Supporting Creativity with Powerful Composition Tools for Artifacts and Performances

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Abstract

Modern software such as word processors, slide preparation/presentation tools, or music composition packages are designed to produce artifacts or performances. Now, some designers are expanding their goals to include creativity support into their software. This essay builds on the genex framework for creativity, which has four phases and eight activities. It focuses on the composition activity by considering tools to support initiation, revision, and evaluation. Some existing tools provide partial support that suggests ways in which to develop more ambitious low, middle, and high level tools. The goal is to enable more people to be more creative more of the time.

1. Introduction

Software tools have enabled users to accomplish increasingly ambitious financial, manufacturing, information retrieval and other tasks. The movement from routine to more innovative tasks is leading some designers to re-examine their software and enhance support for creativity. Initial efforts focus on ordinary tasks such as web-page layout or document design, but some designers are attempting to provide more powerful support for artistic and scientific endeavors. While paradigm shifting breakthroughs such as those made by Picasso or Einstein may not be facilitated by current tools, it does seem possible to enable more people to be more creative more of the time.

Creativity has long been seen as a mysterious process [3]. However, a growing consensus about the phases of creativity is beginning to enable software designers to develop powerful tools [5, 6, 7]. This consensus inspired a four-phase framework called genex (generator of excellence) that was formulated with the intention that it be conveniently implemented in software [15]. The genex framework combined the creativity models that focused on inspirational moments with those that suggested structured processes and those that considered a broader social context. The four phases of genex are:

- Collect: learn from previous works stored in digital libraries, the web, etc.
- Relate: consult with peers and mentors at early, middle and late stages
- Create: explore, discover, compose, evaluate possible solutions
- Donate: disseminate the results and contribute to the digital libraries, the web, etc.

Users may move through the phases in order, but often they return to collect further information, ask for help and emotional support from trusted confidants, and keep trying alternative solutions. When they find a promising result, there may still be much effort to refine it, make it viable, and disseminate it to appropriate people. This four-phase framework led to a research agenda with eight interrelated activities that could benefit from software support [16], Figure 1:

- Searching and browsing digital libraries
- Consulting with peers and mentors
- Visualizing data and processes
- Thinking by free associations
- Exploring solutions- What if tools
- Composing artifacts and performances
- Reviewing and replaying session histories
- Disseminating results

Each activity in this broad agenda leads to a rich literature and ample room for research. Projects at the Human-Computer Interaction Laboratory are already working on four of these activities: searching, consulting, visualizing, and reviewing. This essay concentrates on powerful software tools to support users in composing artifacts and performances [4]. His framework and our user needs assessments from several projects, especially the Library of Congress and the World Bank, form the basis for the analysis in this paper.

