

INSTITUT FÜR INFORMATIK  
der Ludwig-Maximilians-Universität München

# SCRIPTING STUDENT'S INTERACTIONS ON BACKSTAGE

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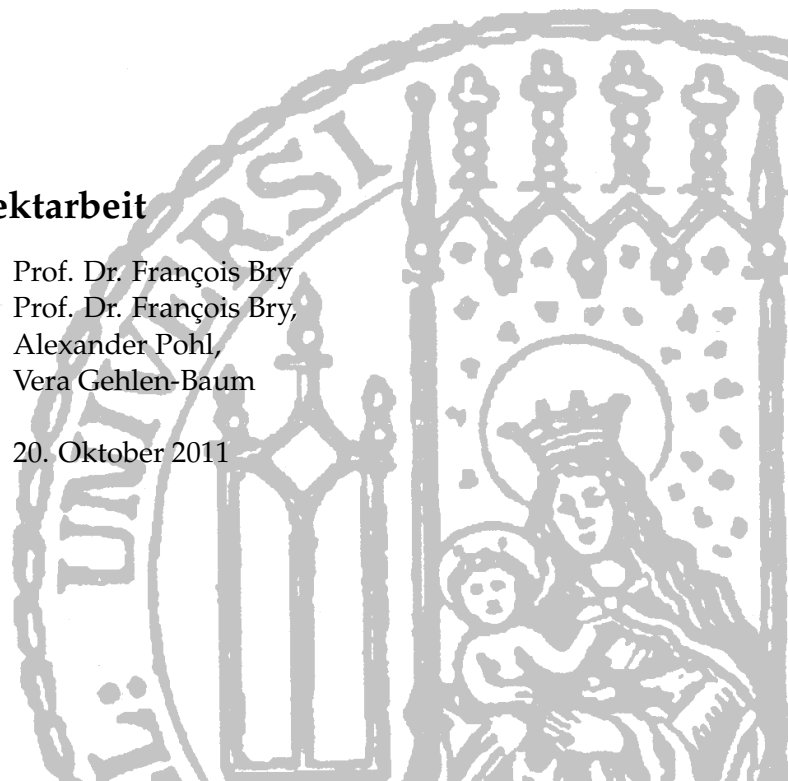
Visualizing Scripts on the User  
Interface

Michal Bednár

## Projektarbeit

**Aufgabensteller** Prof. Dr. François Bry  
**Betreuer** Prof. Dr. François Bry,  
Alexander Pohl,  
Vera Gehlen-Baum

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## Erklärung

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Hiermit versichere ich, dass ich die vorliegende Arbeit selbständig verfasst habe und keine anderen als die angegebenen Hilfsmittel verwendet habe.

München, den 20. Oktober 2011

Michal Bednár



Backstage is a backchannel that enriches lectures with various forms of student-student and lecturer-audience interactions. Although so-called digital backchannels can support students' collaboration and interaction in the lecture, it does not necessarily mean that using a standard backchannel in a lecture always enhance the students' learning performances. For example, in practice there is notable evidence that when debating with peers about a particular theory, many students seldom succeed in reaching a quality level of collaborative argumentation necessary for learning.

Several studies pointed out, that providing learners with so-called scripts have positive effects on e.g. above-mentioned collaborative argumentation in computer-supported learning. In this context a script is a set of instructions that aims at helping learners to improve their argumentation skills and to better acquire knowledge about the discussion topic. A script can provide users formulating an argument with e.g. pre-structured statements "I think that ... because ..." and thus forces learners to explain their reasoning and helps them to build new knowledge.

However, it is still unclear, how scripts can be embedded in a backchannel learning environment like Backstage so as to be well received and efficiently used by the students. The backchannel's user interface design must not confuse the user. For example an implementation via pop-up notification in front of the screen is rather inconvenient because it could remind of warning messages or web-advertisements which many users find annoying. In addition the visualisation of scripts must reflect the specifics of the Backstage platform, e.g. it must not slow down students' collaboration and interaction. This report describes concepts for the embedding of scripts in Backstage's user interface. These concepts have been developed considering best practices in user interface design, human information-processing and visual perception in a web-based environment.



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## Zusammenfassung

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Backstage ist ein Backchannel, welcher den Vorlesungsbetrieb mit unterschiedlichen Formen der Student-Student und Dozent-Hörerschaft Interaktionen bereichert. Obwohl die so genannten digitalen Backchannels die Zusammenarbeit und Interaktion von Studenten während einer Vorlesung unterstützen können, bedeutet es nicht zwangsläufig, dass die Nutzung eines Standard-Backchannels in der Vorlesung immer den Lernerfolg von Studenten verbessert. Zum Beispiel gibt es in der Praxis deutliche Belege, dass viele Studenten während einer Diskussion über eine bestimmte Theorie selten das Qualitätsniveau an kollaborativer Argumentation erreichen, welches für das Lernen notwendig ist.

Mehrere Studien zeigten, dass die Unterstützung von Lernenden mit so genannten Skripten positive Wirkung auf z. B. die oben genannte kollaborative Argumentation im computergestützten Lernen hat. Ein Skript in diesem Kontext ist eine Zusammenstellung von Instruktionen, die darauf abzielen Argumentationsfähigkeiten von Lernenden zu verbessern, um Wissen über das Diskussionsthema besser erwerben zu können. Ein Skript kann die Nutzer bei der Formulierung eines Arguments zum Beispiel mit vorstrukturierten Aussagen "Ich denke, dass ... weil ..." versorgen und dadurch zwingt die Lernenden dazu ihren Gedankengang zu erläutern und hilft ihnen neues Wissen aufzunehmen.

Es ist jedoch noch nicht klar, wie Skripte in eine Backchannelumgebung wie Backstage eingebettet werden können, so dass sie von den Lernenden gut aufgenommen und effizient verwendet werden können. Das Design der Benutzeroberfläche des Backchannels darf den Nutzer nicht irritieren. Zum Beispiel eine Implementierung als Pop-up-Notifikation ist eher ungeeignet, weil sie an Warnungsnachrichten oder Internetwerbung erinnern kann, die viele Nutzer belästigend finden. Zusätzlich muss die Visualisierung von Skripten die Besonderheiten der Backstage-Plattform beachten, z.B. sie darf nicht die Kollaboration und Interaktion von Studenten

verlangsamen. Dieser Bericht beschreibt Konzepte für die Einbettung von Skripten in die Benutzeroberfläche von Backstage. Die Konzepte wurden unter Berücksichtigung von Erfolgsmethoden bei User-Interfacedesign, menschlicher Informationsverarbeitung und visueller Wahrnehmung in einer web-basierten Umgebung entwickelt.



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### 1.1 Motivation

The benefits of new computer and web technologies in mass academic education and the possibilities to make collaborative learning more effective have been investigated in several studies [10, 6, 21]. These studies focus on the computer-mediated inter-student and lecturer-student communication in large audiences and aim at increasing students' active participation in the lecture. One of the few communication and collaboration media which support student's collaboration and interaction via a microblog messaging service is Backstage. In Backstage, learners can communicate via short messages (comprising a few ten characters) and therefore are able to quickly exchange information without disturbing the lecturer's discourse. Additionally, messages can be rated by the audience, so that the lecturer can get an overview of the backchannel discourse in form of an aggregated ranking of messages. Thus the lecturer has the ability to react on learners' needs during the lecture. For example, he can present explanations regarding a topic in more or less detail. On the other hand, the lecturer can also test the topic-related knowledge of students with the aid of quizzes (e.g. multiple choice tests) and gain information about their current knowledge or motivation [4].

Although communication via so-called digital backchannels might increase students' collaborative activities, it does not necessarily mean that using a standard backchannel in a lecture always enhance the students' learning performances. However, several studies have shown that providing learners with so-called external

scripts in computer-supported learning environments has positive effects on knowledge acquisition and can increase learning success [3, 13]. For instance, when discussing a topic in a lesson, scripts can provide users with sentence starters "I think that ... because ..." and thus assist learners in explaining their reflections by pre-structured statements. Thus, a script in this context is a set of instructions, that aims at helping learners to improve their argumentation skills and to better acquire knowledge about the discussion topic. A detailed definition and introduction of the script concept will be provided in the following section.

Despite the fact that experimental studies [3, 13] report on the positive influence of scripts in computer-supported collaborative learning (CSCL), it is still unclear how scripts can be embedded in a backchannel learning environment like Backstage in such a manner that they are well received and efficiently used by the students. So far, it has not been sufficiently explored how the graphical user interface has to be modified to support scripts and how to most appropriately visualize scripts. For example, a script implementation via pop-up notifications is not always suitable, because in some cases pop-up windows could be confused with warning messages or may be perceived the same way as web-ads, that many internet users dislike [16] and tend to close automatically. This report describes concepts for the embedding of scripts in Backstage's user interface. These concepts have been developed considering best practices in user interface design, human information-processing and visual perception in a web-based environment. We furthermore strive for a flexible design, that can be easily adjusted according to the lecturer's needs.

