

PROJECT DOCUMENTATION

Interactive Learning with HISTOGLOBE

WINTER SEMESTER 2014/15

VIRTUAL REALITY GROUP

FACULTY OF MEDIA

BAUHAUS UNIVERSITY WEIMAR

Authors:

Marcus KOSSATZ
Chris HORNISCHER
Max WEBER
Sebastian KÖPSEL
Tobias WESTPHAL

Supervisors:

Dipl.-Med.sys.wiss. Patrick RIEHMANN
M.Sc. Henning GRÜNDL
Prof. Dr. Bernd FRÖHLICH



H I S T O G L O B E ®



Contents

1	Introduction	2
2	User Centered Design	3
3	User Interface Elements	5
3.1	Hivents	5
3.2	Map	7
3.3	Timeline	12
3.4	Search Bar	14
3.5	Hivent List	14
3.6	Hivent Boxes	16
3.7	Control Buttons	18
4	Field Study	19
4.1	Teaching Material	19
4.2	Study Material	21
5	Conclusion	25
5.1	Future Work	25

1 Introduction

HISTOGLOBE is an interactive information visualization for people who want to get an overview of history. Our vision is to revolutionize how history is taught and learned. With our modern web technologies everyone is able to feel history in a nice, intuitive and simple way to understand the present and be prepared for the future.



Figure 1.1: Interactive Learning with HISTOGLOBE

Traditional media can not explain complicated relationships adequately: A book tells stories linearly, but history is complex and multi-dimensional. A static wall map can only display single frames of history, but hardly its dynamics.

We combined the geographical and temporal dimensions of history in one interface. The combination of time and space helps you to understand the historical context.

This way we are able to present students in school our way to experience history, guided by teachers or on their own.

This is HISTOGLOBE!

2 User Centered Design

HISTOGLOBE aims to be helpful and usable for two specific target groups: history teachers and students in schools. The root problem we defined is that history is considered as boring and not interesting by a large portion of the students. One of the reasons we identified is that there exist not a lot of interesting and modern teaching material for teachers. We want to tackle this problem and develop a solution to help teachers presenting content of the history lessons in an interesting, informative and interactive way and for students to understand events and their coherences in history better.

We found a school in Jena, 25 km east of Weimar, that served as a development partner for the project, an instance of HISTOGLOBE directly designed for the usage in class.



Lobdeburgschule Jena
miteinander leben lernen

Lobdeburgschule in Jena-Lobeda is a public school for all students from grade 1 to 13. A history teacher in grade 12 invited us to conduct a field study in his class to test HISTOGLOBE directly in school by the end of the project in April 2015. In the time period from October 2014 until the test in April 2015 two members of the project group went every two or three weeks to the teacher in Jena. We presented new concepts, asked specific questions about the interface and the usage of the visualization in class and new problems and questions about the concept raised that had to be clarified until the next meeting.

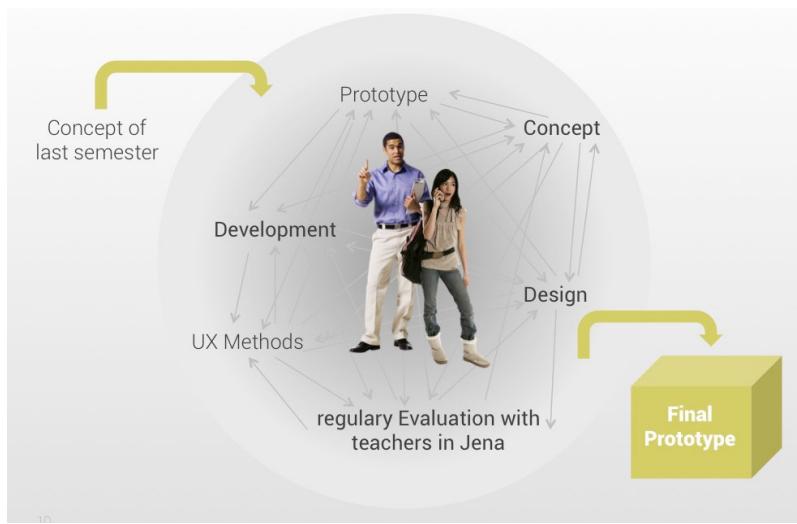


Figure 2.1: User Centered Design

Design Iterations Through the project time a lot of different design concepts were developed. On the one hand we wanted to maximize the utility for the teacher to help him convey the necessary information in class but on the other hand design HISTOGLOBE in a way that we found suitable. We played around with the orientation and the functionality of the Timeline, the information about historical events on the map or the colors of the interface.



Figure 2.2: Several concepts of the design throughout the semester

In the next chapter we want to introduce the final elements of the user interface that were the result of the design iterations with the teacher.

3 User Interface Elements

The interface consists of five main elements: The **Map** is the central element showing the current countries with their names and their borders and the position of historical events, called **Hivents** happening around the current date. This **NowDate** is set on the **Timeline** which allows to control the temporal dimension: Set a new date and see the status of this day in history on the map. Moving the timeline here and back will reveal the historical changes on the map. There are also **Topic Bars** on top of the timeline showing historical topics in a specific time period. The sidebar on the right contains a **Search Bar** for finding Hivents and a **Hivent List** of everything that happened in the selected topic. If an Hivent is selected, a **Hivent Box** pops up presenting the name, a short description and an image or video about the Hivent. Additionally there are **Control Buttons** for zooming the map or timeline, toggling the full screen or high contrast mode for better readability in problematic lighting conditions in the classroom.

