infoscape: an Online Visual Information Landscape for Collaborative Design Education

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Abstract
infoscape is an online collaboration environment developed for an undergraduate digital image design course, aimed to facilitate intuitive transfers of creative ideas between students without explicitly making this the goal of the processes involved. Self-initiated design propagation acts as a strong motivation to create quality design work through a process of continuous self-evaluation, by encouraging students to negotiate with peers. infoscape consisted of a patchwork of image fields which were assigned to individual students, collectively representing a geographical 'information landscape'. Students gradually designed their fields to visually represent abstract features detected within the corresponding physical reality. The game-like approach of fulfilling successive content levels towards a common goal provoked cooperative as well as competitive activities between students, as the challenge consisted of creating a uniform information landscape in which individual contributions stood out but field borders blended in. infoscape broke with some traditional educational practices, such as deadline-oriented assignments and plagiarism avoidance.

Keywords
Participatory Design, Visual Design, Visualization, Web-Based Education, Computer Supported Collaboration

Course Statement

infoscape, a short term for 'information landscape', was a course unit organized for about 100 first year, first semester undergraduate students studying architecture, design computing or computer science at the University of Sydney in 2004. The course was based on teaching digital image technology, visual perception and digital design processes, in the context of online data collections and creative information visualization.
To address the wide level of technical expertise of the students, the educational content focused on the values of asynchronous online collaboration and abstract visual information design rather than the tools, features and functionalities of typical digital image manipulation software. The infoscape concept considered online, collaborative environments as powerful information spaces that are capable of empowering and motivating large groups of people to collect and organize huge data collections collectively in a pleasing, engaging and meaningful way. In contrast to most similar approaches that utilize online collaboration environments in a principally textual context, infoscape explored a mainly graphical approach.
The collaborative, *visual map* metaphor provided the students with an ever-present, dominant design context in which their creative contributions could thrive. infoscape participants traced abstract phenomena within a real-world context, and visually represented these within a geographical landscape metaphor that enforced no predefined data mapping structure (e.g visualization legends or iconographic language) or hierarchical supervision (e.g. curation of submissions). As a non-hierarchical collaborative tool, the infoscape concept resembles that of *Wikis* [2], a social computing system that allows groups of users to structure and alter website contents to meaningfully organize large information collections. Although the infoscape participants did not even know each other, most of them successfully contributed towards a single, common goal: a multi-layered, visual information landscape. infoscape was authored collaboratively by 96 students over an 10 week period: the notion of single authorship was sacrificed in favor of a large-scale and longtime collective endeavor of which the outcome would have been impossible without the simultaneous effort and enthusiasm of most participants.
infoscape exploited the qualities of online collaboration in an attempt to augment the quality of the resulting design works in several aspects. Firstly, to *motivate* the students to learn from their peers, hereby enhancing their technical or conceptual weaknesses while having the chance to contribute their strengths to the overall design process. Secondly, to offer students different strategies to fulfill the course assignments, varying between active *design initiation* and passive *design propagation*. And lastly, to provoke the students to work often and in a gradual fashion by exploiting the adaptive nature of the information landscape. The peer pressure from neighboring fields forced students to re-evaluate their designs, either by adapting them to developments nearby or by convincing neighbors through argumentation to take over their design ideas.

Creative Collaboration

Collaborative software integrates work on a single project by several concurrent users at separate workstations. The multidisciplinary field of Computer Supported Cooperative Work (CSCW) addresses how computer-based systems support groups of people engaged in a common task (or goal) by providing an interface to a shared environment [3]. Some software tools focus on online classrooms and *e-learning*, while

By offering students a shared, online platform that accommodated a single, common goal and allowed that their individual contributions could be seen and then criticized by their peers at all times, students were motivated to submit good quality work. This characteristic can also be perceived when observing several other online, collaborative initiatives with these characteristics (e.g. Wikis, geo-location maps, Slashdot.org, weblogs, etc.)

others are based on collaborative environments, also called *groupware*. These web-based environments enable shared work, by offering a rich set of tools such as message boards, chats, calendars, team administration, file sharing, project management, idea generation and concept evaluation [8]. Several proprietary and open-source approaches already exist that enable different levels of collaboration (e.g. communication, conferencing, management), targeted to specific subdomains (e.g. education, knowledge management, product development). Recent research demonstrated the potential of *Wiki extensions*, which allow students to be co-creators of course content [15]. kollabor8 [13] uses the online medium to design artistic images through a process of collaborative collage additions. However, only few approaches exist that focus on *simultaneous* creative (visual) design work by *large groups* of participants. We believe that by offering students a 'visual' asynchronous collaboration platform and a common design goal, they will inspired by peers and adopt a meaningful educational strategy regardless of their technical expertise or creativity skills.

Collaborative Geo-Location

Driven by the rapid advances in mobile, geographical position detection, several recent research initiatives attempt to merge the physical presence of people with location-specific information. The power of location-based information became obvious after February 2005, when search giant Google started to merge search results with highly interactive maps based on detailed satellite images [6]. Subsequently, independent developers created various online mapping applications on top of Google's powerful API, resulting in creative applications that merge specific online datasets with geographical maps, enabling the representation of housing data [11] or personal childhood memories [5] (invented by Matt Haughey). Notably, several approaches are creating information-rich geographic maps by large groups of physically remote participants that collaborate within the online realm: for instance, the Geograph British Isles project [12] aims to collect a geographically representative photograph for every square kilometer of the British Isles, the Degree Confluence Project [7] exploits online collaboration to collect images taken at each of the latitude and longitude integer degree intersections in the world, and wifimaps [14] displays interactive maps of open wireless access points within the US. Other *geo-location* projects focus on the visual representation of social experiences related to the built environment: the Bio Mapping project [9] traces and represents the emotions of users as they explore city environments, Urban Tapestries [10] investigates how social and cultural behaviors can be explored by storing the presence of people and sharing their experiences in a city. Although infoscape was originally conceptualized well before these initiatives emerged, it demonstrates how the combination of geo-location and online collaboration can motivate a large group of participants to collect and annotate various real-world phenomena, here applied to a design education context. While utilizing less technological advancements, infoscape attempted to use a collaborative landscape approach to allow for the emergent propagation, peer negotiation and critical review of visual designs.

