

Tools to Support Collaborative Creativity

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ABSTRACT

It has been argued that in order to effectively support collaborate activities, such as creativity, we need to at least support individual and group activities. In this paper we review 3 creativity support tools (CSTs) that support various group compositions. Drawing lessons from the design of these existing CSTs we present the design of our own support tool – Public Social Private Design (PSPD). We finally report a brief evaluation of PSPD describing how it supports various group compositions and the transitions between them.

Author Keywords

Creativity, Group Composition, Creativity Support Tools.

INTRODUCTION

Several studies have shown that effective collaboration requires the support of both individual and group activities [e.g. 4]. This is also true for collaborative creativity [7, 9]. Collaborative creative activities are essential to bring an idea into fruition [1]. Yet individual activities are needed to allow one to reflect upon collaborative contributions [3].

In this paper we examine how CSTs support collaborative activities, in terms of group composition – individual, sub-group and whole group activities - and the transition between them. First, we review and critique 3 existing CSTs. Building upon this review and critique we present our own CST – PSPD. Finally, we report an evaluation of PSPD, describing how it supports the various group compositions of a group and the transitions between them.

CURRENT CREATIVITY SUPPORT TOOLS

Many researchers and practitioners have developed CSTs to support collaborative creativity. We describe 3 examples – The Envisionment and Discovery Collaboratory (EDC) [2], Caretta [8] and i-LAND [6]. Each of these CST supports the dynamic nature of collaborative creativity in different ways. The EDC supports creativity as a group activity; Caretta supports personal and shared activities throughout the creative process; and i-LAND supports individual, sub-group and group creative activities.

The EDC is a computerized tool for supporting social creativity. The main goal of the EDC is to ‘support social creativity by creating shared understanding among various stakeholders, contextualizing information to the task at hand, and creating objects-to-think-with in collaborative design activities’ [2].



Figure 1. The Envisionment and Discovery Collaboratory (EDC)

The current implementation of the EDC (Figure 1) comprises a projected image on a table, which can be manipulated via physical objects (i.e. RFID tagged wooden blocks on a grid structure embedded in the table) and an ultrasonic sketching tool, allowing boundary objects (i.e. sketches and virtual objects) to be created and evolve.

Caretta is a similar environment to the EDC, with the exception that it extends the shared interaction space to account for personal space. Caretta allows stakeholders to discuss and negotiate around the shared space by manipulating physical and virtual objects, while providing the opportunity to examine ideas in their own personal spaces.

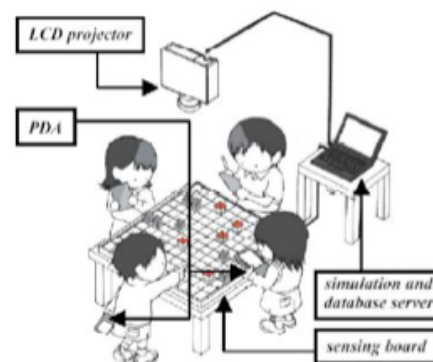


Figure 2. Caretta

Caretta comprises a sensing board, a simulation and database server, an LCD projector and a number of PDAs (Figure 2). The hardware exchanges data through the use of a wireless network. The shared space takes the form of a sensing board that allows users to manipulate physical objects through the use of RFID. The personal space takes the form of a PDA, which images the shared space. Upon bringing the PDA in

contact with the shared space, the visualization on the PDA is updated with that of the shared space. This allows users to work in their own personal space at their own pace, while cooperatively working in the shared space and smoothly transitioning between the 2.

i-LAND is a vision for future work spaces supporting the cooperative work of dynamic teams with changing needs. i-LAND achieves this through the integration of architectural and interaction spaces (i.e. integrating technologies into the meeting room environment). i-LAND has been used in the domains of brainstorming and project organization.



Figure 3. The i-LAND environment

The i-LAND vision has been implemented through the use of several ‘roomware’ components – DynaWall, InterTable, ConneCTable and CommChair (Figure 3). Each roomware component runs a software application for producing hypermedia concept maps using text and scribbles. The use of these different roomware components provides different interaction spaces supporting the compositions of the group.

Meta-Analysis of Current Creativity Support Tools

Having reviewed how the EDC, Caretta and i-LAND support the various compositions of a group and the transitions between them, we critique these CSTs drawing lessons has how to best support collaborative creative activities.