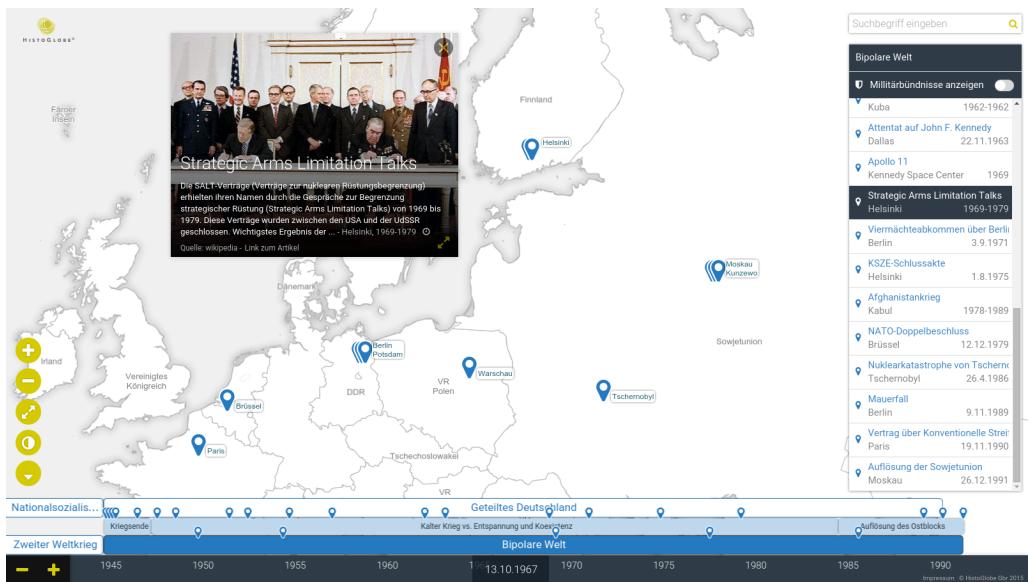


Figure 3.1: The final User Interface of HISTOGLOBE

3.1 Hivents

Hivents mean “Historical Events”. They are the way historical events are defined and presented. They are stored in a database, and have attributes such as name, location, start- and endyear, description and associated media. They are one of the most important concepts to visualize history in HistoGlobe.

3.1.1 Behavior

Hivents are represented on several locations in the UI, with the map, the Hivent-List and the Timeline being the most important ones. Since usually more than one Hivent is being shown, it's important to signify the representation between one Hivent in different UI-Elements. The main interface events to which the feedback occurs are mouse hovering and clicking, which leads to the Hivent being highlighted in all UI-elements.

Upon being clicked on, it changes its status to active. An active Hivent gets focused in the map, its marker are highlighted, it gets tagged in the URL bar and the Hivent box opens.



Figure 3.2: Activated Hivent

3.1.2 Labels on Map

Hivents on the Map were only represented by a marker. Upon being very close they get automatically clustered.

The teacher demanded more information, so we attached labels to the Hivent markers. We tried a Leaflet addon, but it didn't match our expectations of modifiability. To do labels our own, we used how the markers were implemented in the first space. They are Leaflet DivIcons so they are a div with a background image essentially. To accomplish easily modifiable labels we simply added another div element.

In the first implementation the Hivents name was shown, but we realized this isn't appropriate on a map, so we switched to show the Hivents location. With this solution we got easily modifiable small weight labels.

To adjust them to reasonable readability we had to fulfill special requirements. We needed an algorithm which was particularly lightweight, since we can't precompute the labels positioning and due to the fact that we wanted to use HISTOGLOBE on school pcs and mobile devices. Our solution is done by checking for an overlap by comparing the divs Bounding Boxes and moving the left label to the left on overlap.

On high zoom levels the amount of labels was so high the map wasn't readable anymore, so we remove them from a certain zoom level on.



Figure 3.3: Overlapping labels

3.1.3 Hivent Regions

A lot of historical events took place over a region, such as wars, so we wanted a region representation of hivents on the map. We implemented an additional type of map marker to do this. We added an additional optional attribute to the hivents, containing the polygon representing the region. The implementation was done using Leaflets Polygon drawing capabilities.

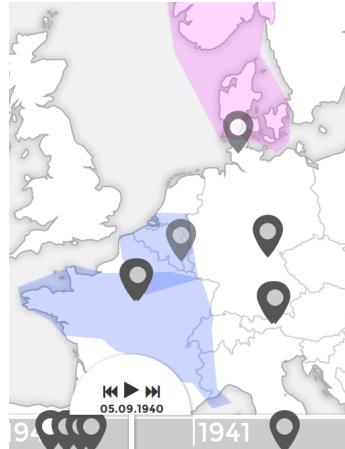


Figure 3.4: Hivent regions with highlights

3.2 Map

The map shows the status of the countries on Earth at this certain moment in history set in the Timeline. For this project we used a self-made dataset of historic countries of whole Europe from 1945 until today and from Western, Northern, Southern and Central Europe from 1871 until 1945. We organized the data in a way that we can visualize these historical changes of areas and names of countries. We also provided a functionality to style the country areas due to a current theme, for example all countries belonging to NATO get a blue background color.

3.2.1 Historic Countries

A country consists of an **area**, represented as a multipolygon geometry, and a **label** with the name of the country and its position on the map.

Areas Everything is based on a dataset of the current countries in Europe from *Natural Earth Data*¹. We extracted only the countries of Europe and loaded them into *QuantumGIS*, an open source GIS software for organizing, analyzing and visualizing areas on Earth. For each historic country we found an historic map online and created the area of the country using the *Vector Geoprocessing Tools* of QuantumGIS. Each area is stored in a single `area_id.geojson` file.

¹1:10m Cultural Vectors | <http://www.naturalearthdata.com/downloads/10m-cultural-vectors/>

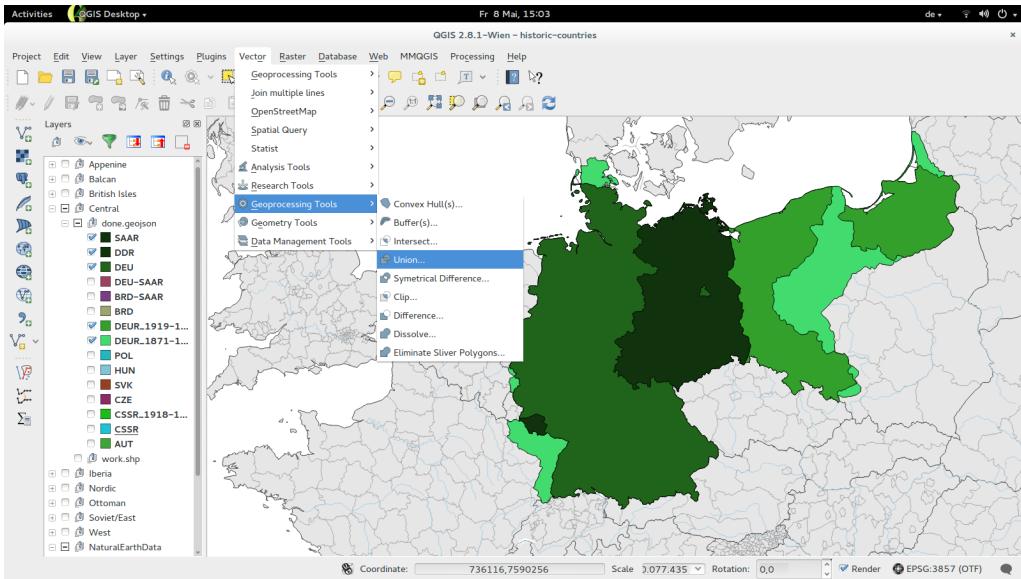


Figure 3.5: Geometry Manipulation of Historic Countries in QuantumGIS

3.5 shows the different areas of Germany from 1871 until today, from light green to dark green:

- 1871 - 1919 German Empire
- 1919 - 1945 Weimar Republic and Third German Reich (after WW I)
- 1945 - 1949 Occupied Germany (after WW II)
- 1949 - 1990 GDR without West Berlin and
- 1949 - 1956 Saarland

Because of the very problematic usability of QuantumGIS and the mass of data that would have needed to be processed we have not reached the goal to create a database of all historic countries in Europe from 1871 on, due to the time constraint.

Labels of a country are stored separately from the areas to account for independent changes of names and geometries: A country can be renamed and borders can change, but both events do not need to correlate. The labels are defined in a table `labels.csv` consisting of the id, the name, the position (lat, lng) and a priority.

The visualization of the labels works with priorities. Each label has a bounding box. According to the label priority, the box increases inversely in size (low priority labels get large bounding boxes). Showing and hiding a label is based on the question if the labels collide, i.e. if their bounding boxes intersect. The algorithm works in the following way:

- If a new label L_n gets added to the map it checks for each shown label L_s^H with a higher priority if it collides with L_n
 - If so, L_n will be hidden
 - If it does not collide with any L_s^H , L_n will be shown. Now it checks for each shown label with the same or lower priority L_s^L if it collides with L_n
 - * If so, L_s^L gets hidden

- If a label L_r gets removed from the map, it checks for each hidden labels L_h^L of the same and lower priority if it collides with L_r
 - If so, L_h^L gets shown
- If the user zooms in, the algorithm checks for each hidden label L_h if it can be shown now: it checks for each shown label L_s^H of the same or higher priority if it collides with L_h
 - If L_h does not collide with any L_s^H , L_h will be shown
- If any hidden labels were toggled to be shown or if the user zooms out, the algorithm checks for each shown label L_s if L_s collides with any shown label of the same lower priority L_s^L
 - If so, L_s^L will be hidden

The problem with this approach is that the label position and priority can not be deducted from the area. Therefore, both have to be set by hand. We are aware that this manual approach is not optimal, but for the scope of that project it is suitable. For the future, a data model should be found in which areas and labels are connected but can still change separately from each other.

3.2.2 Historic Changes

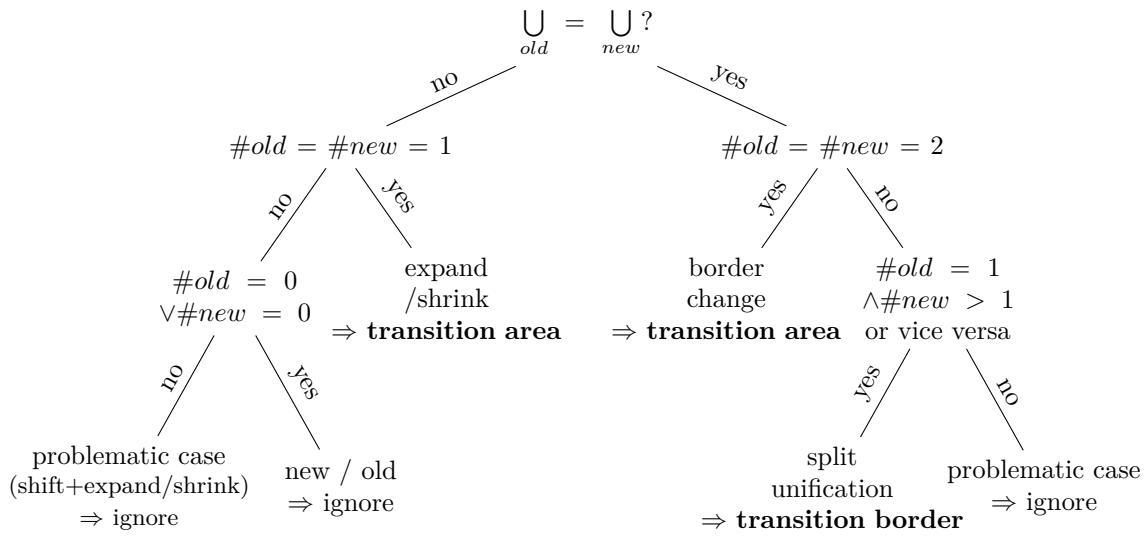
Table 3.1: Examples of Historic Changes

date	name of change	
domain	old	new
25.12.1991	Dissolution of Soviet Union	
<i>area:</i>	CCCP	EST, LVA, LTU, BLR, UKR, MDA, RUS
<i>label:</i>	CCCP	EST, LVA, LTU, BLR, UKR, MDA, RUS
03.10.1990	German reunification	
<i>area:</i>	BRD, DDR	DEU
<i>label:</i>	BRD, DDR	DEU
01.01.1990	End of Socialistic Republics	
<i>area:</i>	–	–
<i>label:</i>	PR-ROU, PR-BGR, PR-HUN, PR-POL	ROU, BGR, HUN, POL
01.01.1979	Separation of Greenland	
<i>area:</i>	DNK-with-GRL	DNK, GRL
<i>label:</i>	–	GRL
01.01.1881	Init state	
<i>area:</i>	–	DEU-REICH-1871, POL-1871, ...
<i>label:</i>	–	DEU-REICH-1871, POL-1871, ...

