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Developing a Reflection Support System in Idea Organization Workshops

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Abstract

Workshops, which are group learning activities designed to facilitate idea creation, require reflection to ensure meaningful outcomes. This paper proposes a method to support reflection for workshops aimed at proposing policies to solve social issues. The proposed approach enables policymakers who did not participate in the workshop to reflect on its outcomes and use them as evidence for decision-making. To achieve this, we developed a system that allows anyone to reflect on and analyze workshop activities. In these workshops, participants typically write their ideas on sticky notes and place them on a single large sheet of paper. The sticky notes are then organized on the paper using the affinity diagram method, which groups related ideas together, to enable participants to structure their ideas visually. The result of organized outputs represents the primary outcomes of the workshop. However, it is challenging for individuals who did not participate in the workshop to reflect on the activities based solely on these final outputs. Therefore, this study focuses on the content of the sticky notes and the way their positions change over time. We recorded the workshop process by capturing overhead video to track how sticky notes were placed and moved on the paper. We implemented a system to recognize the sticky notes and track their movements to analyze the activity dynamics, such as how sticky notes were moved and grouped over time. Furthermore, we investigated the grouping methods used during the idea organization phase. We enhanced the system that allows users to interactively recategorize sticky notes into customizable groups. While the conventional affinity diagram method was still evaluated as being more conducive to providing an overarching view of the ideas, the proposed system was shown to effectively create overlapping groupings and efficiently classify content, demonstrating its practical advantages.

Keywords: *Reflection support system, Policy-making workshop, Idea grouping activity dynamics*

1. Introduction

In recent years, group learning activities known as workshops, which focus on idea creation, have been widely conducted. When considering solutions to complex social issues, it becomes crucial for diverse stakeholders to engage in discussions and reach consensus. Such activities are sometimes referred to as participatory workshops or co-design workshops (e.g., [1], [2], [3], [4]).
The research presented here specifically focuses on the process of creating ideas and of organizing them within these design activities and aims to develop methods that facilitate mutual learning among participants. It is important to recognize that the policy-making process follows from these discussions, and thus it serves as a crucial step in transforming ideas into actionable policies for society. Even if those who proposed the ideas do not participate further, policymakers still need to understand the content of the discussions. Consequently, ensuring that non-participants can also comprehend workshop outcomes becomes essential.
In this paper, we aim to record the activity history of such workshops (called idea organization workshops) using information technology to enable effective participants' reflection. Additionally, we seek to ensure that policymakers can fairly evaluate the ideas, even if they did not participate in the workshop. To achieve this, we developed two systems that support both participants' reflection and non-participants' evaluation of ideas.

2. Overview of the System

2.1 Assumed Activity Flow

In idea organization workshops, participants typically write down their ideas on sticky notes and attach them to a large sheet of paper as shown in Fig. 1. As the workshop progresses, similar ideas are

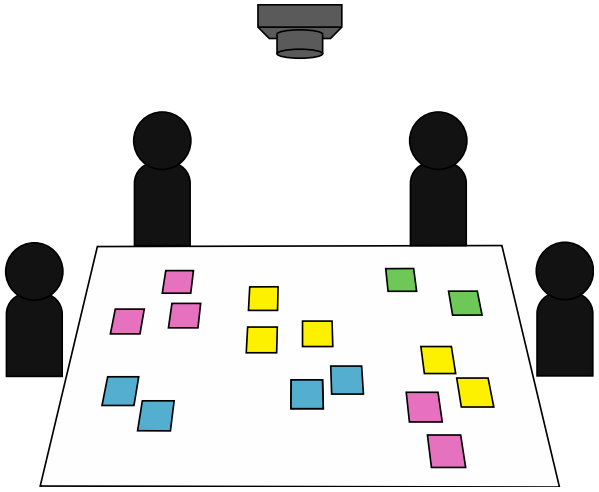

Fig. 1. An example of an idea organization workshop setting

grouped and given names, and relationships between these groups are defined.
The phase in which the participants write down ideas is known as brainstorming. During this period, participants propose ideas inspired by each other, without criticism. The subsequent grouping phase uses visualization methods such as the affinity diagram method or the KJ method [5][6][7]. As participants organize ideas, sticky notes move around across the large sheet. Additionally, both verbal and non-verbal communication among participants influence the placement decisions, either explicitly or implicitly.
The arrangement of sticky notes obtained through this process serves as an outcome of the workshop activities. Participants use this arrangement to reflect on their activities. At the same time, policymakers and other stakeholders continue the process of concretizing the ideas by linking them to policies or other implementation measures. They not only accept the outcome as it is, but they also analyze it to gain a deeper understanding of the provided ideas.