## 1.2 Related Work

Over the last years, several frameworks and studies have been introduced focusing on the support of learning as well as collaborative work by external scripts (e.g. C-CHENE [3], WISE [13]). Though, they rarely focus on effective user interface design and usability research in scripted CSCL environment. In [5] various tools and functions of the main computer-supported collaborative systems have been categorized and based on this several themes of the research agenda have been presented. One of the presented recommendations for the future research is focusing on the appropriate visualisation of scripts. In addition Haake also states, that from the computer scientist's point of view, it is still unclear how scripts can be represented in CSCL environments and how the user interface should reflect them [8]. Since related work can hardly be found, investigation of a good visualisation of scripts on Backstage's user interface is based on best practices in human information-processing,

### 1.3 Introduction to Scripts in CSCL

visual perception in a web-based environment and user interface design principles.

## 1.3 Introduction to Scripts in CSCL

The notion of (behavioral) scripts has been introduced by Psychologists and Cognitive Scientists in the early 70's [1]. Scripts are models for knowledge about courses of actions that are chronologically ordered and often hierarchically structured. The probably most famous example of an internal behavioral script is the often-cited "Restaurant Script" that describes a typical plot of a restaurant visit [13, p. 711]. In this case, usually a typical sequence of events occurs. After entering a restaurant and taking seats, a waiter offers the customer a menu card that the guest is supposed to read so as to order a meal. After enjoying the meal the customer is supposed to pay and leave the restaurant. This typical sequence of activities and events, that is stored as "internal scripts" in our minds, is usually known and followed by the majority of people in our culture. Such an internal script is activated when being in a familiar situation (e.g. restaurant visit) and it additionally provides a guidance how to act in the specific case. Schank and Abelson presented the following simple story in order to illustrate the principle of internal scripts. "John was feeling very hungry as he entered the restaurant. He settled himself at a table and noticed that the waiter was nearby. Suddenly, however, he realized that he'd forgotten his reading glasses" [1, p. 715]. Although the menu card has not been explicitly mentioned, people holding the internal restaurant script intuitively expect that John will have difficulties in reading the menu, a subsequent activity in the plot not yet carried out, because they are familiar with the sequence of activities in a restaurant.

In case people hold insufficient internal scripts, it is possible to support them by external scripts. These scripts provide a sequence of instructions given from the outside. They help people to acquire knowledge about e.g. a specific situation and help them to behave appropriately when the situation occurs. External scripts can support learning and improve individual learning outcomes [13, p. 710]. An effective way of how to strengthen the above mentioned positive influence of scripts on learning is the successive reduction of given instructions [7]. This so-called "fading" means, that in parallel with the learning progress, the learner will get less and less instructions everytime the script is followed.

For instance, saving documents in a word processor is an example of giving external instructions in order to complete the saving-task successfully. After clicking on "save" in the application menu, the user is usually asked to type in the name

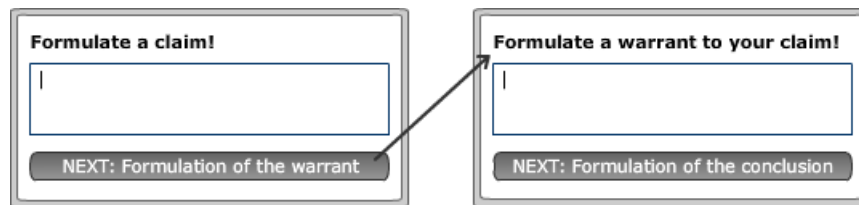


Figure 1.1: Example of an external script for the formulation of a claim and warrant.

of the new file, to select a preferred document file format and afterwards to choose the folder location where the file will be saved. Another example is, when small children learn to write letters in school. They use to have exercise books, where on the first pages each line is fully preprinted with examples of a particular written letter, which children have to post-write repeatedly. The subsequent pages only have one example at the beginning of each line, and on the final pages there are no preprinted patterns, anymore. Thus, with the aid of an external script, children get additional guidance with the aim to adopt required knowledge about writing letters gradually, and to be able to perform this specific action independently. This process of learning denotes so-called internalisation of external scripts. Simply put, a script which is initially external to an individual is expected to become internalized through practice and timely fading of external prompts [11]. So external scripts represent an interesting way of supporting learners during the learning process in a CSCL environment.

To illustrate the possibilities of the use of external scripts in Backstage, we present a typical example of a script that is used in this thesis as a model for the development of concepts. The script follows the finding that, in practice, many learners seldom succeed in reaching an argumentation level necessary for learning and that they rarely relate scientific evidence to theoretical explanations [13]. If during a discussion learners are not able to justify their claim with a solid proof or don't reply to arguments of other learners by using a counterargument, the discussion remains on a low level. According to [13] this can lead to a limited learning success. But if learners try to formulate an argument which confirms their statement, they are forced to deeper elaborate the learning material and to explain their reflexions. In this way they better constuct new knowledge. The following script for strengthening of argumentation skills can be used regardless of the prior knowledge of learners [7]. A potential application for such a script is, for example, when learners are discussing a short story and analysing its characters. In this case the external script will first ask the learner, which character he wants to analyse. If the learner chooses a character of the story for analysis, he can type in the name of the

#### *1.4 Introduction to the User Interface of Backstage*

character into a text field and afterwards click on the “next”-Button to go to the next step. In the second step the learner is asked to formulate and type in a claim regarding the chosen character (see Figure 1.1). In this manner the learner also formulates the warrant which supports the claim and the conclusion. At the end of the script a complete argument with all components is created. If the learner wants to create more arguments, he can always pass again through the external script. As mentioned previously, it is expected that the external script becomes internalized through practice and thus the argumentation skills of the learner improve gradually.

Because an argument consists of several components, it makes in this case sense to split the argumentation script into more steps according to the flow of the argument formation. With the aid of the computer it is possible to better control each step of the instruction sequence. But this does not necessarily mean that each script consists of more components which are presented to the learner successively. The structure of a script can be much simpler than of the presented argumentation script and can consist only of a single short instruction.

### **1.4 Introduction to the User Interface of Backstage**

To be able to explore how to most appropriately visualize external scripts in Backstage, we have to become familiar with its existing graphical user interface (GUI). Basically, the GUI consists of three parts: microblogging view, presentation view and navigation view (see Figure 1.2).

The microblogging view (text editor with the message timeline) in the left part of the window is the central point of communication with the lecturer and other learners. Here learners can type in their questions, comments and hints into a small text input field (see (1) in the Figure 1.2). Slightly above the input field there is an indication bar showing the number of remaining characters of the message (see (2) in the Figure 1.2). Below the input field a “Send” button (see (3) in the Figure 1.2) is placed for sending of written contributions and also for giving feedback to the lecturer regarding the pace of the discourse (too slow or too fast). Another service implemented in Backstage, when clicking on the “Send” button and choosing the type of contribution (question or hint), is the “drag&drop referencing”. This makes it possible, that learners can link their questions and hints directly with the place in the presentation they relate to. To do so, learners can simply place the question or hint icon on the appropriate place in the presentation. Clicking on these icons in the presentation will automatically highlight the corresponding contribution in

