579-588.

[7] R.E. Wendrich, "Raw Shaping Form Finding: Tacit Tangible CAD," *CAD and Applications*, Volume 7, Number 4, 2010, pp 505-531.

[8] M.Planck, Scientific autobiography and other papers (F.Gaynor, Transl.), New York, Philosophical Library, 1949.