Because of the way areas and labels are organized, an historic change can easily be modeled, like seen in 3.1. This event-based data model is maintained like this: if an historic change happens, it needs to have a date and a name of the change, a set of areas that stop exist and a set of areas that start to exist from this date in history on – the same for the labels. Afterwards, the new areas have to be created in *QuantumGIS*, which is most of the work, and new labels have to be defined in the table.

In order to visualize the data on the client side, the areas, labels and changes have to be preprocessed on the server. Especially the transition areas and borders have to be generated.

Transitions are the geometric changes in a change event. There is either a transition area, which is the area that changes the membership of a country (e.g. Alsace-Lorraine 1919 from the German Empire to France) or a transition border, that splits two countries (e.g. The border between Czech and Slovak Republic after the dissolution of Czechoslovakia in 1991). These transitions shall be emphasized with an animation in the moment of the historic change so that it is clearly visible to the user what is currently happening. The transitions are generated like this: For each historic change the set of old and new areas are compared to each other and pass the following decision tree:



Legend: old = set of all old areas, new = set of all new areas
 \bigcup_{old} = union of all old areas, $\#\text{old}$ = number of old areas

Preprocessing happens with a *Python* script performing the following steps:

1. Loading the areas (from `*.geojson`), the labels and the changes (from `*.csv`)
2. Checking the set of areas and labels for completeness and the changes for consistency
3. Generating the transition areas
4. Writing the data to `json` files to be delivered to the client:

- 4.1 `areas.geojson`
- 4.2 `labels.geojson`
- 4.3 `trans_areas.geojson`
- 4.4 `changes.json`

The Workflow at runtime of the program can be seen in 3.6. The diagram is simplified focusing only on the areas, but the process is the same for the labels.

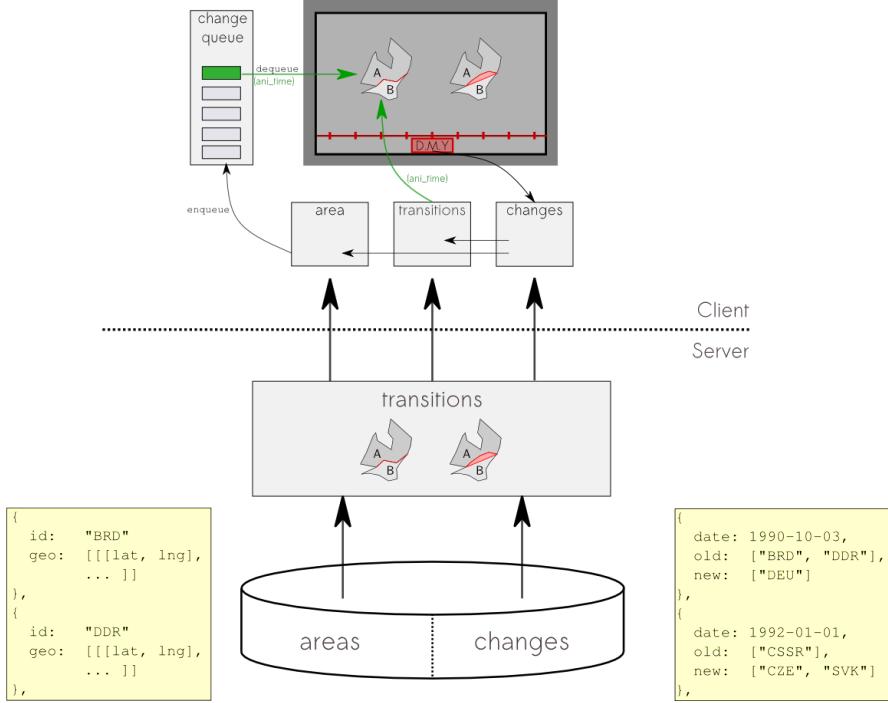


Figure 3.6: Architecture of historic countries on the map

The countries areas, labels and changes are created, preprocessed and loaded to the server. The client gets the four *json* files and reads the data out of them. If the NowDate changes, the Timeline sends the old date and the new date to the Controller that finds out all the changes happened in that time period. For each change the transition areas and borders are faded in on the map and the related old and new areas and labels are enqueue as a change event in a **change queue**. Every 50 milliseconds the queue is processed: for the first change event it checks if the related transitions are fully faded in. If so, the new areas and labels will be added and the old areas and labels deleted from the map. Finally, the transitions will be faded out again. This is repeated until the first change in the queue is not ready to be executed.

For moving the Timeline backwards the mechanism is the same, it is just that old and new areas and labels are swapped, because the historic change happens the other way.

In order to prevent large amounts of changes on the map if the Timeline is moved far, a rule-out mechanism is implemented: There is a list of old and new areas and labels for all historic changes in the period between the old and the new date from the Timeline. Areas and labels that would be added in one change but deleted in another one are removed from both lists, because they would not contribute to the current state. With this mechanism it is possible to move the Timeline at a high speed there and back and always get a fast and consistent update on the map.

3.2.3 Styling the Countries

Each area and each label can have a certain style in a certain **theme**. An example theme we have implemented is called *Bipolar World* (Figure 3.7) and assigns each country in Europe a membership to the NATO (blue) and the Warsaw Pact (red) based on their dates of joining and leaving the alliance. When moving the timeline the user can see how the alliances develop.