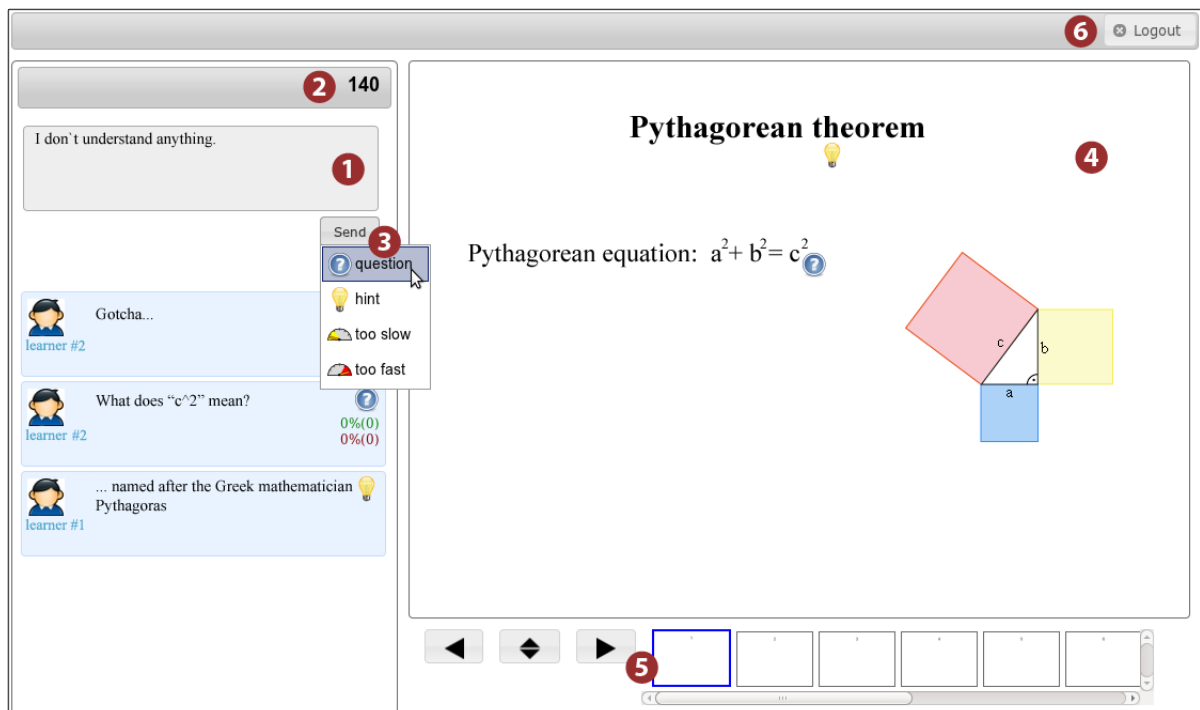


Figure 1.2: Screenshot of the Backstage GUI with the microblogging view on the left containing the input field (1), indication bar for remaining characters (2) and the “Send” button (3). On the right is the presentation view (4) with the navigation view (5) located below. At the top the login bar (6) is placed.

the message timeline. Almost two-thirds of the screen in Backstage are used for the presentation view, which fills up the central and the right part of the window (see (4) in the Figure 1.2). Here the current presentation slides of the discourse are shown. Below the presentation a set of navigation icons and a scroll-panel with the preview of the slides is located (see (5) in the Figure 1.2). On the very top of the window a grey bar with the login/logout-button in the upper right corner is placed (see (6) in the Figure 1.2).

Regarding the colours used in the graphical user interface of Backstage, the foreground elements like buttons, fields, bars and text make use of mainly grey and black colours. The microblog timeline is per default blue-coloured, but messages specified as private are pink-coloured. This information is important, because the number of already used colours is relevant for the colour selection in our concepts. The background colour of the user interface is white, which ensures in combination with the neutral grey and black colour of the foreground a good readability.



## 1.5 Digression: Specification of Collaboration Scripts

In order to achieve the positive effect of external scripts on learning in a CACL-environment, scripts have to be designed carefully. To achieve this goal, Kobbe et. al.[12] presented various components of collaboration scripts, which should be kept in mind during the scripts' design phase. Additionally, these components make it possible to describe and compare different scripts.

**Participants** When creating scripts, one of the key requirements is to first specify the type of user whom we are designing for. Participants can be distinguished e.g. regarding their previous knowledge, or individual opinion. Another requirement is to consider the amount of participants that the script can handle. For example the ArgueGraph-Script[12] makes use of an even number of at least four participants with different opinions.

**Groups** Participants may be grouped by their age, gender, nationality or by the desired group size, among other things. Groups can also overlap, so that some participants can be members of more than only one group.

**Activities** Dependent on the internal scripts of users, activities can be divided into a hierarchical structure of subactivities or steps. For instance, a discussion session can consist of explaining, asking questions, building arguments and counter-arguments, etc. In this regard, Kobbe et al. also introduces so called script mechanisms, which describe the distributed character of scripts, e.g. how activities are assigned across learners (task distribution), and the temporal order of activities (sequencing).

**Roles** Roles are tied to learning activities and they describe the adoption of specific activities by a certain participant. They may also be associated with privileges, e.g. student in the role of the critic is allowed to criticize another student's work.

**Ressources** In general, resources represent objects, which extend the functionality of scripts (e.g. dictionary, calculator-tool). Some of them may also be modified during the script phase (e.g. editable questionnaires). In addition, they can support the interaction between learners in the form that learners need ressources of other participants to perform a task successfully.

In [7] there are two more components presented - *Goals* and *Type of presentation*. The former focuses on the necessity to define the goals, which shall be achieved with the designed script and based on this to choose appropriate script components. The latter describes various presentation forms of scripts. In our case the script-presentation will be adjusted according to the characteristics of the Backstage's user interface.

As can be seen, various components have an influence on achieving objectives of external scripts - their internalisation and thus the ability of learners to perform desired activities and tasks independently. One of them is the form of presentation, which is in our focus. In the next parts of this report several theories and concepts are presented in order to ensure that scripts embedded in Backstage can be efficiently used by the students.

### 1.6 Objectives

The main target of this thesis is to develop an approach for embedding (external) scripts into the graphical user interface of Backstage. Because Backstage is a digital backchannel based on web technologies, the visual representation of scripts has to consider not only the specifics of a learning environment, but also of the web interface. For this reason we introduce some general laws describing human perceptual phenomena (Gestalt Laws) and take human information-processing system into account (Multimedia Learning Principles). We also present an overview of important findings in web usability that should be kept in mind when designing a web interface. We deal with readability in web, text formatting, bad design practices and also effects of colours and contrast that can improve the usability of our graphical user interface. Further we discuss the Backstage-specific requirements that need to be considered. As shown in the section 1.3, scripts can be continuously faded out in order to better support their internalisation. Although fading seems to be a reasonable approach for supporting the learning process, this work only focuses on the efficient visualisation of scripts in Backstage.

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### Basic UI Design Principles for Visualizing Scripts

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A User interface (UI) is the part of a system which makes the interaction between a human user and a computer system possible. It is the main point of contact for both the human and computer [2]. To build a user interface, that is easy to use, concise and that lets users perform a task quickly enough, it is necessary to understand humans' perception. Based on psychological theories and observations of human perception, several laws have been introduced that describe the perceptual phenomena. Many of them can be used as a fundament for a good user interface design. In the following, an overview of the most important user interface design principles is provided, mainly focusing on specifics of a web based user interface.

#### 2.1 Gestalt Laws

The Gestalt laws have their origin in the early 20th century. Back then, a group of German psychologists (M. Westheimer, K. Koffka among others) provided a clear description of many basic perceptual phenomena and produced a set of so-called "Gestalt laws of pattern perception" which are rules describing how we see patterns[25]. According to the phrase "The whole is greater than the sum of the parts", the perception is understood as (un-/conscious) grouping of elements by the human's mind. This grouping is based on, e.g. the form or colour of the elements and looking for relationships between them with the aim to interpret them as known structures. Not the eyes, but the brain is responsible for the construction of perception and this ability makes it possible for human to see in pictures more

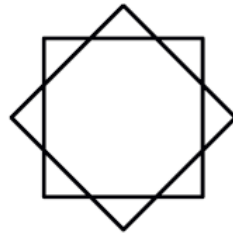


Figure 2.1: Do you see triangles or squares? (Picture taken from [9])

than depicted elements they consist of [23].

The Gestalt laws build nowadays a base for analysis of e.g. the accurate placement or selection of suitable UI elements (pictures, text, etc.) with the aim to achieve the desired effect on users. The number of Gestalt laws in the literature varies, in [25] the most of them are discussed, namely Proximity, Similarity, Connectedness, Continuity, Symmetry, Closure, Relative Size and Common Fate.

**Proximity** Objects that are close together are perceived as a group. This law is one of the most useful in UI-design. To achieve the effect that dedicated objects belong together, we can simply place them in proximity. In turn, the structuring of different content can be achieved by grouping of related elements together and proper whitespacing between unrelated groups. For example, each paragraph of a text deals with a specific subject, but together all paragraphs form a consistent unit.

**Similarity (or Equity)** Not only the physical closeness, but also the similarity of objects can determine how elements are grouped. Objects with the same distinguishing characteristics tend to be perceived as collective entities. The more attributes they have in common e.g. the size, colour or form, the stronger the effect occurs.

**Connectedness** Connecting different graphical objects by lines expresses that there is a relationship between them [25], e.g. node-link diagram.

**Continuity** This principle states that our mind continues visual patterns. Additionally, we also tend to construct visual entities from elements that are continuous and smooth without sudden changes in direction [25]. As can be seen in the Figure 2.2 we see the falling branch as continuing the path (1. arrow), rather than the raising branch (2. arrow). This is because there is no abrupt change in the direction of the falling branch and the path continues being smooth.

## 2.1 Gestalt Laws

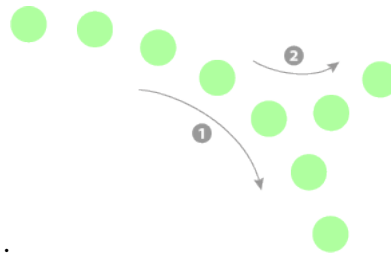


Figure 2.2: Gestalt Law of Continuity: We see the falling branch as continuing the path (1) and not the raising branch (2).