2.2 Support System

To support the activities described in Section 2.1, in this paper we focused on tracking the movement of sticky notes on the large sheet. Based on this, we developed a system that detects and tracks the positions of sticky notes from video data. This system allows the digitization of sticky notes' movements during workshops. The recorded video also captures participants' interaction through the movements of their hands and bodies as well as the movements of the sticky notes. Although such information can be useful for evaluating the system's effectiveness, we decided that this system does not directly process the data except sticky notes' movement.
The goal of these workshops is to visualize ideas by arranging and grouping sticky notes through a process to reflect participants' consensus. However, it is also valuable that re-evaluating and reorganizing ideas from a non-participant's perspective, such as policymakers. Traditionally, because handling paper and pens imposed physical limitations, making it difficult to revert changes or reassess the work once an arrangement was finalized. Since the system developed as mentioned above enables the extraction of information from sticky notes, the information will be represented on a PC, allowing for free reconsideration of ideas in principle.
However, simply replicating paper-based grouping methods digitalization may not be the optimal solution. It is necessary to reconsider the grouping methodology itself. Therefore, we developed a system that organizes ideas in a tabular format, allowing for a different perspective on structuring ideas.

3. Individual Systems

3.1 Tracking System

In the targeted workshops, participants write down ideas on sticky notes and attach them to a large sheet of paper spread over a table. A video camera is installed overhead to capture this process. While a higher resolution camera is preferable for accurately detecting sticky notes in video processing, a standard 4K camera is sufficient. We achieved this setup by fixing home video cameras

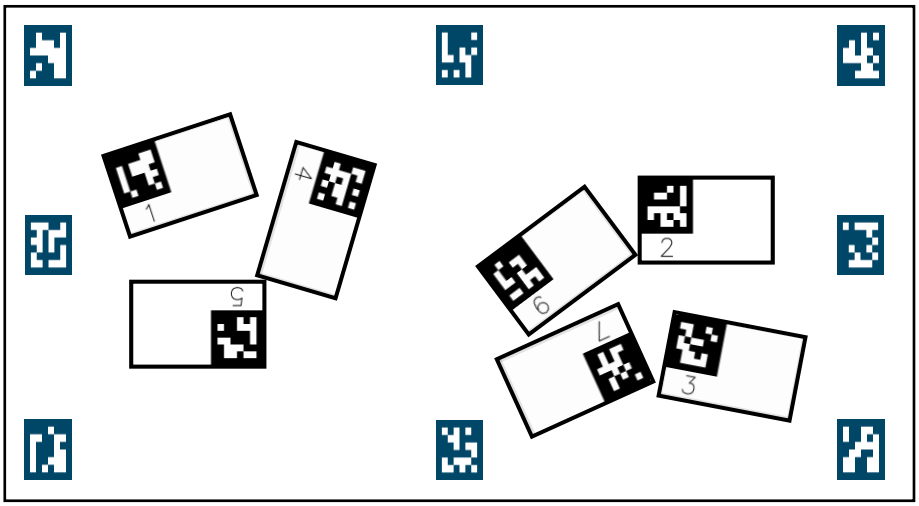

Fig. 2. Sticky notes with AR markers and AR markers to indicate the edge of the large sheet of paper

Fig. 3. An example of detection and identification of each sticky note in the sheet of paper. The rectangular frame surrounding each sticky note indicates that it was detected by YOLO, possibly including false detections.

or action cameras to the ceiling or mounting them on tripods with extension arms.

We aimed for a minimal hardware configuration to ensure wide applicability across different workshop environments. Thus, the only requirement was installing a wide-angle video camera overhead. The initial goal was to enable immediate processing of the recorded video files after the workshop concluded. The recorded video data is copied to a PC and processed in batches.

While real-time processing of captured video data is theoretically possible, implementing it in real workshop settings presents practical challenges. Real-time processing required complex hardware setups and technical expertise, which are not always available at workshop venues. Since typical workshops do not have computer technicians assigned to handle technical tasks, we prioritized a simple and stable system structure and approached for improved feasibility in workshop environments. While real-time processing remains an ultimate goal, we adopted batch processing due to its ease of isolating issues.

Early in this research, it was uncertain that the object identifying algorithms can recognize sticky notes in real-world workshop settings, so we initially used ArUco markers, one of AR marker, printed on the sticky notes for detection [8] as shown in Fig. 2. Afterward, advances in image recognition technology enabled direct detection of sticky notes. We then developed a method using the deep learning algorithm YOLO [9] to identify and extract sticky notes from video footage without requiring printed markers [10] as shown in Fig. 3.

With this tracking system, the position of each sticky note is periodically identified, and their coordinates on the camera footage are stored as information. This allows tracking of individual sticky

note movements and recording of their transition history. Sticky notes are not moved independently but are relocated in groups through participant interactions. Since sticky notes often move collectively during grouping phases, we can also analyze the formation and reconfiguration of clusters. Notably, the frequency of movement can help identify distinct phases in the workshop.