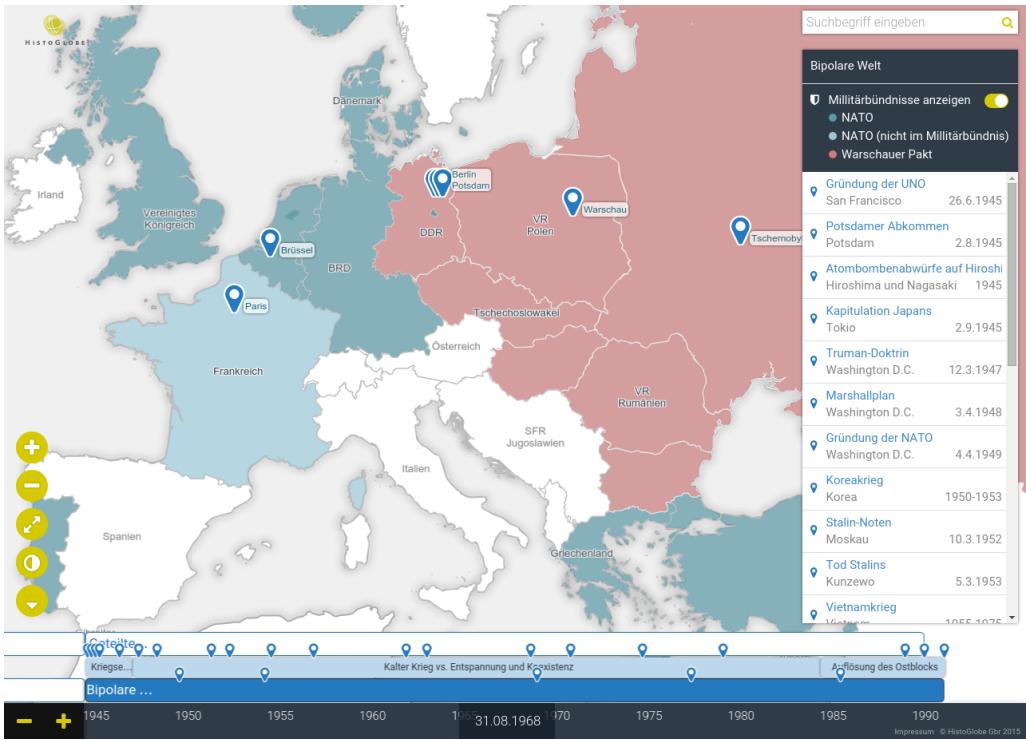


Figure 3.7: Countries colored due to their membership in NATO or Warsaw Pact

The style module was designed in a reusable way: for any new theme there have to be firstly **classes** and their styles defined (e.g. `class: nato, background-color: blue`). Secondly, areas and the membership to a class have to be stated in a table with `area_id, theme_class, start_date, end_date` (e.g. `ESP, NATO, 1982, 1986`). The same has to be done with labels.

3.3 Timeline

The Timeline is our interface to control the time in HISTOGLOBE. It is located at the bottom. In the center on certain moment of history is displayed. With the plus and minus on the left you can zoom in and out. This is done by stretching and compressing the Timeline. It is possible to change the actual date by pulling the Timeline to left or right.



Figure 3.8: Timeline

3.3.1 Structure

One requirement of the teacher is to present time in history not linear but in epochs. The advantage is that he can give focus to special subsets of history. In our implementation we have two different types of epoch bars: German history and world history.

So our actual implementation of the Timeline consists of four layers. The top layer describes the German history from “Deutsches Kaiserreich” to “Geteiltes Deutschland”. The next two layers belong together. They represent the world history from “Imperialismus” to “Bipolare Welt”. The upper of these two layers is only shown if one category of the world history is selected. Like in picture 3.9. Here “Imperialismus” is active and on top of this layer is the subtopic layer with specific topics. The bottom line is used to show the classification of epoch in time and to show the certain moment of history in the DD.MM.JJJJ format as NowDate.



Figure 3.9: Timeline Elements

3.3.2 Behavior

The following section describes the individual functionalities of the Timeline and topic bars. All elements are linked together so if you change one element, all other elements are chained in the same way.

With the two control buttons on the left side you can *zoom* the time. We have limited the different displayed zoom levels to four steps (1, 2, 5, 10). These steps represent the distance of the displayed years. The date change if they begin to overlap the thresholds of each other. So you can zoom in and out and the Timeline is horizontal stretched or compressed.

To change the current date you can *pull* the Timeline. You can also move the Timeline by activate a Hivent. Then it is centered in the middle and the NowDate displays the date of the event.

One interesting task of the Epoch Bars was to *adapt* the labels to different sizes. In most cases the names of Epochs do not fit in their boxes. Therefore we tried different ways to fix this problem:

- write epoch name in two lines (destroys layout)
- dynamic resize of Epoch Bars and no change of zoom level (historically incorrect because epochs overlap)
- dynamic resize of Epoch Bars and with adaption of zoom level (short historical epochs with long names destroys layout)
- leave out vowels (some epoch names are unreadable)
- leave out the middle of the word and replace it with ... (some epoch names are unreadable)

Finally, we have used a combination of two replacement rules like in Figure 3.10:

1. replace the entire word with an abbreviation
2. replace the end of the word with ...

To improve readability of the epoch names we placed it in the middle of the epoch boxes. If they come close to the edge they stick there with an threshold till the box is to small.

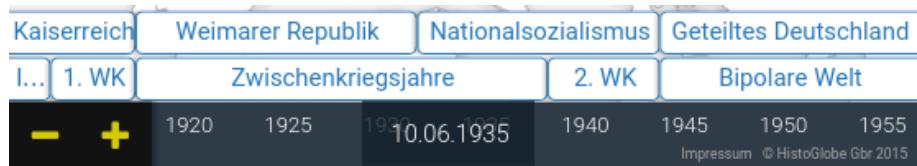


Figure 3.10: Timeline Elements with all improvements

3.4 Search Bar

One way to retrieve information about historical events is our search bar, which is a single-line text box with the dedicated function of accepting user input to be searched for. The user is able to search for events, people, places and time.



Figure 3.11: Search Bar with some search results in drop-down list

Search Algorithm The search algorithm uses the underlying data structure to improve the search process. Each Hivent has a title, location, time and a description. We search over all Hivents and if we match we are looking for the next. So each Hivent appears only once in our result list. Our algorithm has a special search structure. At first we are looking in the title, location and time data field. Then we are looking in the description of the Hivents and parse for text snippets. All results are sorted in search results of the current epoch and search results of other epochs.

Instant Search All possible matches are immediately displayed while the user is typing text. So the search is sent automatically to present the user with real-time results which are displayed as a drop-down list. This often allows the user to stop short of typing the entire word they were looking for.

3.5 Hivent List

The central module to navigate HISTOGLOBE is the Hivent List. Here you can see Hivents with additional informations in one list ordered by date. Each Hivent has a name, a date and a location. She is located on the right edge of HISTOGLOBE under the search bar. They share the vertical amount.