The EDC provides a public interaction space supporting a group’s creative activities through means of an interactive tabletop. However, the limitation of this set-up is that it constrains the group to work together the entire time. Many researchers [e.g. 4] have argued that to effectively support collaborative activities, such as creativity, support needs to be provided for at least individual and group activities.

i-LAND supports 3 different interaction spaces: the CommChair) for individual work; the ConneCTable for sub-group activities; and the DynaWall and InteracTable for entire group activities. The need for this support has been empirically shown, where groups using technologies supporting individual, sub-group and group activities achieve better results than groups working as a full-group for most of the time [7]. i-LAND was built with the vision of technologies being integrated into our existing architectural environment [6], e.g. walls, tables, chairs. However, the very act of integrating technologies into the existing architecture has created barriers between the interaction spaces. For example, an individual working in the CommChair cannot be within the same interaction space as

either the ConneCTable or the InteracTable, as they are constrained to the architectural space of the CommChair. Thus, particular combinations of architectural spaces and technologies impose barriers between different interaction spaces potentially inhibiting the collaborative creative process. How then do we overcome this problem?

Caretta overcomes this problem by integrating personal and shared interaction spaces in the same architectural space. Rather than technologies being integrated into existing artifacts with established physical properties, the technologies themselves are physical objects with their own set of physical properties. Due to the mobility of the PDA, the personal interaction space can be moved in and out of the architectural and interaction space of the sensing board. The disadvantage of Caretta compared to i-LAND is that no social interaction space is provided for sub-group activities. An additional problem with Caretta is inherent in its implementation. Caretta supports only the transition from shared space to personal space, not vice versa. Hence, an individual may go about developing an idea in her personal space, but if she wants to present the idea to other group members, she must either re-do the work in the shared space – if she can even remember how – or present her idea on the PDA. The first solution is both ineffective and time consuming, while the second is impractical due to the nature of the interaction space defined by the PDA [5].

We next describe a tool we have developed to effectively support the various compositions of a group and the transition between them – PSPD.

PUBLIC SOCIAL PUBLIC DESIGN

PSPD is a CST designed to support creativity in the early stages of design.

To achieve such support, PSPD has built upon 3 high-level requirements [9]:

1. Support the creation and dissemination of externalizations to support the phases of the creative process.
2. Support the various compositions of a group – individual, sub-group and group activities – and the smooth transition between them.
3. Support the control of social influences – production blocking, evaluation apprehension and free-riding.

In this paper, we shall focus on the support PSPD provides to support the various compositions of a group and the transition between them. We now describe how PSPD provides this support through its framework, hardware and software.

Framework

The PSPD framework builds upon a framework developed by Kostakos *et al* [5] for the analysis and design of pervasive computing systems. This framework considers the architectural space in which one is interacting with

technologies, the interaction spaces created by those technologies and the types of information or services presented by the technologies. It considers each of these in terms of their “publicness”.

In the case of PSPD, the design meeting room was considered a public space. Through the different interaction spaces created by different technologies, we can support the various group compositions of the design team and the corresponding publicness of the externalizations produced. For example, a public interaction space supports whole group activities; a social interaction space supports sub-group activities; and, a private interaction space supports individual activities. This framework was instantiated by the PSPD hardware and software.

Hardware

The PSPD hardware supports group, sub-group and individual activities through public, social and private interaction spaces respectively (Figure 4).



Figure 4. Public Social Private Design (PSPD)

An *interactive tabletop* (consisting of a plasma screen with a Smartboard overlay, powered by a PC) provides a public interaction space, allowing all group members to engage, collaborate with each other, and interact with the technology.

A set of *tablet PCs* provides a number of social interaction spaces, allowing sub-groups to form, collaborate with each other and interact with the technology. The more constrained interaction space supports only small sub-groups comfortably, providing a feeling of social inclusion for its users and exclusion for others.

A set of *PDA*s provides a number of private interaction spaces, allowing members of a group to work individually. The very constrained interaction space provides a private design environment for an individual user.

Software

The PSPD software aimed to support the creation, manipulation and dissemination of externalizations. The PSPD software ran on all the PSPD hardware. Particularly important to supporting the transition between group compositions was the dissemination of externalizations.

The PSPD software allows externalizations to be disseminated in two ways: saving and sharing.

Saving an externalization allows it to be disseminated to the level of privacy of the device on which it was created.

Tabletop: Saved externalizations have a “public” privacy level. They are viewable and retrievable through the PDAs, the tablet PCs and the tabletop itself.

