Exploring the creative process in a brainstorming session to develop a web-based system for idea selection

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ABSTRACT

Betting on new and promising ideas is fundamental for innovation in various sectors, helping the world that faces so many adversities. To increase these ideas, the stages of evaluation and selection of ideas in the creative processes need to be improved and not neglected. To minimize this problem and contribute to the scientific advance in the creativity-oriented HCI, we present a tool for selecting ideas used after brainstorming sessions. Our prototype is inspired by the conclusions of an observational study that we conducted with six students in a classroom, in which the students' objective was to plan the making of a video for a social institution that helps the neediest people.

CCS CONCEPTS

• **Human-centered computing**; • **Human computer interaction (HCI)**; • **Empirical studies in HCI**; • **Human- centered computing**; • **HCI design and evaluation methods**; • **User studies**; • **Additional Keywords and Phrases: Creativity, Creative processes, Idea evaluation, Idea selection**;

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1 INTRODUCTION AND BACKGROUND

Creativity is a skill of universal value and use, defined as the ability to communicate extraordinary thoughts, critically affect the perception of reality, contribute to original inventions or discoveries, and generate new ideas to solve complex problems [1–3]. Changes in technology, globalization, and increased competition have created an environment where creativity and innovation are needed during creative processes. The starting point for innovation comes from ideas, and to obtain these ideas, it is necessary to carry out the creative process composed of three stages: the generation of ideas, the refinement or evaluation of ideas, and the last stage, the selection of ideas [4, 5]. The problem, however, is when compared to the idea-generating stage, research on the evaluating and selecting ideas stage has received little attention. Rietzschel and Ritter [6] state that the evaluation and selection processes play a critical role in solving any task that is presented to the individual. Nevertheless, if the evaluation process is less than ideal, the ideas chosen during the selection process are likely suboptimal [7]. The brainstorming technique was proposed as a set of guidelines for creative collaboration by groups. Despite being a standard method used to generate ideas, it sometimes includes the idea evaluation and selection phase because it involves a prolonged effort, complementing the individual creative process. [8–10].

There is a consensus that the evaluation and selection of ideas are fundamental to the success of creative problem solving [11]. So far, some methods have been proved effective in improving the stages of evaluation and selection of ideas. While some researchers have developed digital systems and methodologies (i.e., using expert analysis and other standard metrics) [7, 11–14] to evaluate ideas to help solve creative problems, others have approached more conventional methods (i.e., tested research hypotheses against the definition of what is considered a good idea) [8, 15–18]. However, both employ the same evaluation metrics for idea selection. The most commonly used metrics to measure creativity are originality, viability, utility, and novelty.

Based on this information, we conducted an observational study to understand the methods and tools used during a brainstorming session in a classroom setting. This study contributed to the design of a tool to support creativity and increase studies on the process of evaluation and selection of ideas. The tool allows users to describe ideas through text or images and select preferred methods, like rating or pairwise selections.

2 OBSERVATIONAL STUDY

Starting from the idea that brainstorming embodies complete creative processes, the first step is the generation of ideas, the second step is evaluating ideas, and the last step is selecting the best idea(s) to solve the initial problem. First, we carried out an observational study because we wanted to observe the behaviors of potential users of our system, what techniques they used, and their needs during the creative process. Participants have a background in which they need to use creativity to carry out their tasks. Therefore, this study did not require any training. The techniques we aimed to observe were: whether participants used technology, whether they took

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Figure 1: Students from class, performing the brainstorming in the moment of the experience

notes on the creative flow throughout the session, whether they drew or used conventional writing, whether they evaluated the ideas and then how they selected the ideas, and whether they used any metrics or methodologies on which they were based to carry out both stages. Second, to get data that would help us start the development of a tool that helps users evaluate and select ideas. Thus, we conducted descriptive research to collect qualitative data that would help us organize, classify, and identify patterns of students' behavior and attitudes during the creative process. Using the technique of structured observation in a classroom environment, we observed 6 students (2 females, 4 males) aged between 19 and 24 years, as show in figure 1

We structured a guide before the experiment that contained the description of the study (location, course, discipline, class classification, number of participants, and experiment time), the task that the students had to perform, and the notes on what we observed. This study was carried out with the consent of the teacher and the students themselves, who signed informed consent before starting the study.

2.1 Task

Students must create a video to promote/highlight the work carried out by the social institution and the video narrative must contain a message related to one of the following topics: a retrospective of the work already carried out by the institution, called of volunteers and the fight against food waste. Therefore, the first step for the students was to hold a brainstorming session during the class to ideate and select possible ideas for what the video will be like.

2.2 Procedure

The study was carried out in a classroom for 60 minutes. We started by explaining the entire scope of the study, and then we delivered the document with the study protocol and authorization to participate. After signing the consent to participate in the study, the students grouped themselves into two groups of three people in each group and started the brainstorming session. The entire session was recorded through photographs and notes on paper, following the guidelines that we had previously planned.