Visual Information Landscape

The infoscape concept is based on two educational courses, titled *Information Landscape* and *Dreamscape*, organized by Prof. Maia Engeli in 1998 and 1999 at the chair of CAAD and Architecture of the Swiss Federal

Institute of Technology Zurich (ETH-Zurich), at which the main author of this paper was a teaching and research assistant. Similar to infoscape, these courses facilitated the online design of a collaborative visual landscape [4]. More specifically, these landscapes contained graphical textures copied and cropped from website links that were related to specific 'dream attributes' and abstract keywords (e.g. 'rational', 'contrast', 'air'). infoscape enhanced this information landscape concept in several ways:

- **Physical World Context**. infoscape focused on the visual depiction of real-world phenomena. This approach allowed students to relate their abstract visual designs to the ever-present physical reality.
- **Stacked Conceptual Layers**. infoscape divided the analysis and visual representation in successive phases. Each phase corresponded to separate, semi-transparent layers that were stacked on top of each other, so that students were forced to continuously reflect back to their previous contributions.
- **Data Visualization**. infoscape required students to design visual representation methods that conveyed concepts abstractly, without depicting reality in an iconic way (e.g. drawing little houses) or using traditional geographical mapping techniques.
- **Dynamic Level of Detail**. infoscape integrated a zoom tool that displayed a wide landscape overview. As it made more individual fields visible in the same contextual window, it induced collaboration and idea propagation over a wider range of fields and students.
- **Pervasive Text Tool**. Instead of separating textual and visual communications, the infoscape system displayed textual messages within the same visual context, on top of the graphical landscape itself, visible for all neighboring participants.
- **Game-Like Approach**. Several game-like influences, such as the stacking of successive phases (or 'levels') that reflect on one another and the desire to fulfill common, shared goals in a collaborative fashion (e.g. multi-user levels, shared virtual worlds) motivated the participants. Each participant attempted to leave a unique trace within the context of anonymous authorship and visual design blending.

infoscape Concept

infoscape represented abstract features hidden in the physical environment that often were not consciously experienced by its visitors. Consequently, infoscape can be considered as a visual real-world *experience map*, representing the consensus of social impressions from a large group of participants, with the potential to be used as online *knowledge map* for diverse useful scenarios. infoscape asked the participants to investigate meaningful phenomena that are overlooked in traditional maps, and to devise effective graphical depictions for these. Consequently, infoscape represented a wide collection of subjective traces, such as shadows, emotions, sensorial impulses, natural occurrences, electromagnetic radiations or the pervasive presence of commercial logos and iconographical signs.

The infoscape environment aimed to facilitate intuitive transfers of design concepts between students, without explicitly making this the goal of the processes involved. We strongly believe that self-initiated *design propagation* acts as a strong motivational influence for students to generate quality work, and enables them to learn from their peers. It provoked students to reevaluate their work continuously, as they negotiated with peers in order to have their ideas taken over. This process is especially valid in the digital realm, where creative work can be easily copied, transferred and stripped from authorship. In fact, contrary to traditional academic plagiarism rules, 'creative reuse' was actually encouraged, as long as the outcome enhanced one's own original concept or blended visual depictions. The visual landscape metaphor is ideal in this respect: the patchwork of bordering fields effectively provoked both *cooperative* as well as *competitive* activities at the borders of the individual fields, as the ultimate goal consisted of a) creating a common visual information landscape, requiring concealed and blended borders, and therefore b) the propagation of one's visual depictions over multiple fields, requiring strong visual designs and careful negotiations with neighbors.

Asynchronous Collaboration

As shown in Figure 1, the infoscape landscape consisted of 11 by 12 square fields that spanned a large part of the university campus. Each student was randomly and anonymously assigned to a unique field measuring 500 by 500 pixels. Figure 2 demonstrates how each field *influenced*, or was *influenced by*, its eight surrounding neighbors, and how these processes resulted in an 'emergent' common visual language that blended the individual borders between all pairs of neighboring fields. Notably, this visual collaboration occurred *locally*, between immediate neighbors, as well as *globally*, over the whole information landscape, for instance during phase 4, titled 'Flow'. In contrast to the practice of deadline-oriented course units, students were allowed to submit their work as many times as they wanted, but preferably in a gradual fashion, to initiate long-term negotiations with their neighbors (Figures 7, 8, 9, 10). Students regularly checked for any alterations of the visual landscape in the vicinity of their own field and submitted their own gradual contributions accordingly.

By founding the infoscape on a real world geographical concept only a few hundred meters away allowed students to relate their designs to a common context they all shared almost every day.

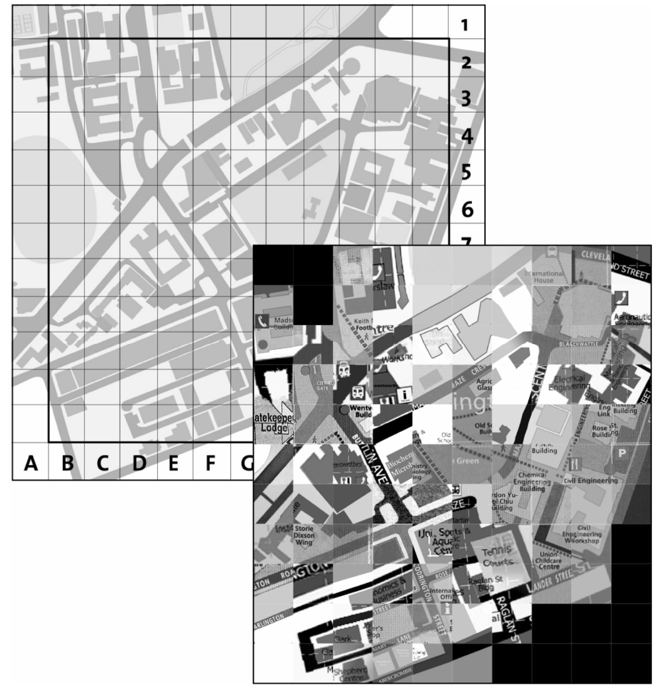


Figure 1. Top: geographically divided university campus map; Bottom: according collaborative map generated by students.

