Review on Idea Generation Tools for Supporting Computer Based Decision Model

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Abstract— Creativity refers to ability of bringing something new in to being for some purpose. An idea generation tool should able to assist any domain area in generating creative ideas using environment and the electronic medium. Several idea generation techniques are in use in the problem solving domains. The quality and quantity of ideas generated play the major role in creative idea generation. Brainstorming is a group creativity technique designed to generate a large number of ideas for the solution of a problem. This paper discusses about computer aided Brainstorming tools to devise an intelligent agent based ideation model with privacy settings between agents and to group agents based on the domain area. Furthermore this paper focuses on reducing problems such as production blocking caused during ideation sessions.

Keywords— Brainstorming, Intelligent Agents, Production Blocking.

I. INTRODUCTION

Creative thinking can give way to many technical ideas, were new innovations will come to existence. For a single problem there can be numerous innovative solutions, it is very important to make evaluation and selection of ideas to achieve better results. *"Creativity"* plays the main role in new way of handling problems. *Creative thinking* gives different solutions based on one person's thought, perception, understanding capability and based on the Environment. Although Brainstorming has become a popular group technique, researchers have not found evidence of its effectiveness for enhancing either quantity or quality of ideas generated. Because of such problems as *social loafing*, occurs when participants in a group feel unmotivated and they think their contributions will not be valued. *Evaluation apprehension*, occurs when individuals withhold their ideas out of concern that others may not approve them. *Production blocking*, occurs when something prevents a participant from verbalizing their ideas as they occur e.g. forgetting an idea while waiting for a turn to speak. Traditional brainstorming does not increase the productivity of groups, it may still provide benefits, such as boosting morale, enhancing work enjoyment, and improving team work. *E-Brainstorming* is a computerized format of sharing ideas and it replaces verbal communication (13). The improvement of electronic brainstorming over traditional brainstorming becomes the fact of production blocking and evaluation apprehension (6). This technique allows the participants to contribute their ideas at same time, and it effectively eliminates *production blocking* and reduces *social loafing*. The productivity of ideas generated has been viewed as the dominant measure of *E-Brainstorming* (11). This paper discuss about the variations of the Brainstorming techniques as it is an innovative idea generation tool and it could be effectively used in intelligent agent based Environment, were the intelligent agents are mapped with unique association thinking of humans to devise automated decision making agent with privacy measures.

II. Brainstorming Techniques - Review

Brainstorming is a technique for generating a large number of ideas for creative problem solving. The term brainstorming was first used by (16). The generation of new ideas, especially high quality creative ideas, is important for a problem. It is a popular method of group interaction in both educational and business sectors. *Brainstorming* engenders synergy i.e., an idea from one participant can trigger a new idea in another participant. Brainstorming has been recognized as an effective group decision supporting approach (14) and developed based on multifunctional system which supports collaborating works on creative activity and decision making. *GSS* (Group Support System) is a suite of collaborative software tools that operates over a computer network and allows people to anonymously contribute ideas (20) and some works have revealed that the application of *GSS* in idea generation improves both the quantity and the quality of ideas generated (7). Briggs; Reinig (2007) provided a theoretical explanation to clarify the relationship between idea quantity & quality, and they recommended guidance for the development of ideation techniques for improving the quality of ideas. Stephanie Buisine; Ameziane Aoussat and Jean-Claude Martin (2007) provided discussion about industrial creativity as a potential application field for embodied conversational agents and focused on creativity tool, the brainstorming.

A. *Brainstorming Strategies*

(1) *Set the problem*: before a session it is critical to define the problem. The problem must be clear, not too big and captured in a specific question such as: What service for Television system is not available now, but needed? If the problem is too big, the facilitator should break it in to smaller components.

(2) *Create a background memo*: it is an invitation and information letter for the participants, containing the session name, problem, time, date and place. The problem is described in the form of a question and some example ideas are given. The ideas are solutions to the problem and used when the sessions slow down or goes off-track. The memo is sent to the participants well in advance, so that they can think about the problem beforehand.