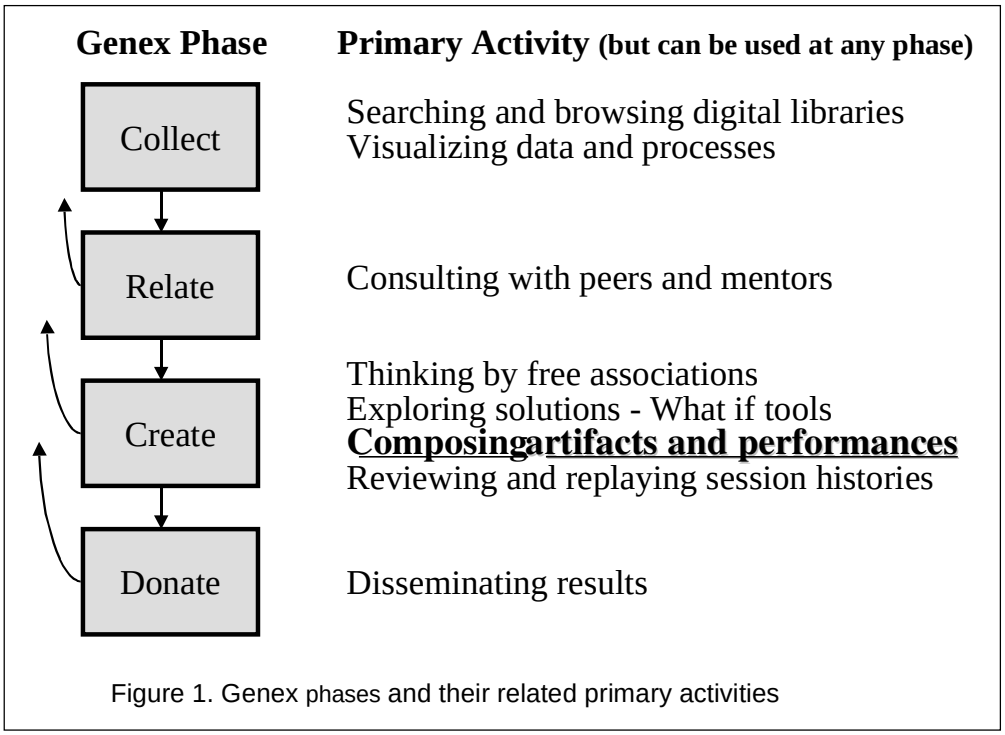

Figure 1. Genex phases and their related primary activities

The activity of composing artifacts and performances is further reduced into three stages: initiate, revise, and evaluate (Figure 2). Many users initiate by collecting exemplars, templates, and processes which are the basis for their first steps. Then they need revision tools to manipulate and refine, and finally they apply critiquing and assessment tools to evaluate their compositions. Of course, the process can be iterative, with users returning to examine other exemplars and revising many times to reach higher quality outcomes.

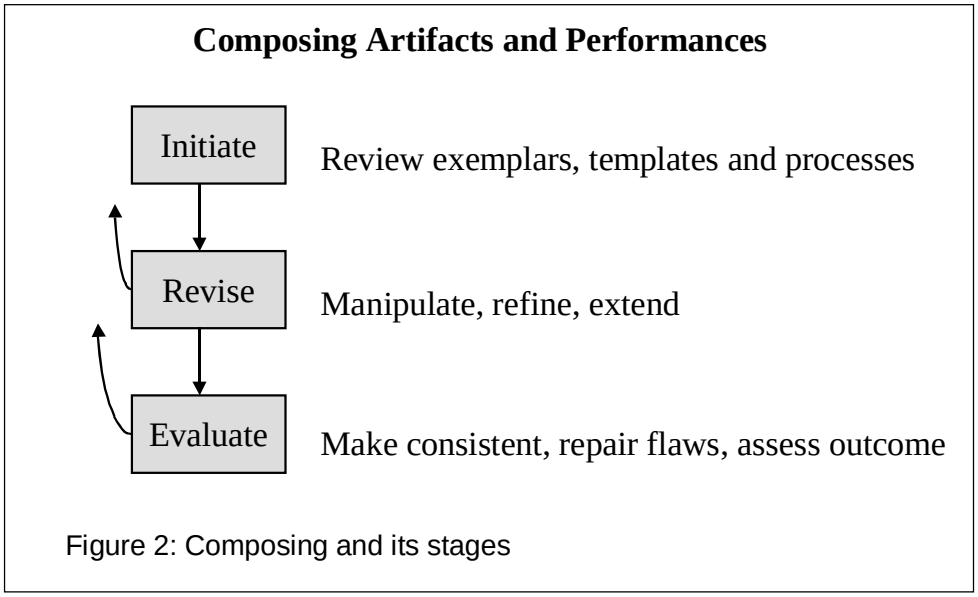

Figure 2: Composing and its stages

The benefit of powerful tools is that novice users can often produce results that rival the quality of what could only be done by experts using more primitive tools. However, there are multiple dangers. First, the tools may constrain users into producing only a limited range of possibilities. Rather than informing authors or artists of a broader range of possibilities, the technology may limit their imagination. In the worst case, users produce