Information Mapping

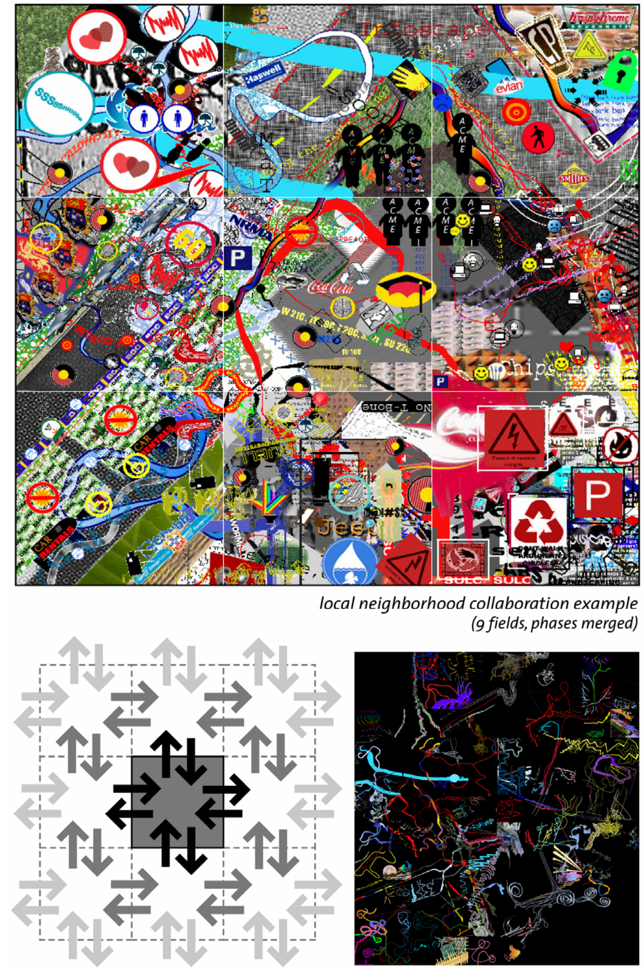
First, students were asked to redraw the geographical outlines that corresponded to their fields, to generate the visual 'background map' that acted as their real-world context for the remaining part of the course (see Figure 1). The course comprised of eight sequential assignments, each spanning between one and three weeks, depending on their difficulty level. Table 1 lists the order of the different phases, the most common image manipulation tools that were used and some content examples created by students. The assignment sequence was motivated upon three justifications.

infoscape can be considered as a large-scale *collaborative information visualization,* as most visual depictions represent abstract, non-spatial data objects (such a emotions, flows, activities, …), in contrast to physically based traditional map representations (e.g. streets, houses, hills, ….)
In addition, the visual cues of the designed data representations, such as size, direction, color, etc. had to be mapped to informational values, such as importance, occurrences, influences, quantities and so on, which conceptually constitutes a typical information visualization approach.

Firstly, the gradually accumulated *knowledge* about digital image generation and adaptation software tools, so that the difficulty level of the technical tutorials would correspond to the representations that had to be generated. Secondly, the *visual granularity* of the infoscape fields, so that later added, and thus above-lying, layers would not unnecessarily disturb, overlap or block previously submitted, underlying images. Lastly, the gradual *contextual interdependencies* of the features that had to be visually mapped by the students. One should note that each graphical feature that depicted an informational feature had to be carefully designed, so that its formality and shape visually conveyed an abstracted data value: its relative position, size, and color should correspond to specific meaningful criteria, such as frequency, relevance and prominence of the depicted concept in physical reality.

Phase Layer Merging

All infoscape users were able to combine different conceptual layers on top of each other and thus explore the information landscape in different analysis contexts. Students submitted each phase separately as a transparent image which was merged with previous phases by the web server in real-time. The literal separation of phases facilitated an accurate tracking of individual submissions, over time as well as conceptually within the landscape framework. In addition, the layer merging functionality provoked some unique, creative design possibilities: for instance, as shown in Figure 3, some students designed transparent zones to highlight 'underlying' objects or to show their influences to their environment by showing them as 'missing'.



local neighborhood collaboration example (9 fields, phases merged)

local collaboration diagram

large-scale collaboration example (96 fields, flow phase only)

Figure 2. Top: Collaboration between adjacent 9 fields, demonstrating field border 'blending', 'copying' of graphical depictions (e.g. circular black-red icons) and continuation of design concepts (e.g. ribbons, icons). Bottom: collaboration diagram and zoomed-out overview showing large-scale collaboration of approximately 96 fields during Phase 4, 'Flow'.

Phase Title	Short Description	Digital Image Tools	Content Examples
background	scanning, drawing or copying the geographical map corresponding to infoscape coordinates	scanner, image transformation, filters	
features	abstract representations depicting unique, static environmental characteristics	vector shape generation & transformation	*power lines, garbage, clouds, antennas, views, shades*
zones	larger areas filled with relevant abstract textures taken from images	digital cameras, texture generation, image filters	*detailed digital photos of phenomena, news articles, posters*
flow	directional lines or ribbons representing any kind of dynamic flow	brushes, freeforms, splines	*wind, electromagnetic radiations, knowledge transfers, social interactions, motion paths*
text	text labels depicting non-visual, abstract characteristics	fonts, text formatting, warping	*emotions, light intensities, chemical compositions, noise levels*
logo	re-creation & design of detected commercial logos	advanced image manipulation & creation	*manufacturers, academic groups, suppliers, service providers*
icon	re-creation & design of meaningful icons	advanced image manipulation & creation	*abstract functionalities, activities, warnings, emotions*
author	personal student representation	all of the above	*hobbies, biographies, childhood photographs, cultural influences*

Table 1. infoscape assignment phase order and detailed content descriptions.

Interface Design

Textual interaction enabled the communication of conceptual thoughts, arguments, motivations and negotiations with neighbors. Students also used the text messages to explain the technical aspects of specific visual effects to less skilled students (mostly in order to have their visual concepts taken over). The last submitted text messages are shown directly on top of the graphical landscape, so that direct visual connotations could be made. As these messages could be addressed to anyone in the neighborhood, students were forced to regularly read and be aware of *all* surrounding descriptions, instead of receiving personalized, private messages, e.g. via email or instant messaging tools. The continuous contextual awareness through the textual layer provided infoscape with a feeling of a dynamic community. The graphical display showed a neighborhood in a matrix of either 9 or 25 bordering fields, enabling the propagation of design ideas over multiple fields. The visual, web-based interface consisted of following interface elements (Figure 4):

- **Navigation**. Four navigation buttons enabled panning the map in north, south, east or west direction for exploration purposes.
- **Zoom**. A zoom button, providing an overview over a field's direct neighborhood (resizing them to 50% or 100%). Zooming enabled the propagation of design ideas and text messages over larger areas.