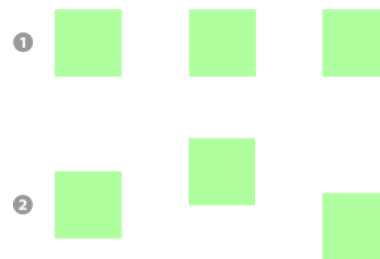


Figure 2.3: Gestalt Law of Symmetry: Symmetrically arranged objects (1) are perceived as a collection compared to asymmetrical arrangement (2).

**Symmetry** Like proximity, symmetrical arrangement of objects can lead to a collective perception. For example, symmetrically arranged squares in the first row in the Figure 2.3 are more likely perceived as a collection in comparison to the asymmetrical arrangement in the second row. In addition symmetry can attract attention, but on the other side can also have a calming effect or even provoke boredom.

**Closure** Contours tend to be seen as objects. Even if there are gaps in them, they tend to be perceived as closed (see Figure 2.4). When closed contours are seen, humans tend to partition the space into “inside” and “outside” the contour [25]. This law can be used for content structuring. For example, content that belongs together can be enclosed by a border or put into a separate window in the same way computer and mobile operating systems do.

**Relative Size** This law discusses how smaller and larger components of a pattern tend to be perceived. Smaller components tend to be perceived as con-

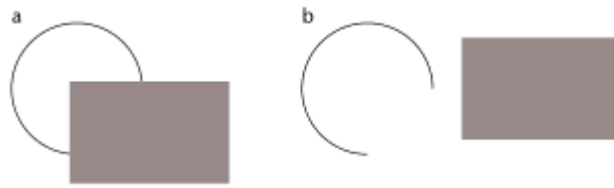


Figure 2.4: In (a) we see a circle behind a rectangle and not a broken ring (b). (Picture taken from [25])



Figure 2.5: Smaller (black) components of the circle tend to be perceived as constituents of an object (propeller). Larger (white) components are seen as a background. (Picture taken from [25])

stituents of an object, larger components as a background. For example, Figure 2.5 presents a circle divided into four small black and four larger white parts. The small components are perceived as a propeller, the larger components as a white background.

**Common Fate** The principle of common fate concerns motion perception and states that viewers mentally group elements moving into the same direction.

The presented Gestalt laws can be used as a guide to build a suitable graphical user interface with embedded scripts in Backstage. Especially the law of Proximity and Closure can help us to better structure the visual presentation of the learning material and to link it with associated scripts. For example, we could enclose scripts, presented text and pictures of a discourse that belong together by a border or simply connect them with lines to visualise the relationship between them. Considering the law of Symmetry, we also know a method how to attract users' attention.

## 2.2 Multimedia Learning Principles

But the Gestalt laws are only basic principles of perception and state nothing about multimedia learning. Therefore in the following, principles concerning processing in multimedia learning and specifics of web usability are presented.

## 2.2 Multimedia Learning Principles

The user interface of a computer supported learning environment should always take the human information-processing into account. Because humans working memory has limited capacity, the total amount of processed information picked up by eyes and ears at a single point in time is limited. Thus, it is necessary to focus on reducing the so-called extraneous overload [14]. In other words to reduce the amount of information presented to learners at a single point in time so that it can be processed successfully. According to [14] the extraneous overload occurs, when the amount of cognitive processing required to understand the essential and extraneous material in a multimedia message exceeds a learner's cognitive capacity. The reduction of this overload can be achieved, e.g. by excluding some graphics or text in a computer-based presentation so that the key information remains unchanged. Such an exclusion has to be decided very carefully. Also directing the user's attention towards the essential content is of high relevance. To handle these issues in multimedia learning systems, several design principles have been introduced [14]: the Coherence, Signaling, Redundancy, Temporal Contiguity and Spatial Contiguity principle. Each of them has been justified by experimental tests.

**Coherence Principle** The Coherence principle states that people learn more deeply, when irrelevant words, sounds and pictures in a multimedia presentation are excluded. In the case, when the material that is interesting but not relevant for learning is excluded, the learner is not burdened with unneeded information.

**Signaling Principle** Another possibility to reduce the extraneous processing and to show learners what to concentrate on, is to provide them with so-called signals. These are cues listing the organization of the presented content, e.g. a list highlighting each step of an instruction.

**Redundancy Principle** This principle refers to reducing of the redundancy in a message, which occurs when the same information is presented in multiple forms [24]. According to this, students can learn better from graphics and simultaneous audio information than from graphics, audio and additional on-screen text which is redundant.

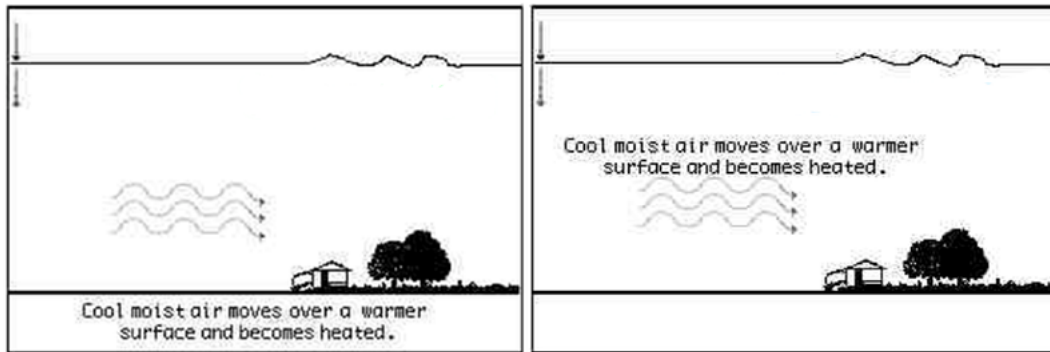


Figure 2.6: Left the separated, right the integrated solution (spatial contiguity).  
(Picture taken from [14])

**Temporal Contiguity Principle** Related to the Redundancy Principle, people learn better when corresponding visual and audio information is presented simultaneously rather than one after another.

**Spatial Contiguity Principle** Concerning the Spatial Contiguity Principle, the learning results are better when corresponding pictures and text in a presentation are near to each other. As an example, Mayer describes a situation when lightning formation is explained with the aid of pictures and related text. When the corresponding graphics and text are placed far from each other, learners always have to scan back and forth between them. But creating an integrated solution, where the explanatory text is directly placed near the graphical illustration, learning is not interrupted through scanning and hence more effective (see Figure 2.6).

While the coherence and redundancy principles focus on minimizing the amount of presented information and thus relate to the selection of relevant content, signaling and the spatial contiguity principle focus on directing learner's attention towards the core information [14].



### 2.3 Web Usability

User behavior in a web-based environment has been subject of observations since the beginning of the internet era [20]. The leading researchers in this field are Jacob Nielsen and Ben Shneiderman who identified many usability issues. They also proposed a collection of principles how to prevent them. Usability in this context is a quality attribute expressing how easy a user interface is to use, how easy it is to learn for novices and how useful it is for a user [20]. In the following an outline of the most important findings in web usability that can be applied in Backstage is discussed.

#### 2.3.1 Reading of Web Content

The most interesting outcome of the eyetracking studies conducted by Nielsen and his colleagues is that people do not read the text in web, they scan it. Through path observation of where web users are looking during browsing, it could be determined that they are fast searching in a text for the needed information and are not reading it word by word. To explain this behaviour it is assumed that they have to do this to orient themselves in the information flood and to decide if they stay on the page or leave it [20]. Additionally users tend to read the web content in a kind of an F-shaped pattern, a behaviour that is dominant across websites with different style and layout [17]. As can be seen in Figure 2.7, users first focus on the upper (beginning) part of the webpage's content and start reading it in a horizontal movement. Afterwards they continue reading in a shorter second horizontal movement further down the page. Finally they scan the left side of the content in a vertical movement.

Another finding regarding the distribution of reader's attention is that people spend more than twice as much time looking at the left than at the right side of a page [19]. This behaviour is expected in countries that read from left to right (e.g. English or German). On the other hand, Nielsen states that in countries in which people read from right to left we wouldn't necessarily find a mirror image of this phenomena, because the layout of their webpages is not always right-justified [19]. Joining these findings together, Nielsen recommends to put important information into the first two paragraphs to increase the chance that it will be read by user. We should also place it on the left rather than on the right side. Left place on the right side can be used for less important content. Further, paragraphs or bullet points should start with information-carrying words, so that they can be quickly perceived by users while scanning the left side of the page.



Figure 2.7: Heatmaps showing the areas users looked at most (red) and less often (blue). (Picture taken from [17])

### 2.3.2 Text-formatting and Readability

Not only the right placement of the text has an influence on how it is perceived by readers, but also the text length and its formatting is important. According to [20] long and redundant text frustrates users. Another problem is that for human eyes it is tiring to read from a computer monitor and such reading is slower than reading from a paper [15]. Thus the number of words in a text should be approximately only the half compared to conventional publications. The editor should only focus on the main information, omit unnecessary words and use simple sentences (at best in note form). Additionally short headings, enumeration lists and short paragraphs with enough white-space between them make reading easier.