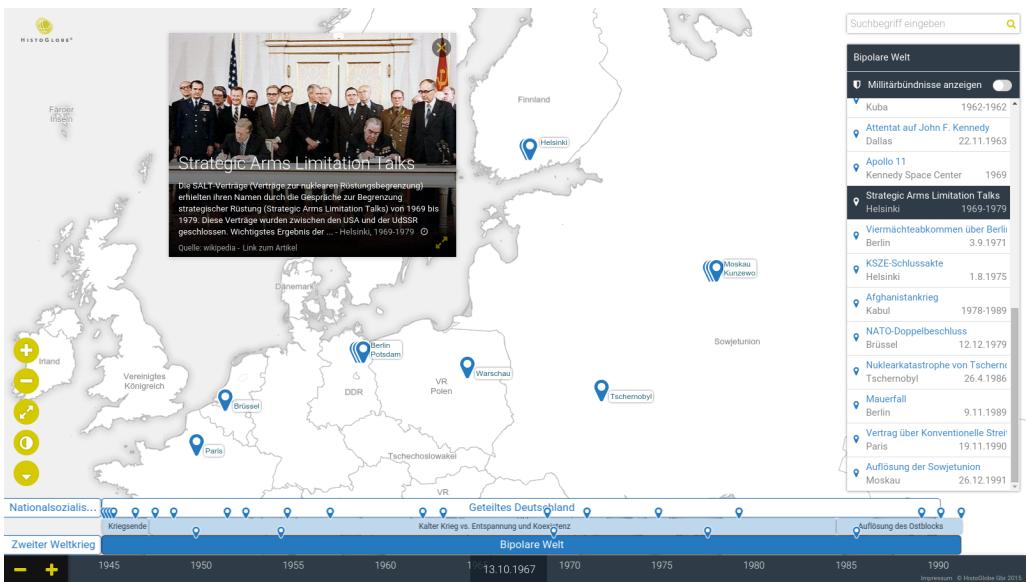


Figure 3.12: Hivent List

3.5.1 Structure

The Hivent List module consists of title bar, an optional area and a list of Hivents. The title bar and the optional area have a fixed size and a fixed distance to the search bar. The list has a fixed distance to the Timeline and has the remaining amount available.

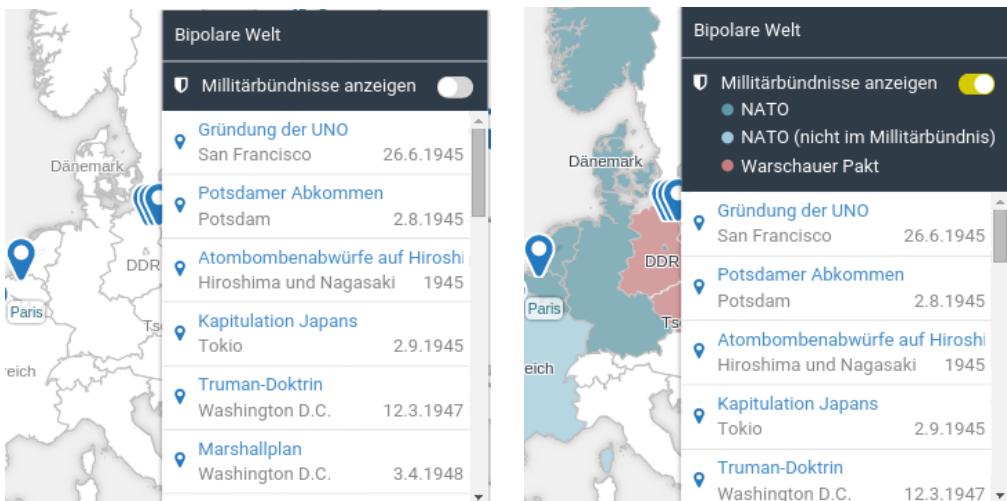


Figure 3.13: Hivent List with and without active bipolar alliances

3.5.2 Behavior

The main function of the Hivent List is to give an overview to the user and than to enable and disable single Hivents. In the initial state of she is not available. For *activation* you have to click on one epoch. The second way is to search something and the Hivent List is initialized with the epoch of the searched Hivent. To *deactivate* the Hivent list you can click on die active epoch in the Timeline.

The Search Bar is also a module to navigate through HISTOGLOBE . So they *share space* on the right side. If the Hivent List is active and you want to look for some other Hivent the searched results take the space of the Hivent List and only the title bar of the current epoch is displayed at the bottom.

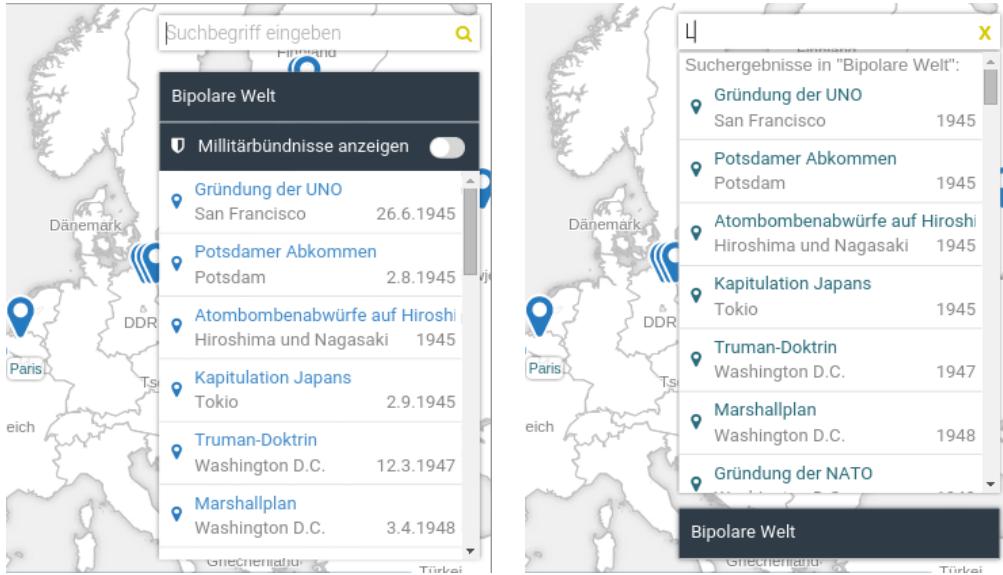


Figure 3.14: Hivent List with and without search results

Between the title bar and a list of Hivents is the *epoch depending area* located. In our implementation only the "Bipolare Welt" has options as seen in Figure 3.13. Here you can switch the color of the countries on map in relationship to the membership to UNO and Warsaw Pact.