2.3 Analysis and Results

We categorized both groups with the letter A and B, respectively, to investigate the role of evaluation and selection of ideas during the brainstorming session. Group A consisted of three young male adults, and group B consisted of three young adults, two female and one male. The choice of each group was at the discretion of each participant. Both groups started the session with the choice of material they would use during the session to take notes. They had pen, pencil, paper, and computers at their disposal. However, both groups used pen and paper to point out their ideas.

Group A: after analyzing the guideline with the description of the assignment, they started to write the ideas in the form of a list on a sheet of paper. One of the group members stood out more than the others because he took the initiative to speak and contributed more ideas, while the other two members followed his reasoning. We understood that he was a possible leader, therefore, a decision-maker about what was the best idea to implement. They discuss each idea according to its complexity at the implementation time and classify them as "crazy ideas" and "normal ideas."

Group B: after analyzing the guideline with the description of the assignment, they started by writing single words and then composing the idea through complete sentences. One of the group members is a potential discussion facilitator because she used the ideas of other group members to discuss the pros and cons of the ideas and asked her colleagues for their opinion. While the other, she was considered a possible leader because she imposed herself on her colleagues, she made the decisions about the ideas and whether she put herself on the list of ideas. Then they indicate the pros and cons of each idea and how they can solve the existing issues in each idea, and for the selection stage, they choose the idea they like the most.

We observed that the idea generation phase is well consolidated, as the participants managed to generate many ideas by debating among them. We also observed that the participants evaluated each idea and then selected it. However, it was not an easy task, as they did not know concretely how they performed it. Through these steps, we realized that they were left with many doubts about whether they were doing the right thing because they did not know if the method hey were using to choose the idea was the most correct. The main conclusion we draw from this analysis is the lack of a method that helps participants evaluate their ideas. This tool helps them minimize uncertainties and increase the participants' user experience during the creative processes.

3 WEB-BASED SYSTEM PROTOTYPE

A prototype web-based system was developed based on some results obtained in the observational study, as indicated in the previous section. However, we decided to develop a digital tool because we wanted to take advantage of the technological age and the familiarization users have with systems and applications. The prototype allows users to input and evaluate their ideas, as shown in Figure 2

The user starts by logging into the system, then creates an idea through an image, a title, or a brief description. Each idea can be assigned to a specific topic (i.e., health, cuisine, sport).

The evaluation can be done through two methods, using a 5-point Likert scale, which is a technique widely used to obtain an accurate assessment of each idea, or using a classification strategy - paired comparison, as described in work by Zhu et al. al. [7] where ranking strategies help users select the most creative ideas, that is, the ones

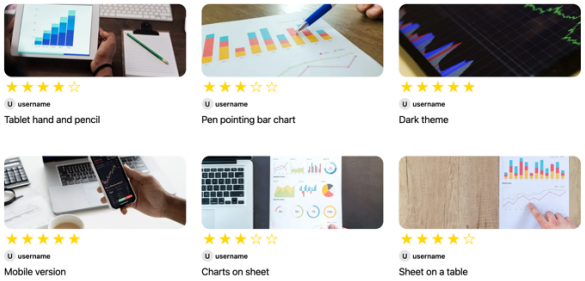

Figure 2: Evaluation using the 5-point Likert Scale

that best suit the task they want to solve. These two methods were based on the information collected from group B when evaluating the ideas. The Likert scale was represented through stars under each image of the idea, as shown in figure 2, the user can indicate how much he likes the idea, by specifically selecting the number of stars. Using the evaluation provided by multiple users, the system can calculate a weighted average from the star rating responses, the value that we will use to order the ideas and present the final ranking. The idea with the higher average for the star rating will be placed on the first position of the ranking.

If the user prefers to evaluate ideas using the classification strategy, he must indicate which idea is preferred for each pair of ideas, as shown in figure 3A. The system presents two ideas, side by side, and the user selects the one he prefers. The result of the comparison is stored, and the winning idea earns one point. This pairwise comparison is performed until all ideas are compared against each other. The final results, shown in figure 3B, present the ideas ordered by how many points they gained: the idea that won all comparisons is ranked first, and the idea that loses is ranked last. At this stage, these results are individual, and each user can view their classification through a list with a description of all the comparisons made.

When several users use the system, they send their paired comparisons, and the system uses their ranking to create the global ranking, as shown in figure 4. When several users use the system, they send their paired comparisons, and the system uses their ranking to create the global ranking, as shown in figure 4. Calculating the global ranking occurs automatically and is similar to the one we present—the individual user.

The paired comparison, implemented as described, assumes the natural intransitivity when asking for preferences: A is preferable to B, B is preferable to C, and C is preferable to A. However, as a consequence, we have to ask the user for more interactions than we would if we considered the transitive relation: A > B and B > C then A > C. This transitive relation is maintained if we use the short merge algorithm. For example, the user has to provide input for fewer comparisons, as shown in figure 5. This algorithm only replaces the steps of comparing the ideas in pairs, as the automatic calculation of the global ranking is done in the same form as the pairwise comparison.