To improve users' ability to scan a text more quickly, some text-formatting methods can be used. It is for example the proper selection of the typeface, which can positive influence the readability. Generally, there are two main types of typefaces - serif and sans-serif (Figure 2.8). Serif typeface is characterized through small fine details on letter's edges and stroke ends. These so-called serifs usually help people to read a printed text more fluently and faster than a sans-serif text [20]. Letters in this font group additionally can consist of strokes with different width, which may

### 2.3 Web Usability



Figure 2.8: Example of a serif (left) and sans-serif (right) typeface. (Picture taken from [23])

evoke an artistic effect. In contrast, letters in a sans-serif typeface have no or rarely differences in the stroke-width and lack serifs.

According to [23, 20] serif typefaces are not suitable for the use on monitors (especially with small resolution), because the visibility of serifs and thin lines can then be very poor. Thus sans-serif typefaces are more suitable for viewing on monitors. In the web design the used typeface can be easily adjusted via cascading style sheets defining a “serif” or a “sans-serif” font-family such as “Georgia” or “Arial”, “Verdana” which were designed extra for reading on a computer screen. If a web designer is not sure which typeface and font should be used, [20] recommends to use “Verdana”, because it can be displayed on all computer systems and is comfortable to read also in a small font size.

Another important component of text-formatting is the usage of color and contrast. Combining a suitable font type, font colour and contrast may help to structure information, to attract user’s attention and can make reading easier. In doing so we should not use more than four different colours and more than three different fonts [20, 22] at once. Otherwise we can achieve the opposite effect. Using too many colours e.g. for the highlighting of the text and other visual elements can cause that none of them will be perceived as highlighted [20]. That’s because the majority of people can not keep more than five to seven colours and the corresponding meaning in mind at the same time [23]. Another important aspect is the selection of an appropriate background colour. Because reading from a computer monitor is more difficult than from a paper, the contrast between the color of the background and of the text should be high. But this basic rule is not convenient for every colour combination. For example blue and red are colours with a very high contrast, but on monitors they cause glimmer effects that make reading more difficult. On the other hand, when using low contrast colours for the text and background, e.g. light grey and white, the text is not recognizable from the back and reading can evoke eyestrain. Also for that reason it is recommended to use dark colours for the text and “cold” colours with low saturation for the background [20]. The best solution seems to be black text on a white background. Additionally this combination is

perceived by users as at most reliable compared to e.g. red text on a white background which is often perceived as an advertisement [23]. A deeper analysis of the use of colour and contrast is provided in the Section 2.4.

Beside the typeface, text and background colour two more aspects are relevant for a good web page composition. The text alignment, as mentioned in the Section 2.3.1, should correspond with the eye-movement. Therefore it is recommended to use left justification for regular lines of text [15] and the center justification for headlines. The other aspect relates to the use of animated text. Nielsen discourages from the use of flashing text, because it is very difficult to read. The only case when animated text is useful is when we need to highlight changes on a page or to attract viewer's attention. Even if this is our goal, we should not use endless animation loops, but rather animate the text only once [15] e.g. through slow one-time enlargement of the text after the web page completes loading.

### 2.3.3 Bad Design Practices

With increased popularity of the internet new design practices have been developed in order to attract the internet users. But these attempts have often been done without taking usability into account. Nielsen could identify some design practices that prevailed until today, despite the fact that they cause many usability problems. Such a problem is for example the lack of the "go back" functionality (for example in complex AJAX or Flash applications), opening of web sites in new windows, pop-ups, or design elements looking like advertisements [20]. To beware of "bad" design practices in our concept creation, the following is an overview of design techniques that should be avoided.

**New Browser Windows** When a user clicks on a link at a website, he usually expects that a new website containing new content will be opened in the same browser window. From user's point of view this is important also for that reason, because he can revert this action anytime by clicking on the back button of the browser. But if the webpage opens in a new window, this "go back" functionality is lost. According to [20], web designers do this intentionally, especially when links on a website refer to external pages. Their intention is to keep viewers on their own page. As a consequence, too many windows "pollute" the working environment and burden users with unnecessary effort in closing them [20]. Another problem is when the opened window does not fill in the whole screen. In this case it can easily happen, that the user accidentally clicks on a window at the back and unintentionally brings it to the foreground. Undoing this action is quite time consuming and interrupts

## 2.3 Web Usability

the actual work. For this reason opening of new windows should be avoided. Although nowadays all popular browsers (e.g. Internet Explorer, Firefox, Chrome) support tabbed browsing, the above-mentioned problems are not completely neglectable. It is an advantage that the user can close all opened tabs at once by simply closing the browser window. But if a webpage opens in a new tab, the “go back” functionality in this tab is still not available and the user can not revert this action by clicking on the back button. Additionally too many opened tabs can clutter up the UI of the browser and can also have a negative impact on browser’s performance.

**Pop-ups** Related to the problem with the opening of new browser windows, another similar practice is considered problematic. It is the pop-ups, which are small windows suddenly appearing and overlaying the content of a website in a browser. Most often they are used to show advertisements. The surprise effect (sudden appearance) in combination with advertising mostly causes a negative impression, and probably this is the reason why many web users find pop-ups annoying. In a web experience survey, 95 percent of users rated pop-ups as very negatively or negatively [16]. Because of this, the majority closes pop-ups as soon as possible without paying attention to their content [20]. Some people close them even automatically. Although pop-ups have potential for a good application in the interaction design, e.g. for showing additional information or guidance, according to [20] their bad reputation discourages from using them as a regular website element. An additional analysis of the potential use of pop-ups for the script visualisation is provided in the Section 3.1.

**Banner Blindness** Banner blindness describes the behaviour when people ignore almost everything that looks like an advertisement, regardless of its content. Because the internet users are “attacked” from all sides in order to gain their attention, they “developed” a self-defence system against these visual elements [20] and overlook also the at most flashing and colourful banners or animated boxes. This finding could be confirmed in several eyetracking studies [18, 20]. As can be seen in the Figure 2.9 advertisements, logos and other additional information highlighted in green boxes did not attract any eye fixation. To overcome this effect, Nielsen recommends to use plane text or elements that look like a native site component. In this case, there is a chance that we will be able to attract users attention.



Figure 2.9: Heatmaps from Nielsen's eyetracking studies regarding banner blindness. (Picture taken from [18])

## 2.4 Effect of Colours and Contrast

As mentioned in the section 2.3.2, the use of colour and contrast in a user interface is not trivial. They influence how design elements are perceived and how good is the usability of a user interface. Johannes Itten, a Swiss painter, designer and theorist is the author of the so-called "seven color contrast" theory. This theory defines the mutual influence between colours and their effects on viewers [22]. In the following a summary of this theory is provided with recommendations for a good UI design.

**Simultaneous Contrast** According to this finding, the colour perception of an object is dependent on the colour of its surrounding. For example black surrounding makes the yellow colour of a circle more intensive than a white surrounding (Figure 2.10). This contrast can be used to attract viewer's focus by strengthening the colour of an object through the background colour. We should also keep in mind that the same colour can be perceived as an other colour dependent on the background. For example white colour on a red background looks a little bit greeny [22]. Thus the colour combination should be chosen carefully.

## 2.4 Effect of Colours and Contrast

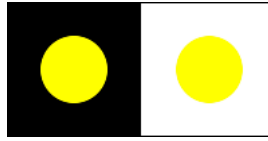


Figure 2.10: Yellow on black is more intensive than yellow on white [22].

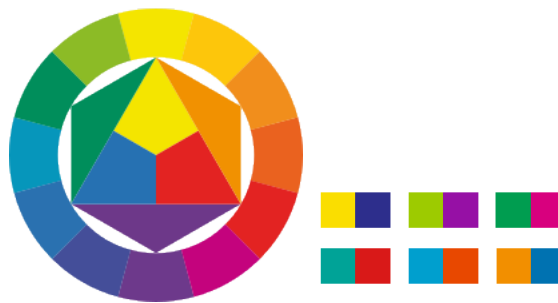


Figure 2.11: Colour wheel acc. to J. Itten (left) and complementary colours acc. to H. Küpper (right). (Picture taken from[23])

**Contrast of Complements** This contrast describes the effect of the combination of two colours that are placed on the opposite side in a colour wheel. Such colours are called complementary and when used next to each other it helps to strengthen their intensity. In contrast, mixing complementary colour results in a grey or black color. The use of this contrast can have an harmonious effect on a viewer [22]. Because there is more than only one colour wheel, it is impossible to define concrete complementary colour-pairs. For example, according to Itten's colour wheel blue and orange are complementary colours. However, Küpper's model states that the complement to blue is yellow (Figure 2.11).