3.6 Hivent Boxes

In HistoGlobe Hivent Boxes are the main method to display information beside the name, the location or the date of an historical event (Hivent). Every Hivent Box consists of a name, a short description about the Hivent, a link to the article on Wikipedia and multimedia content like an image or a video, if such a thing exists for the Hivent.



Figure 3.15: Hivent Box displaying information of an historical event with an image

Small Hivent Box The small version, as displayed in figure 3.15, is the default representation of our Hivent Boxes. This version is moveable on the map per drag and drop and consists of the same information like the the big Hivent Box, but with a smaller description length.

Big Hivent Box In figure 3.16 you can see the big Hivent Box. As mentioned above this version differs only in description length from the small Hivent Box and of course in its size.

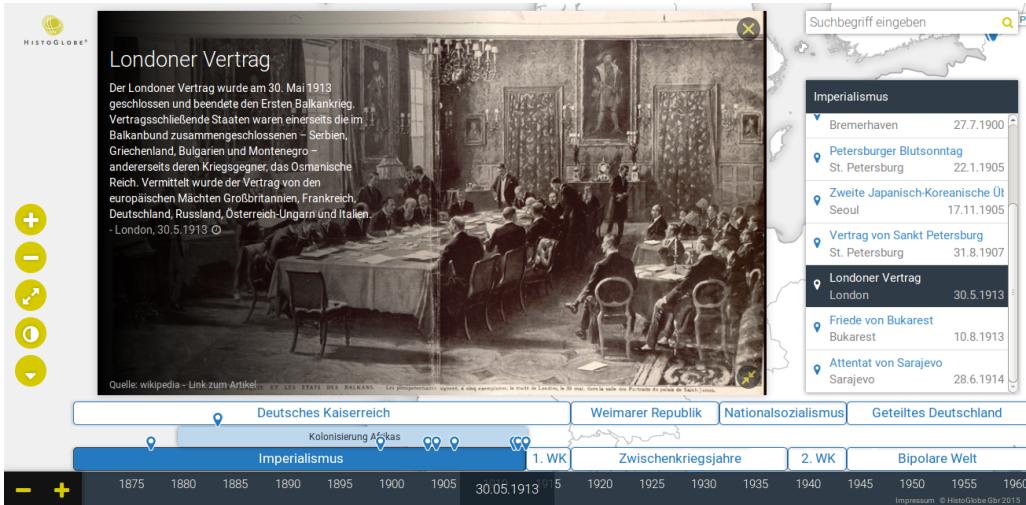


Figure 3.16: Big Hivent Box

Resize Button - Extend This button downright is only available in the small version of the Hivent Box and allows the user to switch to the big Hivent Box.

Resize Button - Compress This button downright is only available in the big version of the Hivent Box and allows the user to switch back to the small Hivent Box.

Multimedia Button This button on the right is available in both versions of the Hivent Box, the small and the big one, but only if there is existing multimedia content. With this button the user can switch to the multimedia content.

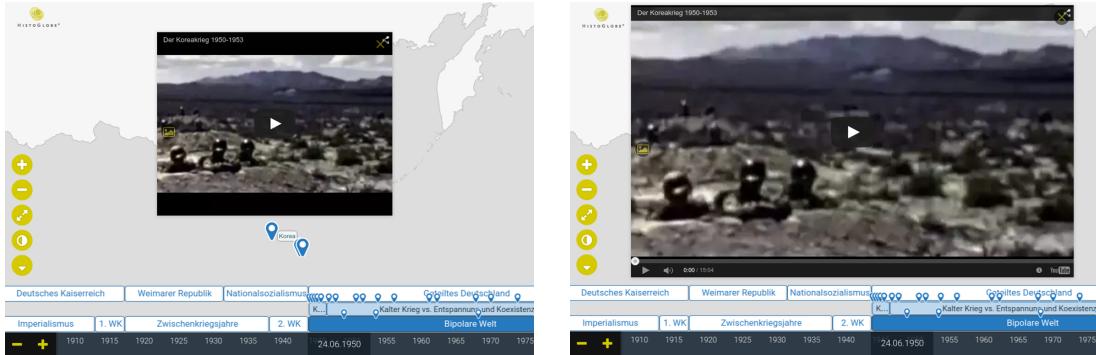


Figure 3.17: Multimedia content in small and big Hivent Box

Image Button This button on the left is only available in the multimedia view of the Hivent Box and allows the user to switch back to normal view.

Close Button This button in the right upper corner is available in every view and version of the Hivent Box and allows the user to close the box.

3.7 Control Buttons

- Change the size of the map - zoom in
- Change the size of the map - zoom out
- Switch to fullscreen mode or back to normal view if fullscreen mode is active
- Enable high contrast mode or switch back to normal view if high contrast mode is active
- Minimal user interface - hide/show Hivent List and Topic Bars

4 Field Study

In the end of the project we tested the visualization directly in school in two different sessions with respect to the two different target groups: In one class the teacher used HISTOGLOBE as a teaching material and in another class the students used it as a study material to research about an historical topic.

4.1 Teaching Material

Our research question for the first test was if HISTOGLOBE is suitable as a teaching material in the classroom. The teacher wanted to use the software to explain the historical context (name, time and location), the content and the consequences of four major conferences at the end of World War II: Casablanca 1943, Yalta and Potsdam 1945.

4.1.1 Planning

Because there is just one test in one class with one teacher and the course of a history class is somewhat arbitrary, we did not use any quantitative measures to answer our research question. Our main focus was finding out whether the current concept of HISTOGLOBE is suited as a teaching material and if there are major usability flaws. We decided to use the following methods:

1. Video recording of the whole class to analyze the usage of the teacher afterwards.
2. Semi-structural interview with the teacher after the class to get more insight into his usage of the software.
3. Short Questionnaire (see: appendix 5.1) for the students after the class.

4.1.2 Conduction

On Thursday, 16.04.2015 from 11:35 until 13:05 the teacher held a lesson about the four major conferences after World War II. In 15 minutes during the lesson he actively used HISTOGLOBE to show the students the location, the date, the name and an image of the conference. He asked the students about the context and content of the conferences using the visualization. He swapped between his own prepared teaching slides and HISTOGLOBE . He once used the software spontaneously (see Figure 4.1): A student asked “What is a satellite state?”, and the teacher explained it by the Soviet satellite states (GDR, Poland, Czechoslovakia and alike).