something that is little more than painting-by-numbers. Second, viewers of the polished products may be deceived or misled in their assumptions of the skill, knowledge, and capability of the authors. Authors who build on previous work, but fail to credit their sources are acting unethically. Similarly, viewers who are unaware of the use of sophisticated tools may make naïve judgments. Third, experts may threatened by the proliferation of products that formerly required great skill. Such transformations have happened throughout history (e.g. artists who disparaged photography or weavers who destroyed automated looms), but the transition is often turbulent.

While keeping cognizant of these dangers, designers can proceed to improve existing tools and create new ones. Of course, a computer scientist's approach might be to consider recursion, and build a tool to build tools, however we will leave that for a future date [20]. For now, the focus of this paper is the narrow goal of encouraging thoughtful design of software tools to support the activity of composing artifacts and performances.

2. Composition tools for initiation

Blank sheets of paper and a pencil are an invitation to be creative. Poets, playwrights, composers, mathematicians, and artists have all appreciated its freedom and open-ended possibilities. Paper and pencil are responsive, since the users see results immediately, and direct, since the users feel in control of a predictable environment. However, paper and pencil limit artists' revisions to what can be accomplished by additions and erasures. Since artists want to explore alternative lighting, texture, layouts, or sizes they often resort to multiple sequential sketches. Repeated sketching is productive since it refines their skill and compels them to commit time to the task, during which their reflections can lead to new insights.

A tool that enables artists to lighten an image, change to a smoother texture, shift positions of components, or enlarge individual features should support creative exploration of alternatives [10]. Of course, modern digital painting and drawing software enable just such changes and many more, such as distortions that stretch features in one direction, unusual effects such as enhanced contrasts or negative reversals, and overlays of multiple images. Actions can be applied to the whole image or to selected components and combined actions can produce amazing variations.

But great art is more than clever pixel manipulation. Every work of art emerges from a rich context of culture in which creative artists seek to engage viewers. Artists want to startle/reassure, enthrall/disturb, or remind/convince the viewers about classic themes such as religion, war, love, or death or contemporary issues such as civil rights, environmental preservation, or consumerist society. Art can also be used for practical purposes such as to sell products, promote events, or decorate offices.

Understanding the interaction between the low-level details and the high-level concepts is fundamental to developing composition tools that support creative work [8, 1, 2, 17, 18, 19]. Every artist who approaches a blank sheet of paper brings a lifetime of learning about the high-level concepts that are embedded in the artist's culture and experience. The artist's intentions and goals drive the process, but they are sometimes unnoticed by naïve observers who see only paint or pixels.

Similarly for authors, word processing software easily enables change to fonts, sizes, styles, or justification but these low-level revisions are only part of the writing process. An effective writing environment would support mid-level notions such as outlines, paragraph structure, or consistent terminology and high-level conceptualization of goals and intentions. Writing teachers are clear that pre-writing tasks include formation of the goals, statement of the audience, and choice of rhetorical styles. These cannot be automated, but they can be supported by providing authors with exemplars, templates, and processes.

For example, the Microsoft PowerPoint slide construction and presentation system begins by offering users four choices (Figure 3):

- AutoContent Wizard: a process (Figure 4) that guides users in composing slide shows on topics such as a Financial Overview which has these components: Agenda, Highlights, Income, Revenue by Division, Revenue by Location, Balance Sheet, Assets, etc.
- Template: a set of colorful backgrounds and layouts for items in each slide. A powerful feature is that users can work in one template and then switch to another (Figure 5).
- Blank Presentation: a set of layouts for a single slide that combine titles, lists of bulleted items, charts, or pictures (Figure 6).
- Open an existing presentation: standard dialog box for opening files, with the capacity to search within a set of presentations (Figure 7).