**Hue Contrast** Occurs when pure vivid colours are used (e.g. basic red, blue, yellow) in any combination (Figure 2.12). This contrast can be used for signaling and especially for highlighting of areas with colours where the user should pay attention [22].



Figure 2.12: Example of the Hue Contrast



Figure 2.13: Example of Quality Contrast. (Picture taken from [23])

**Light Dark Contrast** Describes the effect when different brightened colours (lightened with white and darkened with black) are used. The light dark contrast makes it possible that a black (dark) text can be clearly recognized from its white (light) background, for example.

**Cold Warm Contrast** Colours in the colour wheel from yellow to magenta are referred to as warm and from violet to green as cold (see Figure 2.11). The contrast built by a combination of cold and warm colours has an activating and stimulating effect [22]. With the aid of this contrast it is also possible to simulate depth. The more distant an object in the nature is, the “colder” and more bluish it appears. On the other hand, the more closer an object is, the “warmer” and vibrant is its colour [23].

**Contrast of Quality (Intensity)** It is the contrast between the vivid and dull variant of the same colour (Figure 2.13). These variants can be created by the addition of black or white colour to a pure colour. In the case when the pure colour is surrounded by its dull variant, it is perceived as more intensive [23] and therefore can be used for marking of important content areas. Less important content can get a less intensive colour tone.

**Contrast of Quantity** The effect of a colour is dependent on its intensity and size of the area filled with this colour. For example, to achieve harmony a yellow spot surrounded by bright colours has to be bigger than a yellow spot surrounded by dark colours [22].

As can be seen, colour contrast is a useful and important factor that should be always paid attention to during the design process. For attracting attention or highlighting of areas we can use colours of the hue or simultaneous contrast. To structure content according to its importance, more and less intensive variants of one colour (contrast of quality) are particularly suitable. Further, the readability can be improved when the contrast between text and background is high enough (but not too much), e.g. light dark contrast. All these findings will be considered when developing concepts for embedding scripts into the user interface of Backstage.



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### GUI Concepts for Scripts

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Following the introduced theories and findings, in this chapter we present principles for a proper visualisation of external scripts on a graphical user interface (GUI). We divide them into three parts:

1. principles regarding the visual structure of the user interface with embedded scripts and the placement of scripts,
2. principles regarding the formatting of script elements,
3. principles for directing user's attention towards scripts.

Based on these principles, we formulate a summarized list of the most important visualisation guidelines for the display of scripts. We also take into account the Backstage-specific restrictions when embedding scripts into the GUI. Based on these restrictions and visualisation guidelines, we present several concepts of how scripts can be embedded in Backstage.

### 3.1 Principles for the Visualisation of Scripts

As mentioned in the Sections 2.1 and 2.2, to better structure the content on a user interface and to link it with external scripts, the Gestalt laws of Proximity and Closure can be combined with the spatial contiguity principle. Thus, for graphical

conveying that a script is related to a specific content on a page, the two should be placed in proximity and/or be enclosed by a common border. This way, learners don't have to scan back and forth between them, which does not interrupt the learning process. It also reduces the distraction and hence could contribute to a better comprehension of external scripts. For example, when learners are asked to discuss some characters of a short story as described in the Section 1.3, it would be advantageous to place the argumentation script and the text of the story next to each other. This placement would allow learners to quickly look up important facts in the text at any time. Such a "proximity" effect can be strengthened by similar appearance (e.g. border form, colour) of the two elements or their symmetrical arrangement. The connection between content (e.g. a text or a presentation) and scripts can also become visible by connecting them with lines. Because this solution might lead to confusion in complex visual compositions, e.g. when there are more scripts that relate to a particular content, resulting in many crossed lines on the screen, it is not recommended [22]. Considering Nielsen's usability and eye-tracking studies (Section 2.3.1), particularly the observation that people spend over twice as much time looking on the left rather than on the right side, scripts might best be placed on the left side of the user interface. The right side of the interface can be reserved for showing less important information. We also assume, that according to the "F"-shaped reading pattern, it is better to place scripts on the top of the web-based user interface, so that they can be immediately perceived by users.

Not only does the position of scripts determine how effectively they are perceived by learners, but also does the layout and formatting of scripts matter. The first important point, which we have to consider, is that scripts should be kept concise. We should always focus only on the main and relevant information and use simple short sentences. According to the coherence principle (Section 2.2) this can lead to a better learning outcome. Further, to ensure a good readability of scripts, it is highly recommended to make use of left justified text-enumeration lists and paragraphs. At best, the script instructions should start with information-carrying words, so that they can be quickly read and understood by learners. The textual organization and highlighting of script instructions by bullets or enumerations, as described in the signaling principle (Section 2.2), is an additional method which helps learners to orient themselves in the script and shows them what they should concentrate on. Regarding the typeface, sans-serif fonts should be preferred. For the choice of a suitable colour of the text, we should use high contrast colours, preferably colours of the light dark contrast to ensure that the text can be always clearly recognized from the background. Because scripts could consist not only of text, but also of graphics, animations or even audio information, according to the redundancy prin-

### *3.1 Principles for the Visualisation of Scripts*

ciple we should omit redundant information presented to learners through the same channel, e.g. the same information presented through the visual channel as animation and collateral text (subtitles). But on the other hand we should also always consider specific needs of learners, e.g. some of them can have hearing or literacy problems. So the decision, if the use of redundant information is suitable and necessary, should be made by the educator and that's why our visualisation guidelines do not restrict it.

To attract the attention of learners towards scripts, various techniques can be applied to a graphical user interface. One of them is the symmetrical arrangement of important user interface elements. For example, when the external script and the content it relates to (text of a short story in the presentation view of Backstage) are symmetrically arranged in a row. Probably the most effective way of how to highlight important areas on the screen is the use of appropriate colours and contrast. In this case especially the simultaneous and the hue contrast can be applied (e.g. pure vivid red or green colour on a dark background). To differentiate between more and less important parts of a user interface, we can use the contrast of quality. For example, scripts (important elements of the UI) can be highlighted by a vivid variant of a colour, whereas the rest of the user interface can get a less intensive tone of the same colour. When working with colours, we should keep in mind, that we should not use more than four or five different colours at once, because otherwise the desired effect will not occur [20]. If we want to attract users's attention with intensive colours, complementary colours of e.g. Itten's colour wheel may be an option [22]. The intensity of these colours becomes stronger, when they are used next to each other. Additionally, their combination can achieve that the user interface appears more harmonious. One more and often used technique for attracting attention and also highlighting of changes in a user interface is the use of animations. It is for example animated text or animated boxes. If it is intended to use the former, according to Nielsen's usability studies, we should only animate the text once, e.g. at the beginning of the script instruction. If the latter solution is preferred, it should not look like an flashing colourful advertisement banner, but rather as a native UI component. Otherwise it can easily happen, that this element will be ignored.

Finally, we should also consider the presentation form of scripts carefully. As described in the Section 2.3.3 Nielsen discourages from opening of new windows and using of pop-ups. Especially pop-ups could be considered as a suitable element for the script visualisation, because they can attract attention. But there are some significant disadvantages related to this design element. Although pop-ups can attract user's attention, their sudden appearance in a small window overlaying the

browser provokes a negative impression. Because of this most people close them before they even look at their content [20]. Arisen from a discussion with Mrs. Gehlen-Baum such a behaviour could be observed within the exploration of over-scripting at the LMU [7]. In this study, scripts were implemented in a web-based learning environment as pop-ups. It came out that such a visualisation form was often ignored and pop-ups were quickly closed by students. Another problem is that it is not possible to work with a pop-up and Backstage at the same time. If a learner works with Backstage, the browser window usually fills up the whole screen and so the pop-up window is not visible. For this reason students would always have to switch between these two windows in order to bring one of them into the foreground. This is quite time consuming and interrupts the actual work. Further, it is not possible to adjust the appearance of pop-ups in such a way that they look as a native site component. This is important in order to ensure a consistent graphical design of the Backstage UI. Therefore we do not consider pop-ups as a suitable element for the visualisation of scripts.

To put the above-mentioned principles and findings together, we created a list of visualisation guidelines for a good implementation of scripts into a web-based graphical user interface:

- If scripts relate to a specific content on the user interface, the two should be placed in proximity and/or be enclosed by a border. Such a visual composition does not interrupt the learning process when scanning back and forth between these elements and contributes to a better comprehension of external scripts. Similar appearance (e.g. same border shape, colour) of both elements or their symmetrical arrangement can strengthen this effect.
- The (fixed) placement of script elements on the top left side of the graphical user interface can lead to their better perception by users.
- The length of external script instructions should be kept short. Further, scripts should start with information carrying words and omit irrelevant information.
- Use of left justified enumeration lists and bullets in script instructions can improve readability and shows learners what to concentrate on.
- High contrast colours of the dark-light contrast should be preferred as text and background colour.
- An effective way for highlighting important areas on the screen and for at-

### 3.2 *Proposal for Embedding Scripts in Backstage*

tracting viewer's focus is the use of colours according to the hue and simultaneous contrast, max. 4 - 5 different colours.