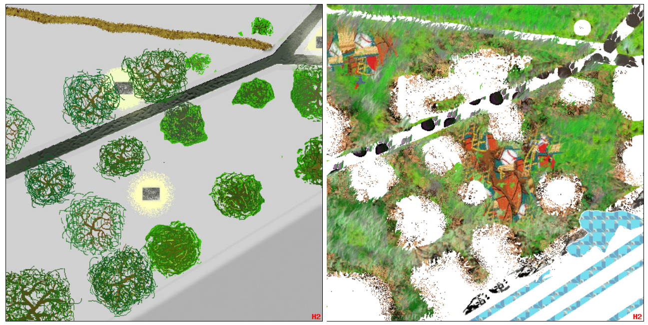


Figure 3. Left: phase 'Features', right: subsequent phase 'Zones'. By leaving transparent zones empty in phase 'Zones', 'the world in between' became highlighted, and the features below were still visible and not obscured when both phases were merged on top of each other.

- **Phase Selection & Merging**. Checkboxes depicted different phases, so users could select specific phases and merge them (respecting all transparent pixels). This tool is used to investigate phases separately or in the context of previous submissions.
- **History Calendar**. A calendar enabled users to trace past submissions in time, to detect the 'original' authors of specific design ideas or to assess individual collaborative efforts over time.

Technical Implementation

The infoscape system utilized no database, mainly because of the wish to avoid complex programming issues during the limited development time. Instead, each single text or image submission was time-stamped and stored in a simple file system. Searching and data mining algorithms were transferred to small online scripts that parsed through the file system. In contrast to initial expectations, the maintenance and debugging efforts were minimal. All scripts were programmed in the PHP programming language, while the interface used simple DHTML techniques.

Figure 4. infoscape online interface, with landscape view, overlaying text message, interaction panel, history calendar.

The core of infoscape was programmed by one person with non-expert knowledge of the PHP language within a time span of two weeks (with further development of more advanced features during the course itself). All images were dynamically created by merging the user-selected layers (transparent GIF) on top of each other into a single image (PNG format) by PHP's image generation capabilities [1]. A set of simple scripts processed the password-protected submissions by students, provided map navigation, merged images and retrieved historical submissions. The assumption that the large number of students combined with real-time, dynamic image generation would cause computing performance or networking issues proved unsubstantiated. Although the infoscape only showed the latest text and image submissions, all past submissions were stored for later marking assessments and were always accessible via the calendar interface.

Presentation

The infoscape landscape was presented on different visual media, to make students continuously aware of their contributions relatively to the whole collaborative effort. The active phases of the landscape were printed on large-scale posters, which were displayed in corridors and computer labs (Fig 5). Computer screens in the entrance hall flashed random infoscape fields and their accompanying text messages, making students aware of the continuous dynamics and the intermediate contributions of peers. A 3D VRML world was developed that stacked all layers in three dimensions, revealing the amount of abstract information stored in each phase and demonstrating how the information could be more intuitively explored by superimposing phases and 'jumping' and 'flying' through them (Figure 6).

Figure 5. Different presentation media: displays and posters in the entrance hall and building corridors.

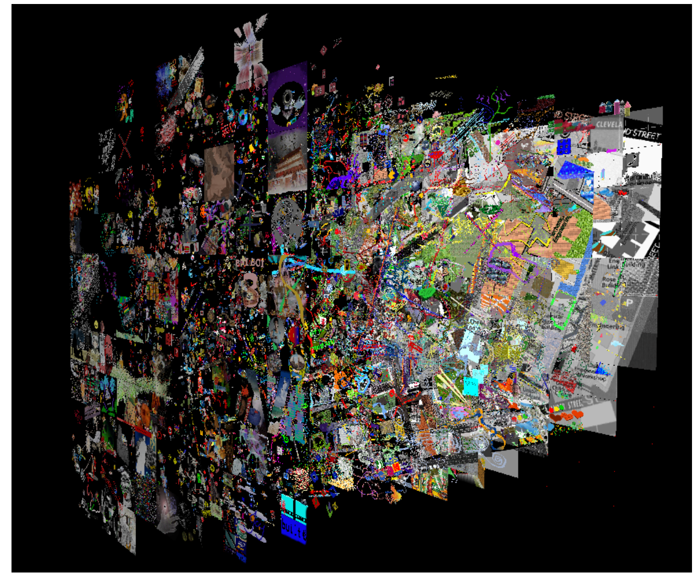


Figure 6. Stacked 3D model (VRML) of all successive infoscape phases.

Student Design Strategies

As the students possessed a relatively broad range of relevant software expertise, the infoscape system needed to allow different educational *strategies* to fulfill the course successfully. Its conceptually broad approach enabled experienced students to focus on some unique aspects, such as conceptual thinking, visual abstraction, textual argumentation and active collaboration, while the less-skilled students could concentrate on learning the basic image manipulation tools that were required to visually represent their design ideas. As the infoscape fields were divided randomly and anonymously (while exchanging names or contact details was not permitted), students had to collaborate with unknown peers distributed in separate tutorial sessions with varied levels of expertise.

The infoscape design is based on the assumption that course concepts for large groups of students should offer different strategies to fulfill the course requirements. Allowing several options increases the participatory motivation of students, and therefore their educational *experience*.

Following student design strategies could be recognized:

- **Design Initiation**. Some students attempted to initiate strong visual design ideas that could be pursued and propagated by others, by either a) submitting relatively early, or b) creating visually dominant design gestures. These fields stand out by their visual design quality or by their intense textual correspondence with neighboring fields. Often, these textual conversations switched between conceptual and technical issues, so that less knowledgeable students who wanted to take over these sophisticated visual design ideas could learn the appropriate techniques directly from their peers.
- **Design Adaptation**. Some students gradually took over design concepts from others, by returning to infoscape often and altering their fields to new situational contexts. These fields can be recognized by many communications directed to all neighbors.
- **Conceptual Argumentation**. Some students mainly focused on the communication side, and created works of art textually as well as graphically.
- **Lurking**. Other students 'undermined' the gradual collaboration goal by submitting only once, mostly just before the final phase deadline. Notably, most these submissions were of quite high design quality as they were completely adapted to their direct neighborhood and propagated the best design concepts, in order to avoid negative consequences by individually standing out in the landscape.