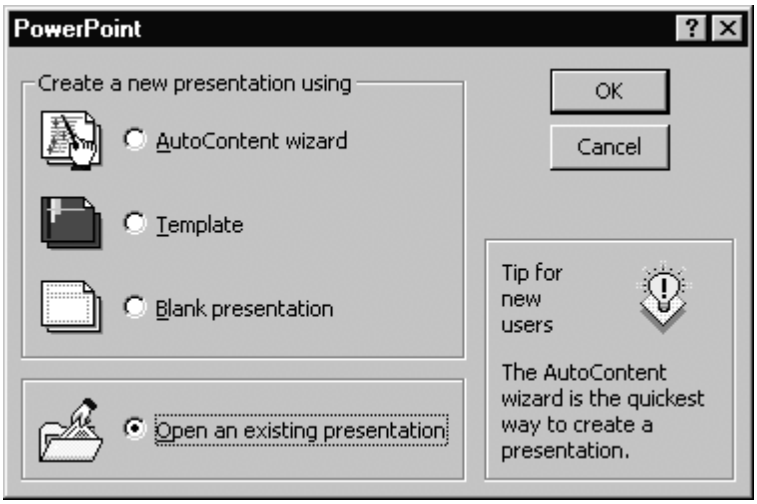

Figure 3. Microsoft PowerPoint offers users four ways to begin work: An AutoContent Wizard to design a full presentations, a Template to design a slide, a Blank presentation, and an opportunity to open an existing presentation.

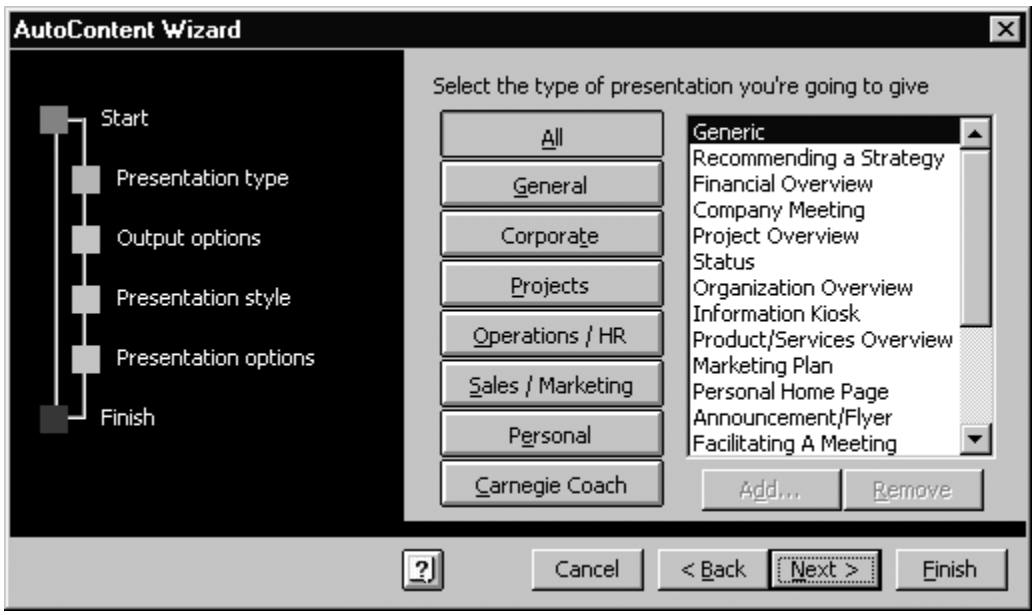

Figure 4: The Microsoft PowerPoint AutoContent Wizard provides starting sets of 5-15 slides that help organize a user's presentation.