- To tier the importance between UI elements the contrast of quality can be applied. Important elements should get a vivid tone of a colour. Less important elements should get a less intensive tone of the same colour.
- Flashing text and obtrusive colourful animations in scripts should be avoided.
- Scripts should be not implemented as pop-ups or new browser windows.

### **3.2 Proposal for Embedding Scripts in Backstage**

Before starting with the development of concepts, we need to analyse the specifics of Backstage and of its already existing UI. This is important in order to find out if there are some restrictions that have an influence on the embedding of scripts. As shown in the Section 1.4, the user interface of Backstage consists of three views. Each of them fulfills an important functionality. The microblogging view in the left part of the screen (see Figure 1.2) is the central point of communication and is crucial for the interaction during a discourse. The presentation view and the navigation view are essential for the presentation of the content of the discourse and navigation between the slides. All these components fill out almost the whole user interface of Backstage. Thus there is only very limited free space that can be used for the placement of external scripts. The only not yet used area where scripts could be placed is the empty grey bar with the login button at the top of the UI (see (6) in the Figure 1.2). The fact that there is not enough free space in the Backstage UI is a great restriction which we have to take into consideration in our concepts. Another specific of Backstage that has to be considered is the time factor. In Backstage, the interaction between learners and between learners and the lecturer happens quickly. For that reason the ability of learners to interact and to contribute to the discussion should be not slowed down by the script. The visual structure of the script has to be clear enough, so that it can be quickly read by learners. Additionally also the placement of the script can have an influence on how fast and effectively it is perceived.

Taking these restrictions into account and following the introduced visualisation guidelines, we created three independent proposals of how scripts can be embedded into the UI of Backstage. The Proposal A focuses mainly on scripting of activities in the backchannel, whereas in the Proposal B the focus is on scripting of

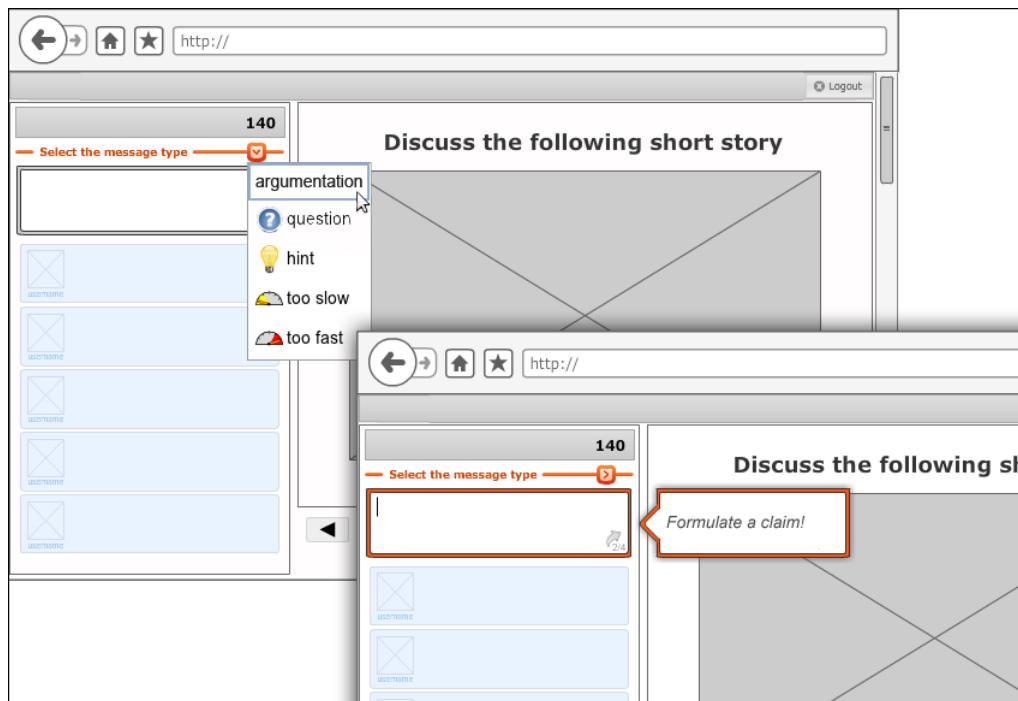


Figure 3.1: Proposal A with a script block placed in the microblogging view and highlighted by a red border.

activities in the lecture, e.g. performing an exercise. The Proposal C represents an universal approach. In each proposal we used the argumentation script (see Section 1.3) as a template for an external script instruction. In the following these proposals and related sketches are presented.

### 3.2.1 Scripting Activities in the Backchannel

In the Proposal A we focus on scripting of the backchannel activities (microblogging) during a lecture. Because of the lack of free space in the UI and to not slow down students' interaction by the script, in the Proposal A (Figure 3.1) scripts are visualised directly in the text input field of the microblog. If a learner wants to write a message, in this proposal he is supposed to first choose the type of the contribution (e.g. argumentation or question) from a drop down list at the top of the microblogging view (see the window at the back in Figure 3.1). This differs from the earlier interaction flow in Backstage, where this action was performed at the end of the message-writing when clicking on the "Send" button (see Section 1.4). As can be seen in our example, we choose the message type "argumentation". In this case, this message type is scripted. But there might be also some other message types, that are not scripted, e.g. "too slow" or "too fast". These messages give

### 3.2 Proposal for Embedding Scripts in Backstage

feedback to the lecturer regarding the pace of the discourse and therefore there is no need to script them. Clicking on “argumentation” in the list will cause, that the argumentation script will be shown directly in the input field of the microblog. At the same time the field will be highlighted by a coloured border in order to attract learner’s attention. For this purpose a colour of the hue contrast is suitable. In the Figure 3.1 we used a red border colour with the aim to attract viewers’ focus and to indicate the importance of this UI element. Analogous to the meaning of the traffic light colours also a yellow or orange colour can be used for signalling of importance. To strengthen this effect, the border may flash for a while using the same colour. Because flashing elements can be perceived as obtrusive (see Section 3.1), the animation should happen only once at the beginning of the first instruction.

After reading the script instruction, the learner is in our case asked to type in the name of the character that he wants to analyse. If the learner clicks on the input field, it will be automatically emptied and the script will be shown in a separate block. This script block partially overlays the presentation view and has the same border colour and appearance as the input field (see the front window in the Figure 3.1). Additionally, this block points to the microblog and is symmetrically arranged according to the input field. This strengthens the effect that these two UI elements belong together (Section 2.1). In this way the script will be always visible, also during the typing of text. To proceed with the next script instruction, the learner is supposed to click on the “forward/send” icon in the bottom right corner of the input field. We decided to place this icon to the right and not to the left side, because we write from the left to the right and therefore we assume that the placement at the end of the last line is more intuitive for an element which denotes the completion of a task. If all steps of the script are completed (e.g. a complete argument is formulated), this proposal specifies that the output (formulated argument) will become automatically visible in the text-input field of the microblog and thus will make learner’s contribution easier and quicker. At the same time the “forward/send” icon will not show the current step of the script (e.g. 2/4) anymore, but will only consist of an arrow. A click on this icon or pressing the enter key will send the message.

The placement of scripts in the input field and the horizontally arranged block element is favourable for several reasons. The two elements, where scripts are shown, are in the top left part of the user interface. This can increase the chance that scripts will be effectively perceived by learners (see Section 2.3.1). The script is also close to the presentation view with the content of the discourse. As described in the Section 3.1 such a visual composition does not interrupt the learning process when scanning back and forth between the script and the presented slides. Regarding the

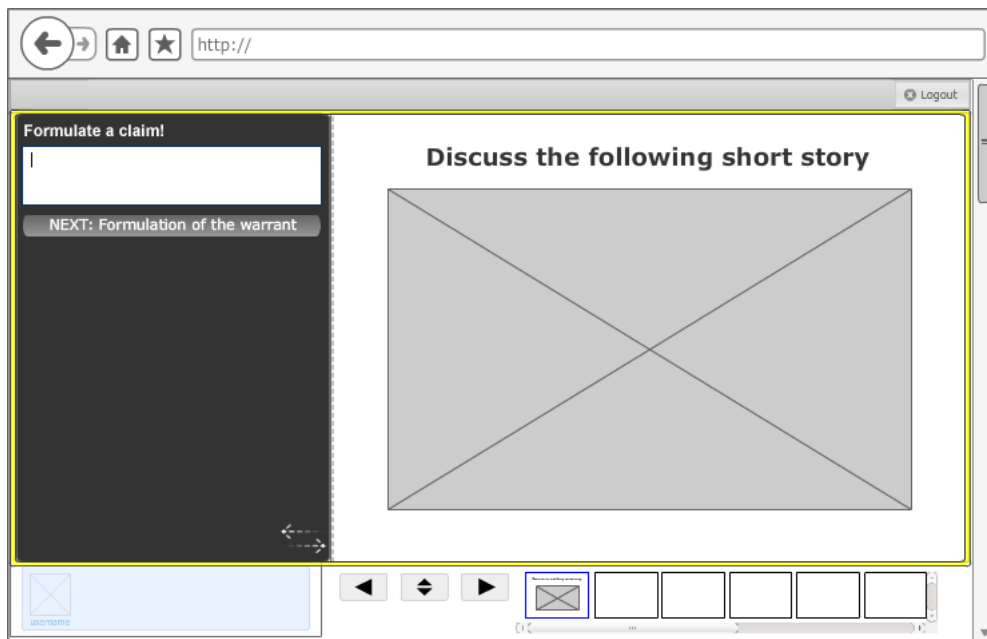


Figure 3.2: Proposal B with a script placed on the left of the presentation view. Both are enclosed and highlighted by a yellow border.