Educational Design Characteristics

Because of the unique features of the infoscape concept, students were challenged with some aspects that differed radically from their traditional course unit approaches, including:

- **Plagiarism Allowance**. Students were allowed to take over visual features from one another, as long as these made sense in the context of their own fields (e.g. the same depicted concept occurred on multiple fields), or when it was required to visually blend field borders (e.g. fields sharing concepts). Obviously, this rule stands in sharp contrast with the common strict plagiarism rules adapted by most academic courses. As mentioned before, tolerating 'copying' allowed less-experienced students to take over conceptual as well as technical expert features, by asking their peers directly. Notably, simple copy-and-paste actions were mostly impossible and technical expertise was still required.
- **Regular Participation**. Students were invited to work often during short time periods instead of once (and long) just before the final assignment deadline. This approach enabled neighboring students to adapt their fields gradually, which would be impossible when all the fields would be submitted shortly before the deadline. Regularly executed efforts that incorporated gradual design adaptations from neighbors and peer comments most often resulted in increased design quality. Often, students were initiating complex negotiation processes with neighbors in order to have their design concepts assimilated. Interestingly, such conversations typically lead to a 'tit-for-tat' approach: specific visual features would only be taken over by others when their original authors would do the same for them.

As with any creative design course, there was no established specification readily available to distinct a 'good' designed infoscape field from a 'bad' one. Therefore, short critique evaluations given at the start of each lecture for the whole group were critical to establish a common recognized level of expected design quality to ensure the success of the infoscape as a

The collaborative aspect 'forced' good students to work together with weak students, as this was the only way that their high quality design concepts would propagate over multiple fields. At the same time, weaker students could thus learn from their stronger peers, and could fulfill the course requirements by taking over and creatively combining compelling design ideas of others if they were not creative enough to create their own.

whole. As these feedback sessions took place several times during the course unit, the lecturer could intervene rapidly if required.

Collaborative Design Characteristics

It was recognized that infoscape, as an online educational collaboration environment, exhibited the following unique characteristics:

- **Design Context**. The continuous presence of a dominant, ever-present context (the surrounding fields) to which the students had to react through their designs as well as through their communications, so that uncreative students never had to start with 'empty paper'. This context was present in two scales: overall, by the gradual development of the whole landscape and the students' relatively small contribution to it (1 out of 92: approx. 1%), and on a local neighborhood scale, consisting of direct neighbors with whom one could interact via graphical exchanges and text messages. Although students were unaware of the identities of their neighbors, the notion of a pervasive context resulted in a sense of community. As a result, a specific and prevalent (although undefined) system of symbols, signs and behaviors 'emerged' that seemed to be commonly used over the whole infoscape (e.g. dominant use of primary colors, non-orthogonal orientation, etc.).
- **Gradual Collaboration**. Students were motivated to collaborate with fellow students to take over design ideas, or to copy designs of others to generate a consistent, collaborative landscape artifact. Students quickly realized that sharing designs allowed for the contribution of unique concepts to the overall goal, while their own weaknesses could be improved by comprehending and incorporating the designs of others.
- **Peer Learning**. At some occasions, less experienced students wished to take over strong visual features of technical skilled students in their neighborhood, but were unaware how to generate them. Interestingly, the only way for these strong students to propagate their design concepts was to explain these weaker students textually how these effects were created. As a result, students often learned from their peers, even without knowing them and without any external pressure, except of the wish to see their design concepts taken over by others. In addition, the process of textual explanations and negotiations increased the awareness of how designs had to be rationalized and conveyed to others, a useful skill for all designers (see Table 2).
- **Self-Motivation**. As in most course units, some students preferred to 'lurk', that is to watch what is going on without becoming actively involved. However, students who did not participate quickly stood out in the landscape. Student neighbors attempted to motivate these persons to collaborate by 'yelling' textual messages, or even designed 'negative consequences', for instance by graphically avoiding these specific fields.
- **Work Continuation**. Most students checked the local changes in relation to their own work several times per week for short time periods, and thus re-evaluated their own work often. This behavior of regular reconsideration and resubmission, clearly improved the design quality of many individual works. Due to its continuous adaptation and refinement, the infoscape environment showed some elements of surprise and curiousness, which can also be found in web blogs, forums and newsgroups.

Phase	Field	Comment
flow	F2	for E2, I used liquify>twirl clockwise tool to make such a pattern, you can continue with the flow. for G2, continue my flow and use 'filter>stylize>wind', then set 'blast' and 'from the left'
logo	G9	I put up the sports centre logo at the centre with big size as it was the most frequent use. and adopted some ideas from other infoscapes around mine. Especially the Philip Morris logo is for cigarette butts on the footpath. all different skewed logo shapes indicate the exercising movement of gym users. I thought it could be fun to design an architect*s logo who designed this sports centre (yellow and red geometry.)
features	G9	thanks F9. excellent. G10, I try to match your block, but it will be better if you give me some tips to make the same effect. H9 can you extend your features to my border so that I can connect it as I think your idea is good. but, also give me some tips how to make those layer shadow effects? Cheers.
features	I10	H9 and H10: Could you make the black wall of the courts match up with mine? It fits with I9 well, but needs to be shifted right a little to fit with mine. thx.
features	J10	K10: to create these clouds, all you need to do is 1.create one or more coloured rectangles (3399CC) (blending: color) and 2.then use the filter *motion blur*, to create the desired effect. 3.Also to get the edge, erase the outlines with a different brush. 4.Then create another layer of white (blending: normal) over it and motion blur it. (Note: when saving, saving with *pattern transparency dither*). Not that much, huh....
flow	H2	G2.Why aren't you collaborating? What's the deal here? It's due tomorrow, we've had two weeks, and all you've put up is a few white lines with no explanation. Forgive me for being frustrated, but I'm sure you would be if you were in a similar situation. Get your act together dude.

Table 2. Some examples of textual communications left by students to their direct neighbors, demonstrating both conceptual descriptions of their designs, as technical explanations of some used image manipulation methods to less expert students.

- **Design Abstraction**. Students were required to detect and visually map unique features in the built environment. As a result, students became aware of non-obvious, everyday influences that surround our physical experience, and considered how these could be abstractly visualized within a two-dimensional map metaphor. Consequently, infoscape users can thus investigate whether the university campus is still visually recognizable for specific phase layers, and if, for example, specific dominant flows or zones necessarily corresponded to existing streets or physical building perimeters (see Figure 8).