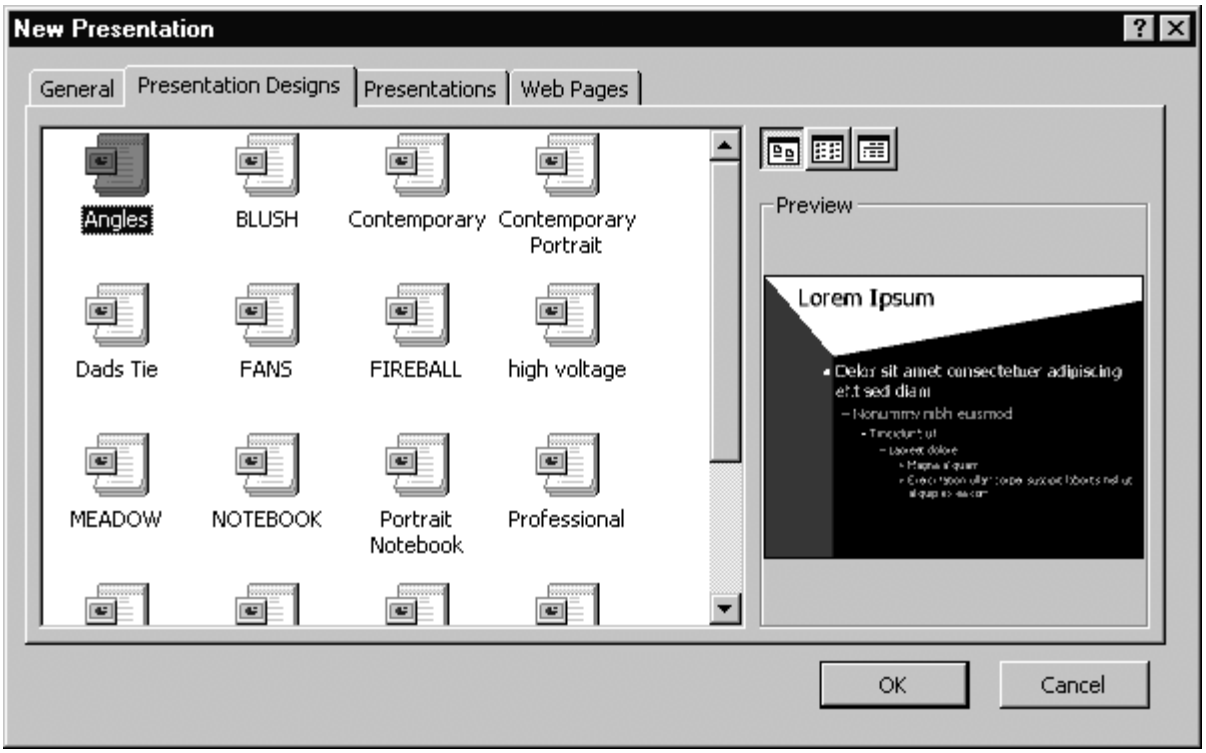

Figure 5: Microsoft PowerPoint's second offering provides colorful templates (although the title should be Template) for individual slides and allows users to switch templates even after they have created their presentations.