(3) *Select participants*: The facilitator composes the brainstorming panel consisting of the participants and an idea collector. A group of 10 or fewer members is generally more productive. Many variations are also possible with some suggested compositions like, several core members of the project who have proved themselves several guests from outside the project, with affinity to the problem, one idea collector who records the suggested ideas.

(4) *Create a list of lead questions*: The facilitator should stimulate creativity by suggested a lead question to answers.

(5) *Session conduct*: The facilitator leads the brainstorming session and ensures that ground rules are followed.

(6) *Process*: participants are encouraged to write down the ideas and the idea collector should number the ideas. When more participants are having ideas, the one with the most associated idea should have priority. During the session, managers and other superiors are discouraged from attending the session.

(7) *Evaluation*: Evaluating the ideas and selecting one as the solution to the problem proposed to the group.

B. Brainstorming Techniques

1. Nominal Group Technique

It is a type of brainstorming that encourages all participants to have an equal say in the process. Each idea is voted by the group. This process is called distillation. In this technique the participants do not experience the potential synergy that comes from the ideas of others (6). And also they do not experience *production blocking*.

The effects on *evaluation apprehension* and *social loafing* depend on how the session is structured. If the ideas are submitted anonymously then *evaluation apprehension* would be decreased. But *social loafing* would increase. Nominal groups are considered to be superior (1) to brainstorming in which group members interact verbally. This technique includes lack of opportunity during the process for cross fertilization and convergence of ideas.

2. Team Idea mapping method

This method works by *association*. It may improve collaboration and increase the quantity of ideas and is designed so that all attendees participate and no ideas are rejected. The process begins with a well-defined topic. Each participant brainstorms individual, then all the ideas are merged on to one large idea map. The ultimate result of idea mapping is that it enables you to advance in to the minutes of details about any topic. This gives the perspective which needs to come up with extremely precise approaches to the problem that are all encompassing and truly address all facts of our problem at once.

The *hierarchical* thinking of *idea mapping*, on the other hand opens up new opportunities for success that could not be arrived at in any other way. (17)*Idea mapping* technique is extremely versatile and it generates and synthesizes ideas more quickly

3. Directed Brainstorming

Directed brainstorming is a variation of *electronic brainstorming*. It can be done manually or with computers. This method works when the solution space is known prior to the session. In this method, each participant is given one sheet of paper and session questions. They are asked to produce one response and stop, and then all of the papers are randomly swapped among the participants. The participants are asked to look at the idea they received and to create a new idea that improves on that idea based on the initial criteria. The forms are then swapped again and respondents are asked to improve upon the ideas and the process is repeated for three or more rounds. This technique is expected to increase *creativity*.

This technique has been found to almost triple the productivity of groups over *electronic brainstorming*. This method is comparative, (9) point-counter point and metaphors. People using (4) *directed method* produced solutions with higher average *creativity* ratings and higher concentrations of creative solutions.

4. Group passing technique

Each person in a group writes down one idea and then passes the piece of paper to the next person in a clockwise direction, who adds some thoughts. This continues until everybody gets his or her original piece of paper back. By this time, it is likely that the group will have extensively elaborated on each idea. The group may also have an "Idea Book" and the distribution list. The first person to receive the book lists his or her ideas and then routes the book to the next person on the distribution list. The second person can log new ideas or add to the ideas of the previous person. This continues until the distribution list is exhausted.

A follow-up "read out" meeting is then held to discuss the ideas logged in the book. This technique takes longer, but it allows individuals time to think deeply about the problem. The most basic principle of (2) group brainstorming

achieves quantity not quality. This method is a complex social activity that requires a strong facilitator, clear ground rules, suspension of verbal criticism and sometimes even "homework" to act as a catalyst for ideas.

5. Individual Brainstorming

"Individual Brainstorming is a use of brainstorming on a solitary basis. It typically includes techniques like *free writing, free speaking* and *word association*. This technique is useful in creative writing and has been shown to be superior to traditional group brainstorming.