Student Design Assessment

One of the most important advantages of using web-based environments is the possibility to track and store all interactions that occured in the online realm over time. The infoscape system time-stamped both textual and graphical communications, so that possible relationships could be investigated between resulting, visually strong collaborations and the design quality marks the students received. In practice, the assignment assessments were divided in four different criteria: Design Quality, Technical Expertise, Content (conceptual) and Collaboration (with peers), resulting in

about 92 students x 8 phases x 4 criteria = 2944 different marks. ‘Collaboration’ qualified and counted the number of textual and graphical submissions, ‘Content’ denoted the concepts that students chose to analyze and visually explore, while ‘Design Quality’, evaluated the image as an independent artful or aesthetic artifact, which ideally includes original visual depictions and explorative concepts executed with a high level of detail and sophistication.
infoscape is based upon the assumption that the process of continuous submissions has a significant effect on design quality, as students reconsider their design often and gradually, in order to ‘push’ their designs to neighbors for more overall visual prevalence. To prove this hypothesis, our current research investigates whether there is a significant correlation between the number of gradual submissions per phase and its design quality mark, so whether ‘good designs’ always correspond to a long process of continuous adaptation and reconsideration, or could be the result of a single submission and non-collaborative behavior. Preliminary results are promising, as they show how high design quality marks are statistically related to a high number of textual and visual collaborations and inversely, low marks to ignoring the propagation of strong neighboring design ideas.
However, the infoscape system did not track whether students were ‘inspecting’ the landscape, as it only stored digital submissions, whether graphical or textual. In hindsight, it might have been very useful to implement a ‘login’ feature that traced whether specific students took at least the time to follow developments, as most students only resubmitted their work after significant changes in their immediate neighborhood and their passive reevaluations might thus have not have been recorded by the system.

Our first statistically motivated evaluations of the submission data (timestamps of all submissions and comment contents) and student end marks have shown that there is a relationship between high design quality works and the number of successive textual or image-based submissions. It was also expected that high-quality works would positively influence the design quality of their directly surrounding fields, an assumption that however could not be proven.

Another phenomenon that could be directly perceived was how the ‘influential reach’ of the collaborations (the number of fields over which a design concept spreads out over neighboring ones) corresponded almost exactly to the number of fields in view of the zoomed-out landscape overview. Therefore, we would recommend to implement more zoom-out levels, so that major visual designs would be visible to even larger areas and thus more students, which would significantly increase the chance of being taken over by more people in a larger range.
Students used many different approaches to textually convey their wishes to their neighbors, ranging from flaming to long, friendly requests. Students could even use normal HTML tags (such as color, text type, size, etc.) in their textual comment fields, a hidden feature that was not communicated to them in order to trace how such unexpected discovery would propagate over the landscape in time. Unfortunately, only one student explored HTML functionality during the last phase.
Furthermore, it was recognized that similarly to physical reality, in the virtual realm of the infoscape, spatial location was an important issue: students with fields on the borders of the landscape were somewhat disadvantaged as they had less other participants to interact with. Remarkably, although the fields on these borders could be regarded as more ‘easy’ locations, as they had less neighboring fields, and thus had to be adapted less times to new surrounding situations, most corresponding students felt some degree of unfairness and disappointment.

Student (User) Evaluation Survey

The course unit was evaluated via a standardized, anonymous web-based survey form that is used for most courses at the University of Sydney. The results showed how students had difficulty to understand the infoscape concept and goals in the initial weeks, as they were introduced with the visual collaborative aspect without a full explanation of the underlying design propagation concept. This feeling rapidly transformed in a great amount of enthusiasm when students started to reflect upon the global online results and the large-scale posters that emerged after some time. Some students complained about the unavoidable (negative) influence of neighbors who did not participate or shared designs over their fields: in effect, starting major graphical depictions that were not followed by neighbors sometimes quickly disappointed students, as there were no readily available means to provoke these students to action except of 'social' pressure through textual and graphical communications of a larger group of neighbors. A possible solution for this phenomenon, at least in an educational context, could consist of marking in between and immediately after the phases.

Conclusion & Future Work

infoscape demonstrates simple principles how large location-based data collections can be captured in an online, visual landscape in a asynchronous collaborative manner, here within a visual design education context. Its game-like aspect of visually neighboring fields enthused its participants almost automatically to actively collaborate with peers and learn from each other for a common goal.

We believe that the infoscape concept has potential to be used as an extension for existing online maps or image-based data collections, which could be enriched with infoscape-like knowledge layers that are collected by a large group of physically remote users. Possible examples include geographical image collections (e.g. The Degree Confluence Project), search engine maps (e.g. Google Maps) or image repositories (e.g. flickr.com) that could visually collect more user-driven information within their existing software frameworks. infoscape landscapes could thus be used as a collaborative information gathering tools for location-based data that can be visually presented to or dynamically updated by visitors through different presentation media, such as mobile phones and mobile game consoles. infoscape's game-like aspect of blending visual contributions within a global, shared landscape sacrifices individual authorship, but instead offers its participants different contribution strategies depending on their personal motivation, design creativity, prior knowledge or technical expertise. Its continuous altering character towards a single common goal provokes participants to participate often and in a gradual way, giving others the chance to adapt and assimilate the gradual additions of visual depictions. Participants are able to defend their creative designs to others and see them almost literally propagate on fields of other authors, based on principles of asynchronous, online collaboration. The visual information landscape enables participants to intuitively share design concepts and technical knowledge in order to create a shared goal, in which the result is larger than the addition of its parts.

As visual image collections and dynamic geographical maps are becoming increasingly popular in the online community, infoscape demonstrates a simple but powerful example of adding personalized knowledge to these repositories in a collaborative, creative and enjoyable way.

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Acknowledgements

We would like to thank all 96 infoscape students and 2 tutors for their great work and enthusiastic participation. We are grateful for Maia Engeli and Bugajska Malgorzata, who allowed the author to develop the original information landscape concept. A static version of infoscape can still be explored online, at **http://infoscape.org** or http://www.arch.usyd.edu.au/~andrew/infoscape