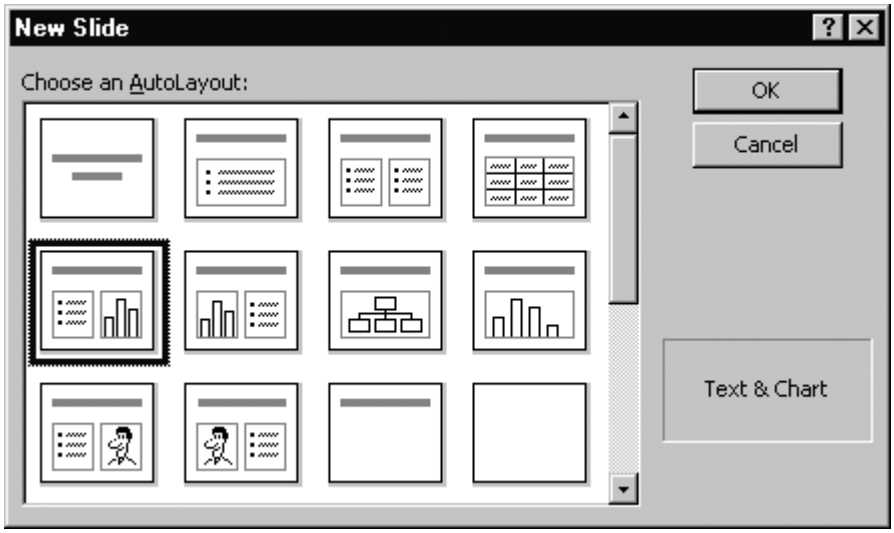

Figure 6: Microsoft PowerPoint third offering provides Blank presentations (although the title should be Blank Presentation) that guide users in formatting an individual slide.

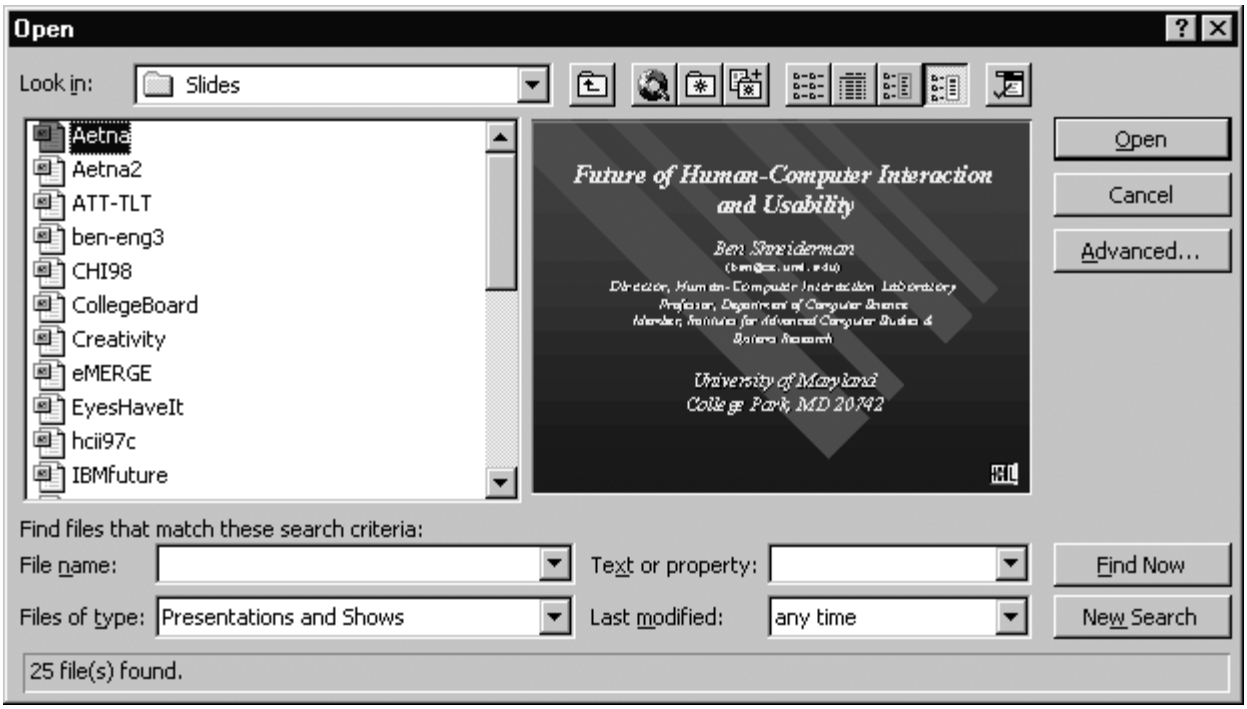

Figure 7: Microsoft PowerPoint's fourth offering enables users to locate and open an existing presentation.