Individuals are more productive than groups for initial generation of creative ideas. This technique is done before and after group sessions. Alex Faickney Osborn (1993) popularized brainstorming, gave advice that is still sound: "*Creativity*" comes from a blend of individual and collective *"ideation"*. Individual brainstorming has a limit to think about some topic and may not be creative towards some topics.

6. Free Writing

It refers to the act of writing quickly for a set time from ten to fifteen minutes, just putting down whatever is in the mind (12), without passing and worrying about what words to use and without going back to modify what has been written. The power of *free writing* is realized in its focus on the process of learning and discovering through on-going thinking and writing. This technique provides effective writing strategies. As a *"Writing-thinking-discovery"* tool, focused *free writing* can be used to promote *critical thinking* in disciplinary learning. *Free writing* is one of the dependable versatile prewriting techniques.

7. Cubing

The prewriting activity is an information gathering technique. *Cubing* is the problem-solving technique, (5) which helps thinking about the topic and accumulates a sufficient amount of words on paper. *Creativity or divergent thinking* is becoming a popular issue raised in various fields. There is no doubt that it is an important ability for us to improve the quality and quantity of our knowledge. The methodologies for enhancing this ability, such as *lateral thinking* had been proposed for several years.

Cubing elements, are (1) Describe it, (2) Compare it, (3) Associate it, (4) Analyse it, (5) Apply it and (6) Argue for or against it. *Cubing* is an excellent tool for rapidly exploring a topic. It reveals quickly what you know and what you don't know and it may alert you to decide to narrow or expand your topic. *Cubing* asks us to examine a topic in an unusual way and this may prove frustrating to some writers.

8. Clustering

Clustering is a nonlinear brainstorming technique. Its results yield a visual representation of subject and organization. This tool can help the group through the process of forming consensus, while preserving and quantifying different ways of thinking. *Clustering* can be defined as a prewriting technique that enables student-writer to choose an encircled nucleic topic around which whatever may be found in relationship will be chosen to be jotted down in tree-branch like relationship.

Clustering is a non-linear brainstorming process that generates ideas, images and feelings around a stimulus word until a pattern becomes discernible. *Clustering* is a generative tool (i.e. makes use of the unconscious in retrieving information) that helps to connect thoughts, feelings and ideas not connected before. It allows us to loosely structure ideas as they occur in a shape that allows for the further generation of ideas. It taps our associative powers in a self-organising process encouraging us to create personally meaningful patterns. *Clustering* can frustrate more linear thinkers, those who need neatness and order to think clearly.

9. Random word technique

The *Random word technique* is where we can use (8) a random word to generate new ideas. By getting a random word as a prompt and forcing our self to use it to solve our problem we are practically guaranteed to attack the problem from different direction to normal e.g. *Lateral thinking.* To trigger new thoughts and ideas or solutions to a problem we can use a random word to get going. *Lateral thinking* is a term defined by Edward Debono. It involves several steps in order to come up with ideas and solutions. (1) *Check your assumptions*: We have to make sure that we have an open mind whenever we approach a new problem or new situation. (2) *Ask the right questions:* The true leadership is about knowing which questions to ask. This is also true when it comes to lateral thinking. (3) *Creativity:* In order to solve a problem, we need to approach the problem from an unconventional angle. (4) *Logical thinking:* We need logical thinking in order to analyse the ideas.

The greatest thing by far is to be a master of metaphor. "It is a sign of genius, since a good metaphor implies an intuitive perception of the similarity in dissimilar" said Aristotle. There are many ways to use the idea metaphor. One example is the *random word association* technique. One of the simplest, but most powerful, techniques in *lateral*