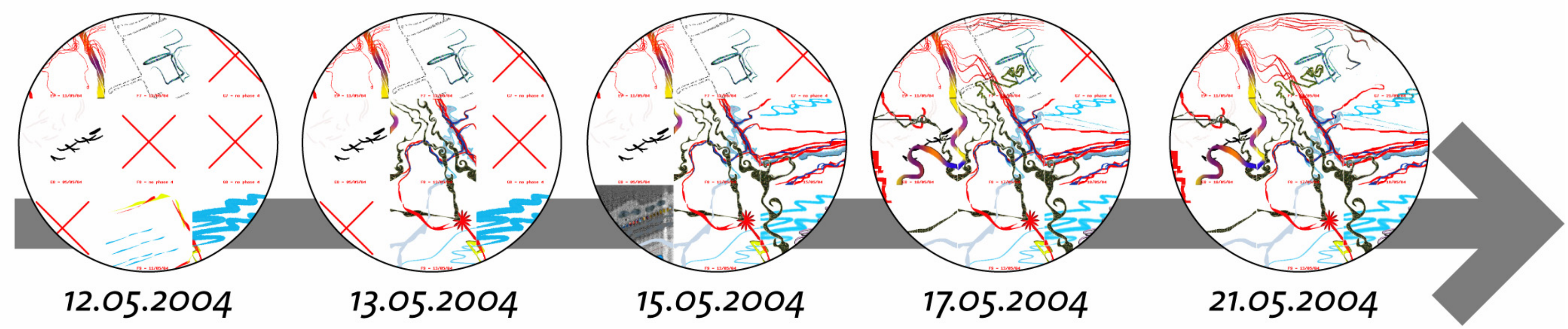

Figure 7. The gradual adaptation in time to a strong design concept ('flow' phase). Shown are 9 neighboring fields, with red crosses depicting empty submissions. The timeline (from left to right) demonstrates how the strong and 'early' visual concept of the middle field influences the later submissions of the surrounding ones: the random, liquid lines are taken over by all its neighbors. Vice versa, the middle field e.g. takes over the red-purple-yellow ribbon from the top left in return. Note that in the resulting mosaic, field borders are almost invisible but individual contributions can still be recognized.

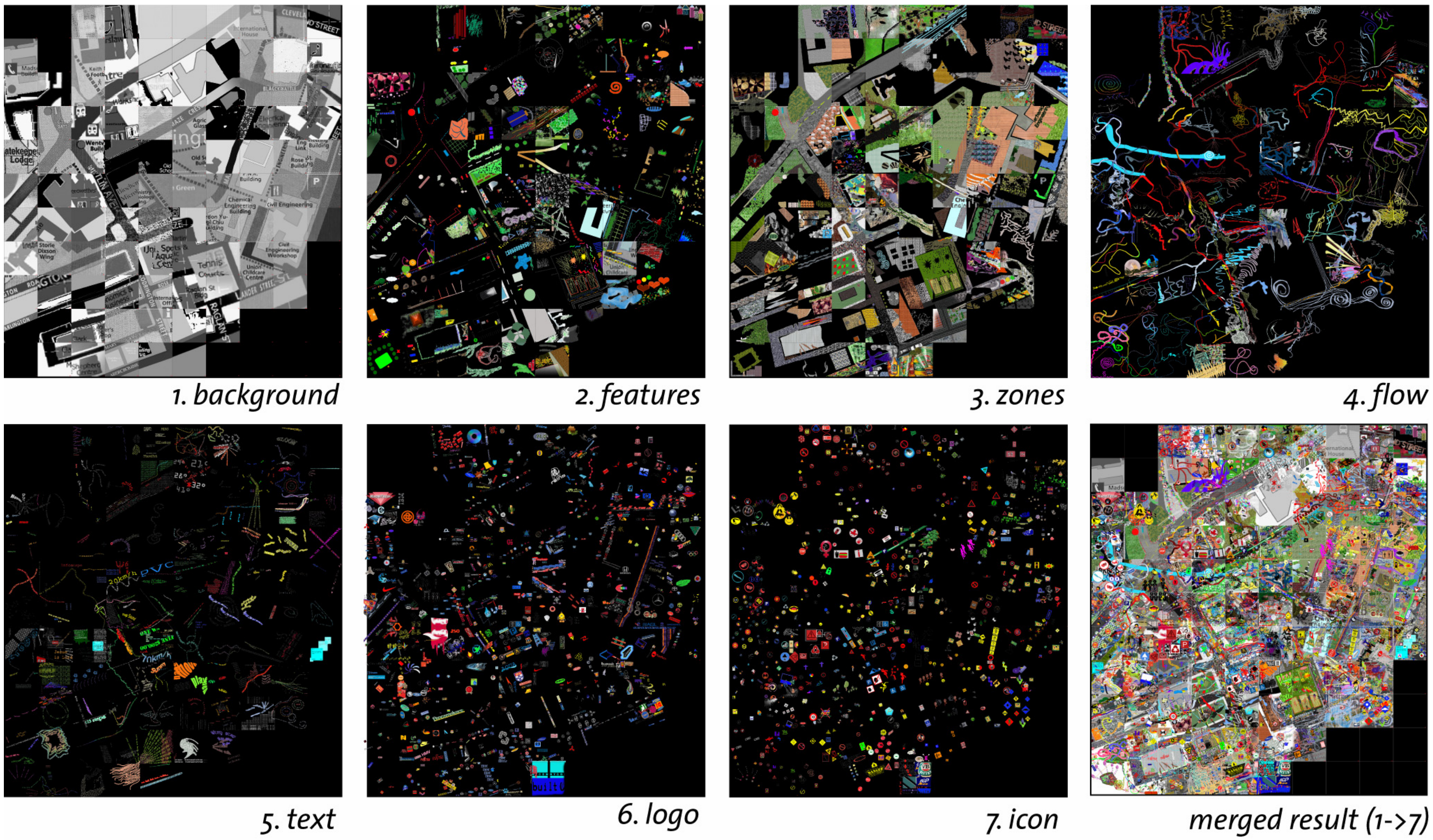

Figure 8. Successive, overall information landscape development. Each phase is represented as a separate, non-merged layer (black denotes transparency). The information landscape as a whole, depicting each phase separately.