Tablet PC: Saved externalizations have a “social” privacy level. They are viewable and retrievable by the members of the sub-group who created them on their individual PDAs or by the sub-group themselves when using a tablet PC.

PDA: Saved externalizations have a “private” privacy level. They are viewable and retrievable only by the person who created them on her own PDA.

Through the share functionality, an externalization may be disseminated to a more public level.

Tablet PC: “Social” externalizations may be disseminated to the “public” level.

PDA: “Private” externalizations may be disseminated to either the “social” or the “public” level.

An externalization cannot be disseminated lower than the privacy level of the device on which it was created. For example, if an externalization is produced on the tabletop it cannot be made private as it was created in a public interaction space. However, if an externalization was created on the tabletop and is subsequently retrieved and modified on a PDA, the modified externalization is treated as a new, private externalization. The original externalization still exists as a public externalization.

PSPD EVALUATION

We ran an evaluation of PSPD to explore whether it had satisfied its requirements, as well as to understand its use in practice – in the scope of this paper we focus on the support PSPD provides for supporting the various compositions of a group and the smooth transition between them. 3 groups of 4 interaction designers used PSPD as a CST. Each group designed an innovative, queue-less, pizza ordering system for use in a pizza restaurant located in a city centre. Their activities were captured through 2 video cameras built into our usability lab, the data from which were later analyzed. The PSPD server also recorded log files of externalization creation and dissemination, including capturing the externalizations created. Post-evaluation methods including questionnaires, a retrospective protocol analysis of the video with the groups and a focus group were used to complement the data recorded during the evaluation.

Supporting Collaborative Activities

PSPD aimed to support the various group compositions of a group - individuals, sub-groups and the whole group - and the transitions between them.

All our evaluation groups engaged in individual, sub-group and group activities. The groups initially started the evaluative activity as a group, framing the problem and sharing past and related experiences. As an understanding of the problem was developed and ideas began to be generated, some members of the groups engaged in individual activities, working through ideas to propose to the group. All groups developed the basis of an agreed idea as a group. When the general idea was established, the group would split, delegating the refinement of the idea into individual and sub-group activities. Sub-group compositions were preferred during this stage of the design activity. Individuals worked in a private interaction space when they had a particular idea of their own they wished to work through. Finally, the group would come back together to present the refined ideas they had developed and how they fitted into the final solution. During this final group composition the design was critiqued to make sure it satisfied the criteria for a solution to their assignment.

An advantage of using the PDAs and tablet PCs was their mobility. Unlike other CSTs [e.g. 6] where the technologies are built into the architecture of the meeting room and are thereby constrained by its physical properties, PSPD allowed the technologies to be merged into the same interaction space. For example, 1 participant was able to generate potential ideas on a PDA while being in the interaction space of the group and the tabletop, able to see and hear what was being discussed. Furthermore, participants frequently switched between interaction spaces, for example switching between working as a sub-group on a tablet PC and then sharing the public interaction space of the tabletop. This supported the transition between group, sub-group and individual activities - the transition between loosely and tightly coupled collaboration [4].

While the PDA, tablet PC and interactive tabletop were each chosen for individual, sub-group and group activities respectively, their use sometimes differed from our intentions. For example, 1 participant decided to use the tablet PC to create a private interaction space. Furthermore, when working individually using a PDA, participants would sometimes show their externalizations to their sub-group collaborators to get some feedback. While it has been argued small interactions spaces are not suitable for collaborative activities [5], the PDA was suitable to briefly present a design facilitating short bursts of collaboration before re-engaging in an individual activity. In another case, 2 participants used their own PDAs to engage in a sub-group activity. Rather than relocate and use a tablet PC, they socially disseminated their externalizations and used the PDAs to view the externalizations while talking about them to each other with their backs to each other on opposite sides of the tabletop. When asked why they did this, 1 of the participant said, "it was not worth the effort, I just wanted to see it (the sketch)". The other participant commented, "by verbalizing the idea across the table, it allowed the others in the group to have an awareness of what was going on".

While not a feature of the current implementation of PSPD, some participants also suggested that the PDA and tablet PC would be suitable devices to extend beyond collaborative activities in a co-located setting, allowing for distributed idea generation [10].

CONCLUSIONS

CSTs need to support the various compositions of a group and the transitions between them.

PSPD provided flexibility for the group to use the technologies to create a range of interaction spaces, in intended and unintended ways, to support their collaborative creative activities. Through the use of the interactive tabletop, tablet PCs and PDAs, the groups were able to engage in group, sub-group and individual activities, as well as transition between these activities.

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