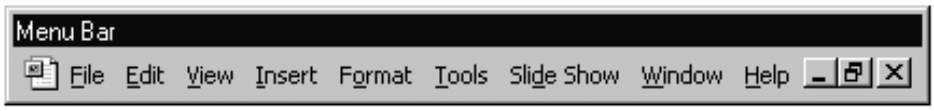

Figure 8: Microsoft PowerPoint's Menu Bar adheres to a standard, but provides only marginal help to novices in converting their high-level goals into a sequence of low-level actions.

Figure 9: A new menu bar that was sequenced by the user's experience might simplify learning for novices.

These are powerful and helpful strategies, that can be extended by template or layout authors within an organization. PowerPoint is an impressive tool, but missing features, a confusing menu structure, and the obvious inconsistencies in layout, terminology, and form might have been avoided if the designers had a more comprehensive framework that guided their design. For example, the menu bar (Figure 8) is more oriented towards the designer's conception of the tool, rather than the user's workflow. Many users struggle to find which pull-down menu contains a desired feature. Of course, Microsoft's designers were constrained by existing guidelines and commonality with other software packages that all benefit from the standard File-Edit-View…Window-Help sequence. However, providing an alternate menu bar or complementary navigation tools has been done successfully by other designers.

One starting point for a redesign could be the four-phase genex framework of Collect-Relate-Create-Donate or a more detailed sequence such as in Figure 9.

A meaningful and task-oriented sequence of menu bar items is likely to help novice as well as experienced users. With this detailed sequence users would probably know that they should select **Learn** to begin by learning

about using the tools and getting help. Then the **Collect** item would contain resources to search and browse to find previous work, relevant web sites, books, maps, etc. and tools for saving these resources or pointers. In addition it might contain copyright tools to record use of copyrighted material and contacts to request permission to use the material. The next menu item, **Consult**, reminds users that they can contact peers and mentors for inspiration, feedback, and guidance. The next three items clearly suggest the stages of creative work: **Initiate Revise Evaluate**. **Initiate** would provide access to exemplars, templates and processes and the blank presentations. **Revise** would suggest low, middle and high level ways to transform the presentation. **Evaluate** would offer checking services and assessment of outcomes. Finally **Publish** and **Preserve** remind users that results need to be saved, disseminated to appropriate readers in appropriate formats, backed up, and preserved in archives. Interesting information such a log of to whom copies were sent plus their feedback and when/where the slide show was presented could also be stored.

Window management features, which are actions on the interface, should be separated from task actions, and placed somewhere else on the window frame along with scroll bars and rulers. Interfaces that enable users to concentrate on their tasks and minimize distractions of managing the interface are substantially more effective and appreciated by users [16].

A menu bar with some sequence such as Learn-Collect- Consult -Initiate-Revise-Evaluate-Publish-Preserve should be useful for most composition tools such as word processors, spreadsheets, music, drawing, or programming. Even more specialized versions for specific products such as a resume, corporate annual report, book review, or city guide could further help focus the users' actions. Instructive examples are appearing in some software and web sites, such as www.theglobe.com/homebuilder. This web site walks users through the process of building their own web pages for an event, a resume, or a fan club. They can view samples and templates, and then be led through the process in a step by step manner.

A much more ambitious tool, Dramatica Pro 3.0 (Screenplay Systems Inc, www.screenplay.com), helps professional authors to compose screenplays [9]. It comes with 67 templates from familiar movies, and enables authors to initiate new screen plays by asking 50 question in the Quick Start approach or the more advanced StoryGuide with 250 questions. Detailed motivations of archetypical characters (protagonist, antagonist, sidekick, guardian, etc.) and plot progressions are coordinated with themes. It provides facilities for revision and maintains some consistency checks, and produces a variety of useful reports. In addition, it feeds into a series of other packages to schedule, budget, and produce movies.