10. Electronic Brainstorming technique

Electronic Brainstorming generates more ideas than verbal groups (10).Electronic Brainstorming is a computerized version of the manual *brain writing* technique. It can be done via e-mail. It replaces the verbal communication and combines both verbal and nominal groups. The participants may experience synergy by building on the ideas of others to create new ideas. This technique is inherently malleable; user can adopt and use them in ways not

intended by their designers. It does not directly change the way in which users interact, but rather offers a set of potential social structures from which users can choose. In this technique all participants can contribute ideas at the same time and can effectively eliminate *production blocking* and reduces *social loafing*. The productivity of electronic brainstorming groups was higher than that of non-electronic brainstorming (or) traditional groups. In the electronic groups, performance increase substantially with group size. The different forms of E-Brainstorming prompts are varied to produce different levels of creativity with in those productivity results. This technique reduces *evaluation apprehension.* Professor Oliver Toubia of Columbia University has conducted extensive research in the field of idea generation and has concluded that incentives are extremely valuable within the brainstorming context (19). E-Brainstorming tools represent plausible solutions to improve the e-research community activities with respect to processes regarding idea generation and idea selection. (15) Most ideation research either implicitly or explicitly assumes Osborn's conjecture that if people generate more ideas, then they will produce more good ideas. Osborn reported evidence that people generate more good ideas in the second half of a brainstorming session than during the first half. Some studies have also reported that certain ideation protocols can elevate both idea quantity and idea quality. However, another work reported no relationship between idea quality and idea quantity. That is, previous ideation literatures were inconsistent in the arguments (21).

Briggs and Reining (2007) provided a theoretical explanation (Bounded Ideation Theory) to clarify the relationship between idea quantity and idea quality, and they recommended guidance for the development of ideation techniques for improving the quality of ideas. A good idea was defined as one that is feasible to implement and would attain the goal. The Bounded Ideation Theory was a causal model of the ideation function (the relationship between the cumulative number of good ideas contributed during an ideation process and the total number of ideas generated). Their causal model identified three essential boundaries of human ideation capability (*an understanding boundary, a cognitive boundary and an endurance boundary*) that influence the production of good ideas.

The *understanding boundary* indicates that the relationship between the number of good ideas and the total number of ideas becomes a curvilinear function with a positive but decreasing slope once an understanding of the task has been achieved. The *cognitive boundary* signifies that because of the lack of additional external stimuli to activate a new part of the group memory, people tend to think inside the box, causing subsequent contributions to increasingly become similar to previous contributions, thus yielding fewer new good ideas (that is, the declining ratio of good ideas to the total ideas over time produces an ideation function with a positive but decreasing slope).

The endurance boundary signifies that because an individual's mental and physical abilities diminish with effort over time, ideation abilities will then decline as ideation proceeds (that is if the ideation process were to continue for a sufficiently long time, then participants might lose the ability to generate good ideas which leads to falling ratio of good ideas to the total ideas overtime and yields an ideation function with a positive but decreasing slope).

III Discussion

Considering the aforementioned past review of the brainstorming techniques, this work argues that the idea quantity could be considered as the dominant measure of E-Brainstorming. E-Brainstorming is further advanced with following directions as, (1) *learning capability for understanding the task*: as ideation proceeds ideation participants need to share and learn more information for a better understanding of the task and to be able to generate ideas, Moreover, the causality among the generated ideas should be easy to characterize and then record in the group memory. (2) *Continued adoption of additional external stimuli*: as ideation proceeds, ideation participants should move beyond the limits of their working memory and simultaneously think about all concepts on their knowledge network. (3) *Alleviation of attention exhaustion*: In the conventional brainstorming process, participants are simultaneously present in the same place, think of ideas and voice their opinions to the group members. In this paper we discussed various idea generating brainstorming techniques to devise a tool for intelligent agent based environment with privacy measures to share the personal data and to group the agents based on their area of interest.

IV Conclusion and Future work

Although current e-brainstorming overcomes the spatial and distance limitation of conventional brainstorming with the technique of electronic communication, all participants must still be present at the brainstorming session at the same time to proceed with the discussion. In this paper we discussed various idea generating brainstorming techniques to devise a tool for intelligent agent based environment with privacy measures to share the personal data and to group the agents based on their area of interest. In future agents are aimed to transform as Neural Network based agents, ideation map used in existing methods are further enhanced to improve the quantity of ideas.

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