3.2 Grouping system

Workshops frequently employ visualization methods like the affinity diagram method to group sticky notes. This method based on semantic similarity involves grouping related sticky notes and arranging

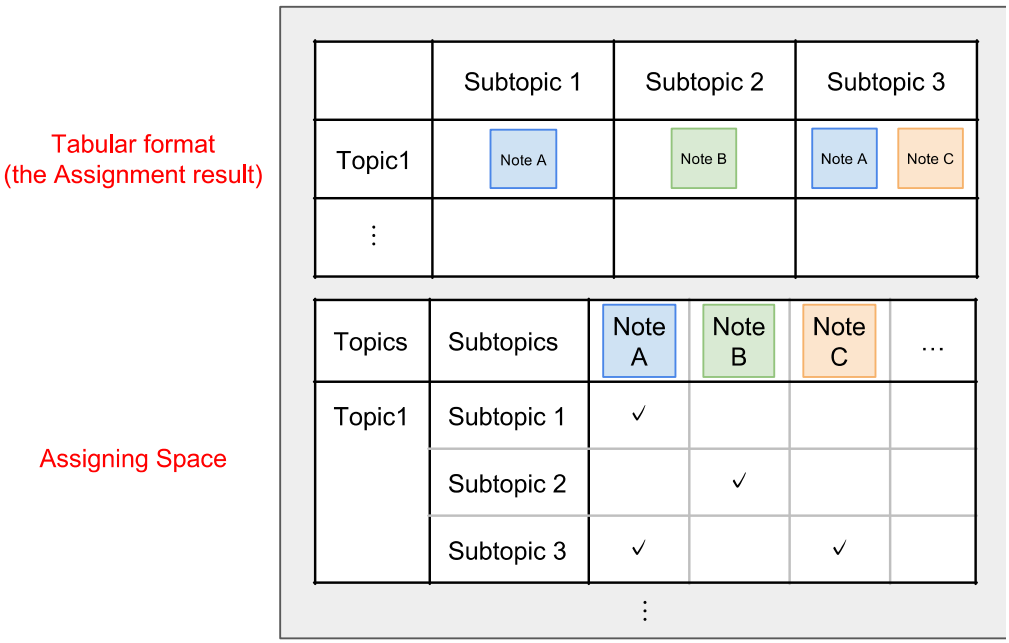

Fig. 5. A schematic diagram of a screen for specifying the topic and subtopic of sticky notes in the tabular format.

Fig. 4. An example of organizing sticky notes in a tabular format.

these sticky notes and groups spatially on a large sheet. This approach is intuitive for participants as it allows quick recognition of meaningful groups. Since it takes time to reach an agreement on the final layout, this method helps to share understanding among participants. However, categorizing each sticky note into a single group is often challenging. Participants frequently assign notes based on convenience rather than strict categorization. They sometimes create intermediate islands between groups to address the challenge of incomplete categorization in grouping.

The physical constraints of sticky notes make it difficult to assign them to multiple groups simultaneously. When an idea is relevant to two or three groups, it may be placed between them or within multiple overlapping areas. However, when such overlap occurs frequently, participants must assign them somewhere. This means that while grouping requires creativity, it is also a challenging task that demands agreement among participants.

Though the affinity diagram method is effective for time-limited discussions, the final arrangement may not always convey the workshop's nuances to non-participants. When ideas are revisited later to aimed at solving social issues, both participants and outsiders might require an alternative form of organization.
From an information processing perspective, a single sticky note can belong to several groups without conflict. A tabular format is more suitable than spatial layouts of the affinity diagram method for organizing ideas efficiently. Therefore, we developed a system that organizes sticky notes in a tabular format. Fig. 4 shows schematic diagram of the tabular format and Fig. 5 shows an example of organized sticky notes within this format.
This grouping system assigns topics and subtopics as the rows and columns of a table. Sticky notes are placed in the corresponding table cells based on these classifications. When a sticky note belongs to multiple topics, it appears in multiple topic rows, while still being a single entity in the data, ensuring consistency. Subtopics are also handled in the same way.

4. Discussion

Workshops generally include an idea creation phase, a grouping phase, a phase defining inter-relationships among groups, and a reviewing phase. Understanding why a particular sticky note was placed in a specific group often requires revisiting the video footage If the participants review manually, it is time-consuming and inefficient. By automatically tracking sticky note movements, we can identify the final modification time for each group and to limit video review to only the relevant footage.
Our preliminary analysis of sticky note coordinates revealed distinct activity patterns, with some phases featuring frequent movement and others featuring minimal movement. This implies the system could detect phase transitions, enabling more efficient video review in the workshop process.
In preliminary tests of the grouping system, the tabular approach clarified topic boundaries, making it easier to identify core themes. Although no significant differences in efficiency were observed compared with the affinity diagram method, the tabular approach shows promise for structuring ideas when revisiting or reassessing them—especially for policymakers or other external stakeholders during review phases.

5. Conclusion

This paper presented a system for recording, reflecting on, and organizing ideas generated in workshops aimed at solving social issues. By tracking sticky notes, the system facilitates flexible digital reorganization of workshop outputs on a PC. Designed for broad applicability and ease of use, the system allows for ongoing evaluations. Future work includes analyzing data from various workshops to further assess its effectiveness and refine the interface for diverse user needs.

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