The best creativity support tools enable users to make low, middle and high level revisions (Table 1). Word processors support low-level revisions to fonts, sizes, styles, justification and other specific perceptual features. They provide dialog boxes and tools to change middle-level components such as outlines, style sheets, or other features of a document. However, creativity support tools are still weak in helping to revise the high-level goals or plans of a document [11, 13]. Authors of a dance composition tool stressed that "an important element of the creative process is the need to move flexibly back and forth between levels. Successive refinement of the low level details may reveal the need to change the high level theme [12]."

One approach to supporting high-level revisions is to provide templates for specific kinds of documents such as a resume. Then the users might be able to make modest transformations such as going from reverse to forward chronological order. Users could also shift the emphasis from education to job experiences by changing the order or adjusting the low-level features to give more space and more prominent headings. Resume building programs also assist users by providing reminders of items to include such as awards, honors, prominent references, or key accomplishments.

Interesting examples of highly specific support tools are income tax preparation programs that guide users with numerous questions and allow legal transformations. It may be extreme to call these creativity support tools, but they are highly successful products based on an intensely studied task. Therefore they may provide insights for supporting creative tasks such as writing a book review, scientific experiment report, or a sonnet. Generators for each of these tasks are available, but typically they guide authors through the low to middle-level initiation and revision. Some critics may complain that a template for a book review or a rhyming dictionary cheapens the creative process, but the outcome is still very much the author's product.

The examples show that there are already useful tools, although their contribution is often limited to low and middle levels. The framework may be useful in helping designers see the full range of possibilities (Table 1).

3. Composition tools for revision

Table 1: A simple framework for characterizing multiple levels of revisions for words, images and music.

	Words	**Images**	**Music**
Low	Fonts, sizes, styles, margins, indentation, justification, highlights, white space	Color, size, positions, texture, shading, lighting, hue, saturation, value	Notes, amplitude, duration, attack, instruments, combinations
Middle	Outlines, paragraph structure, style sheets, terminology, columns, figures, tables	Layers, aspect ratio, grid, cropping, perspective, components, sharpness	Motif, movements, structure, repetition, chords, harmonies
High	Goals, arguments, intention, metaphors, rhetorical style, authority, clarity	Purpose, graphical style, message, impact	Genre, mood, tempo

4. Composition tools for evaluation

As users compose and revise their artifacts or performances, they may be helped by feedback. An important method for feedback is consultation with peers and mentors, which is another activity within the genex framework. However, well-designed software tools can provide some feedback as well. For example, modern word processors contain spelling and grammar checkers to offer suggestions of potential problems and repairs. Most word processors also offer simple counts of characters, words, lines, and paragraphs for those who must write documents within certain length restrictions. Some packages contain readability indexes, such as the Flesch Index, tied to sentence length or word difficulty ratings. These may also produce grade level indexes for those who must adhere to such requirements. More advanced tools might provide concordances with feedback about the diversity of word usage or comments on the excessive or sparse use of fonts, styles, etc. More sophisticated analyses of high-level goals is possible in constrained systems such as the tax preparation system that continuously reports the amount of tax or refund as revisions are made to income and deduction fields.

Similar strategies apply to preparing feedback for screenplay writers, musicians, or artists. For example, page layout programs may indicate production costs as the number of pages grow, as binding options are changed and as color page counts increase. Music programs also keep track of the number of instruments or tracks, and the duration of the performance. More advanced evaluation features seem feasible, especially when the application domain is constrained. Similarly error, constraint and consistency checking are natural next steps for many programs.

5. Conclusions

Software support for creativity is a challenging goal, but designers can make progress by developing an integrated framework such as genex and then focusing on specific activities. This essay dealt with the composition activity and separated it into three stages: initiate, revise, and evaluate. Existing system have some useful features that support these stages, but concerted efforts could lead to advanced prototypes with novel features. These would have to be usability tested, refined, and tested in field trials. Amplifying the abilities of many people to be more creative more of the time seems to be a worthy and attainable goal.

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