formatting of script instructions, in this proposal we follow the visualisation guidelines presented in the Section 3.1 to ensure a good readability of the script and to not slow down the interaction process with other learners. Therefore the text of the script is left justified and of italic font-style in order to distinguish it from the regular input text. Additionally, in our proposal we use the sans-serif typeface “Verdana” that is comfortable to read on monitors.

### 3.2.2 Scripting Activities in the Lecture

Another approach of embedding scripts in Backstage is presented in the Proposal B (Figure 3.2). The focus of this proposal is on scripting of activities in the lecture, e.g. performing an exercise. If during a lecture a script for an exercise is available, the presentation view will be highlighted by a coloured border with the aim to attract viewer’s focus and to signal the availability of the script. This effect can be strengthened through a one-time animation (flashing) of the border. In our example we used a vivid yellow colour according to the hue contrast. This colour is used as a signal that the learner should pay attention to this part of the screen. A double-click on the presentation view will activate the script. This means that the script block slides out (Figure 3.2) from the left side of the presentation view and overlays the microblogging view. The yellow border now encloses not only the presentation but also the script. The border indicates that the script relates to



### 3.2 Proposal for Embedding Scripts in Backstage

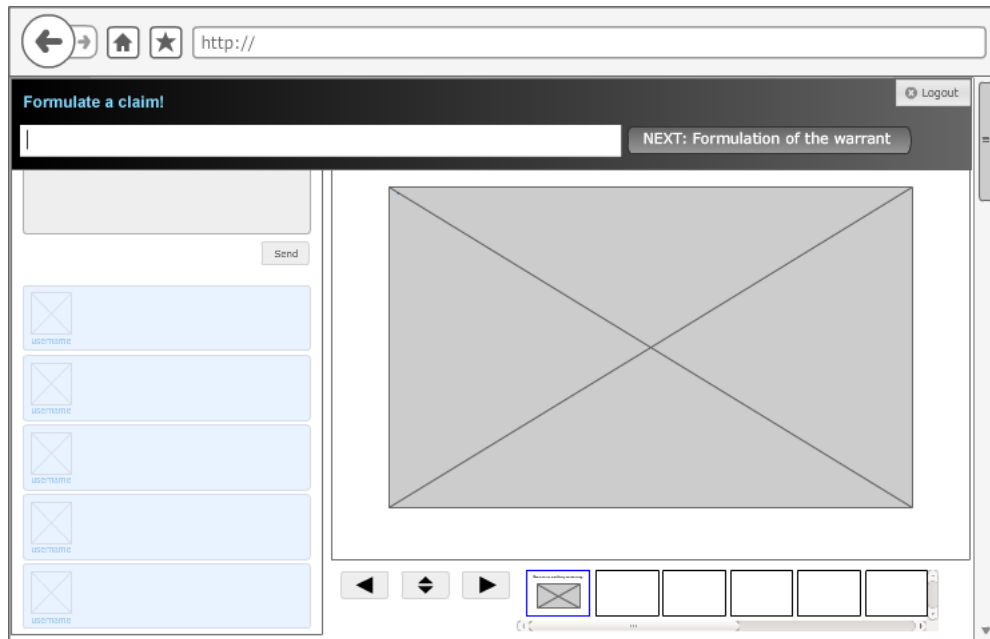


Figure 3.3: Proposal C with a script placed in the top (login-) bar of Backstage

the current presentation slide and strengthens the “proximity” effect. To distinguish the script from the presentation, a dark background is used. According to the dark light contrast bright colours for the text are used. If there is a need to highlight some important key words in the script (not shown in the Figure 3.2), basic colours can be used. Because of the dark background, the effect of these colours will be strengthened according to the simultaneous contrast (Section 2.4). When the script is completed (in our case an argument is formulated), the border colour will change to green to indicate success. In the presented example the formulated argument will be automatically copied into the text-input field of the microblog so that the learner can use it for collaboration more quickly. Afterwards the script block will be deactivated and pushed back so that the microblogging view will be accessible again. In this proposal, it is always possible to show and hide the script through double-clicking on the presentation view. This may be favourable in the case when a quick interaction with other learners is necessary during the script adaptation. Regarding the formatting of the script instructions, we follow the visualisation guidelines presented in Section 3.1 to ensure a good readability and quick “scanning” of the script.

#### 3.2.3 Universal Approach for Visualisation of Scripts

Finally, we present an approach for the visualisation of scripts which can be used for scripting of activities in the backchannel as well as in the lecture. When choosing

a scripted message type in the microblog (as described in Section 3.2.1), or when a script for an exercise is available (Section 3.2.2), the script will be displayed in the top grey (login-) bar of the UI (see Figure 3.3). We identified this bar as a yet not effectively used element in the user interface. This area is suitable for the display of scripts, because according to the introduced eyetracking studies (Section 2.3.1) users first focus on the upper part of a website and afterwards continue scanning it in a kind of an F-shaped pattern. Hence, this placement can increase the chance that scripts will be effectively perceived by learners. If a script is available, the light grey bar will darken and the first words of the script will be shown in a bright colour. According to the simultaneous contrast (Section 2.4) the dark background will make this colour appear more intensive. Another function of the dark background colour is to differentiate the top bar from other UI elements in Backstage and also from browser notifications (e.g. in Chrome). Because most of Backstage's UI elements make use of a light grey tone, the intensive dark colour of the bar can be used to underline its importance (Contrast of Quality). For the text of the script we chose a light blue colour, because we did not want to use too many different colours and thus to confuse learners with too colourful GUI. Moving the mouse pointer over the bar or clicking on it will expand the bar and overlay as much space on the user interface as needed to show the complete script instruction. A click outside of the script will pull the extended script area back and only the darkened login bar will be visible again. After the script is completed (in our case an argument is formulated), the colour of the bar will change back to light grey. Furthermore, the output of the script (e.g. complete argument) will be automatically copied into the text-input field of the microblog in order to make the sharing of this information with other learners easier. In order to ensure a good readability of script instructions, the formatting follows the visualisation guidelines presented in the Section 3.1. For the same reason we also use the sans-serif typeface "Verdana".

## CHAPTER 4

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### Conclusion

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In this report we present concepts of how scripts can be embedded into the graphical user interface of Backstage. Because scripts can improve students' learning performances, we want to ensure that they can be well received by learners and efficiently used in Backstage. For this reason we provide an overview of the most important findings in human information-processing and perceptual phenomena. We also deal with findings and best practices in web usability. Based on this, several attributes could be identified which can have an influence on how good scripts are embedded in Backstage's UI. It is the presentation form and the placement of scripts, formatting of script elements and their ability to attract the attention of learners.

Because Backstage is a backchannel that enriches the student's collaboration and interaction during a lecture, our concepts consider some specifics of this tool, that might be not relevant for a standard computer-supported learning environment. Especially the time factor has to be taken into account in order to not slow down students' interaction by the script in Backstage. Also for that reason we introduce an extra proposal for scripting of the backchannel activities as well as a proposal for scripting of activities in the lecture. Additionally such a differentiation is important to better adjust the visualisation of scripts dependent on their use.

Although the introduced concepts are based on several best practices and findings in web usability (e.g. outcomes of Nielsen's eyetracking studies), their efficiency and how well they are received by learners needs to be verified in practice. With the aid of eyetracking or clickstream studies it could be investigated how well are

scripts embedded in Backstage. Such studies can also provide an indication if there are some other important attributes that are relevant for the visualisation of scripts in a backchannel. It would be also interesting to know, how the presented implementation of scripts into the UI of Backstage in reality affects the pace of students' contribution.

Finally it would be interesting to investigate how the fading of scripts (successive reduction of given instructions) can be implemented in Backstage. It is not sufficiently explored how the presentation form of scripts has to be modified in order to support fading in Backstage.

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