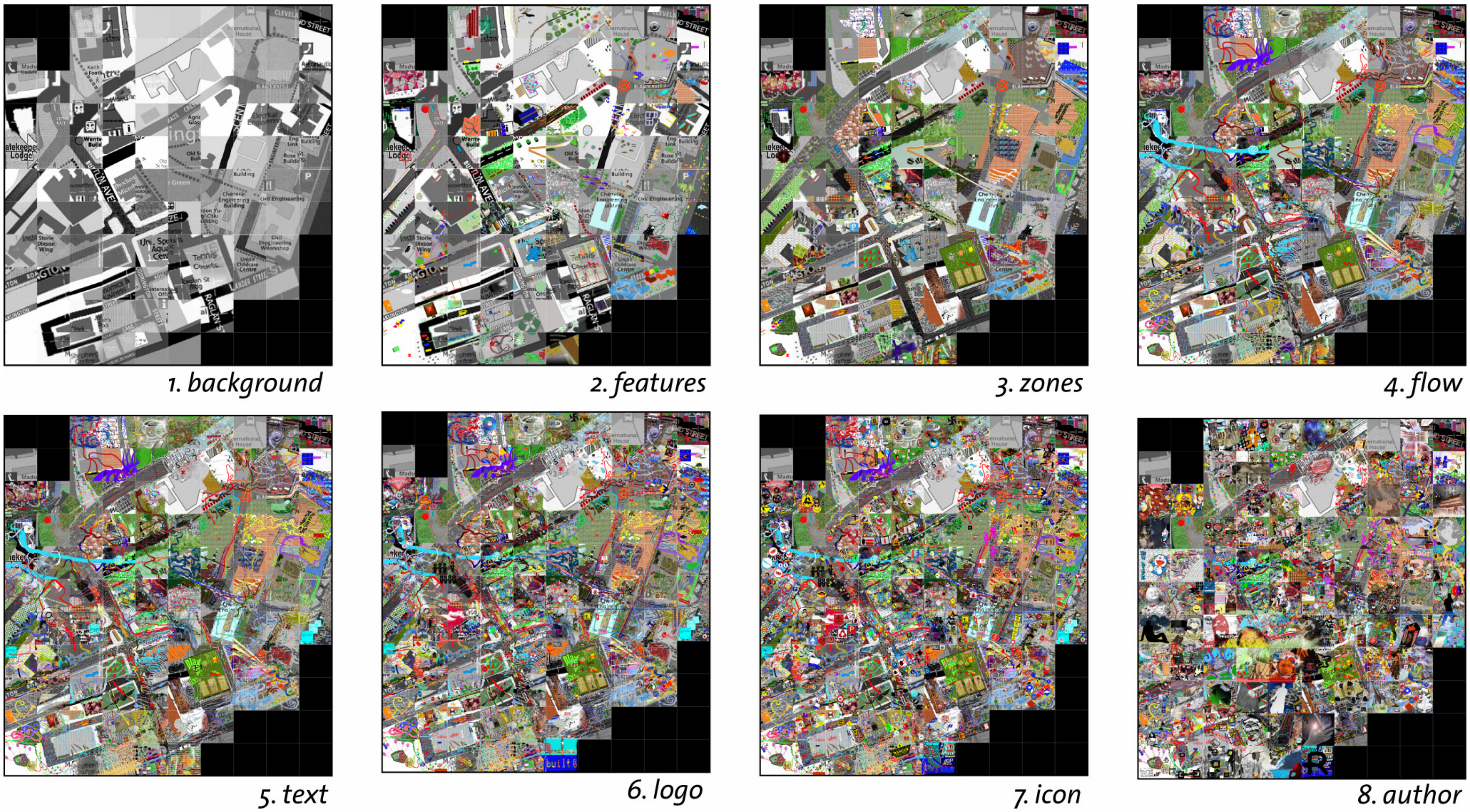

Figure 9. Successive, overall information landscape development, with all phases merged on top of each other (respecting transparency in each separate layer).

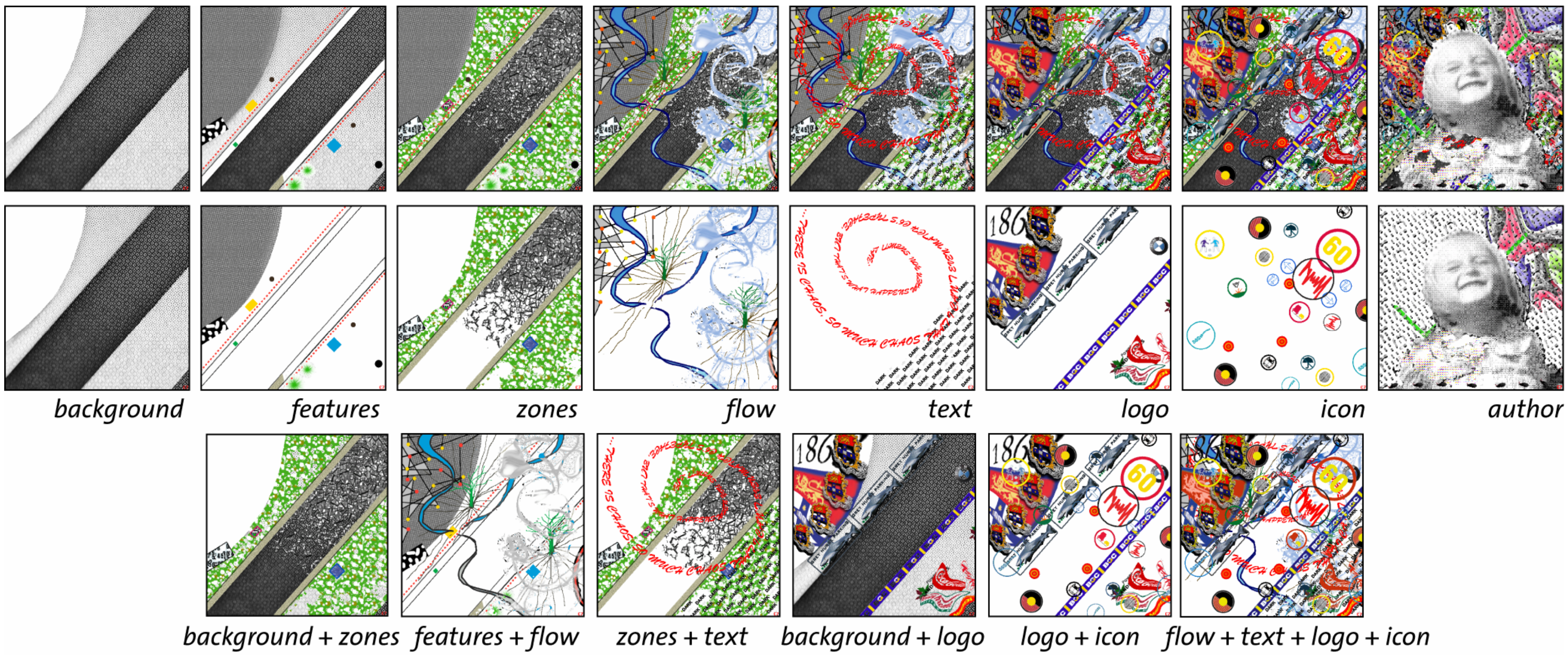

Figure 10. Successive phases of a single, well designed infoscape field. Top: the original student submissions with all phases merged on top of each other; middle: all phases separately (white color is transparent); and bottom: some examples of dynamic merging of different user-chosen phases on top of each other, showing multiple possibilities of combining and merging different phases with each other.