4 DISCUSSION AND CONCLUSIONS

Generating creative ideas in a brainstorming session is a crucial part of innovation. However, the most creative ideas must be selected from a pool of ideas through an evaluation for actual implementation. Research on idea evaluation focuses on whether and under what circumstances people can accurately assess the creativity of ideas and then be able to select and complete the task. This work presents a proof of concept of our web-based application, which was developed based on the literature and data from the observational study obtained in the literature. According to the two main conclusions drawn from this study/development, this can help the user evaluate and select ideas more dynamically. The first conclusion we drew is methodological, and we wanted to investigate whether a brainstorming session helps and influences the participants' performance in evaluating and selecting ideas, which we concluded to be a good tool to support the complete creative process. Our second conclusion is the combination of functionality and meaning because our approach supports the theory that a good selection of ideas aims depends on a sound evaluation because it is difficult to find a method/tool that can keep users in the creative flow while helping to eliminate some of the hard work.

A possible limitation of our conclusions about the observation carried out is the intrusion that we carried out into the space of the participants during the brainstorming session. The behaviors may have been manipulated. One way to minimize this bias would be to conduct a contextual inquiry, conducting observational study and interviews to gain a robust understanding of work practices and behaviors.

However, many guidelines obtained from this study and the prototype remain open for future research. One of the key points with the development of this approach is to contribute to studies on evaluation and selection of ideas. In our future work, we plan to

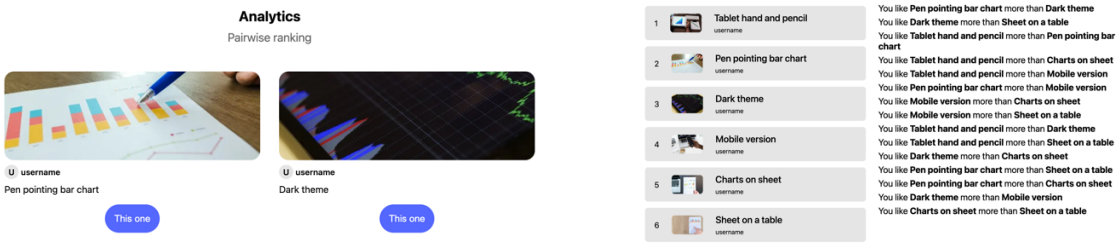

Figure 3: Evaluation using the pairwise ranking

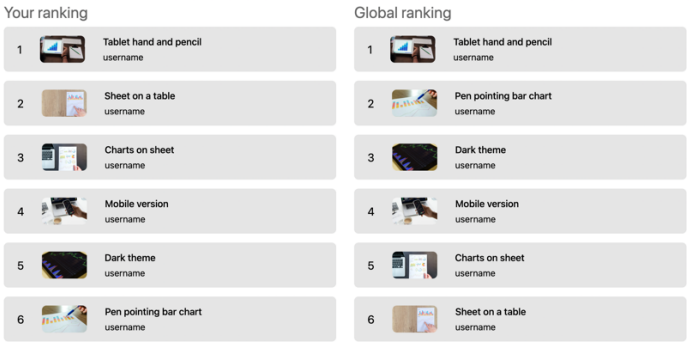

Figure 4: Paired comparisons - Ranking

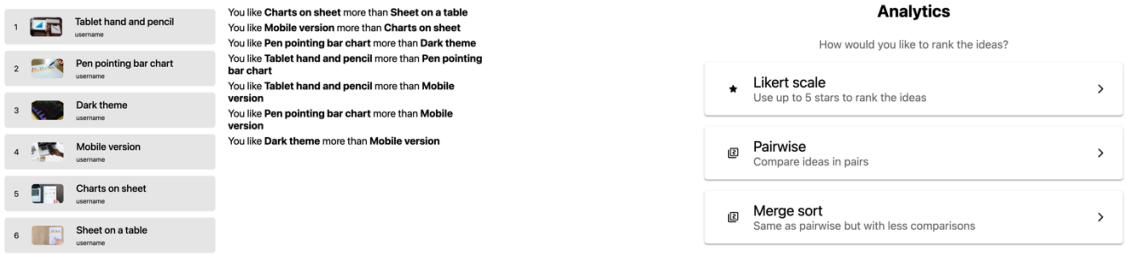

Figure 5: Short merge algorithm

carry out tests on large scales in order to obtain reliable data from the prototype. We propose to explore different tools and methods during brainstorming sessions. For example, the Miro tool and the Mural tool help participants collaborate through a whiteboard. We propose using various selection methods, such as Post-it voting, the Four Categories method, the Bingo Selection method, and the Idea Affinity Diagram. Finally, we propose to explore the interactions between the various metrics used to classify an idea (originality, feasibility, usefulness, and novelty) and their field of knowledge.

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