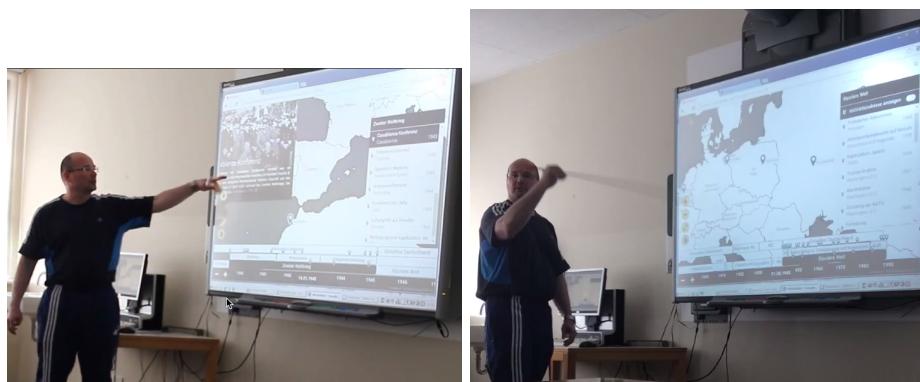


Figure 4.1: The usage of HISTOGLOBE as a teaching material in the classroom

4.1.3 Results

While the teacher used HISTOGLOBE we noticed the following:

- The Hivent List was the only element he used to select an Hivent, neither the Timeline nor the Map.
- The visualization was only in the high contrast mode. It seemed suitable for the very bright lighting condition.
- The teacher used only the mouse, not the Smartboard, as an input device.
- Sometimes there are labels of minor countries on the map, but the important ones are missing. The label display concept has to be thought through again.
- The current date of the visualization is barely visible and should be more prominent.

In the interview with the teacher after the lesson we revealed the following important results of the field study:

- The big advantage of HISTOGLOBE is the map, especially navigation and zooming.
- The teacher sees great potential in visualizing territorial development of countries and membership to alliances.
- HISTOGLOBE is suited for him to show the name, date and location of an Hivent, but not the coherences. In his opinion this shall also not be the focus of the software.
- He believes that the effect on the students is only minor, because they are used to work with a Smartboard and HISTOGLOBE does not give them extra information

The students gave us valuable feedback in the questionnaire (Figure 4.2):

- Most students found HISTOGLOBE interesting, became curious about the software and are willing to work more with HISTOGLOBE
- The biggest advantages seem to be the summary and the overview that the visualization gives to them. Also the factor of time and the picturing of the Hivents because of the images seem well-made.
- Most students did not appreciate the black-and-white design of the HighContrast mode and were confused by the visualization.
- Some students complained that HISTOGLOBE was not used enough in class in order to understand and appreciate it more.

Satisfaction with HistoGlobe

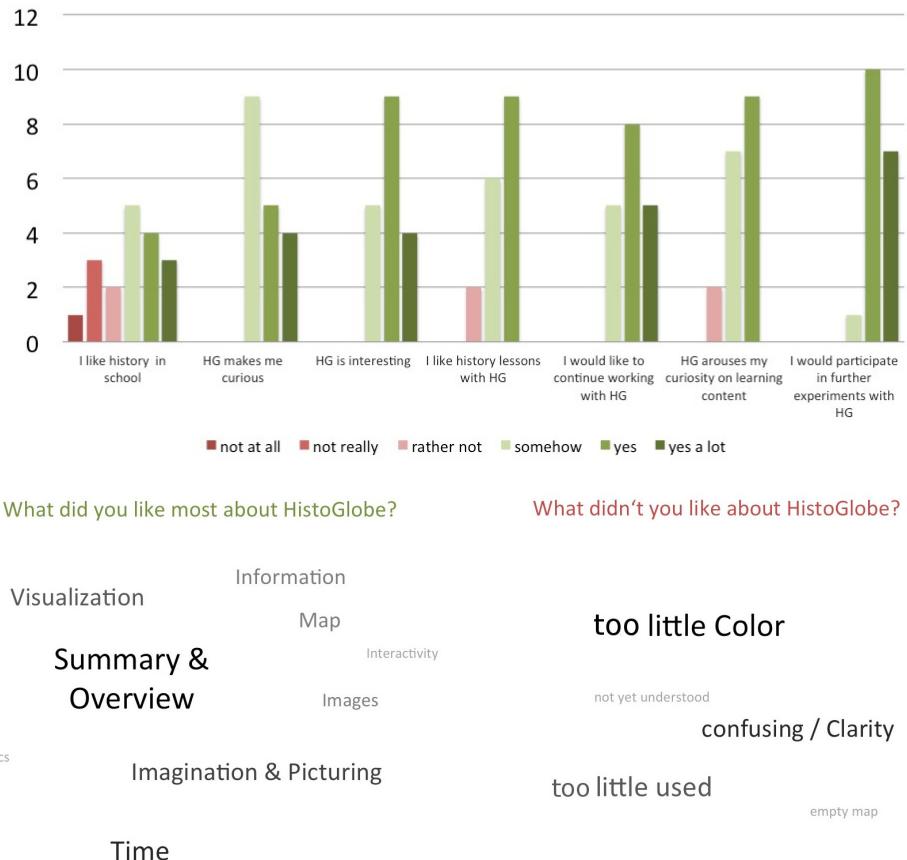


Figure 4.2: Results of the first field study with students

We conclude from the feedback of the teacher and the students that HISTOGLOBE is only partially useful as a teaching material – but we believe it was much more helpful for students to learn.

4.2 Study Material

One week later we had the chance to examine this research question: HISTOGLOBE is suitable as a study material to research about historical topics. In a computer pool of Lobdeburgschule the students work on the task to inform themselves about events in the cold and the hot phases of the Bipolar World 1945-1993. The output was supposed to be a timeline with an overview about the development in the Bipolar World.

4.2.1 Conduction

On Friday, 22.04.2015, from 11:35 until 13:05 the students performed the task stated above. We used the time to find out about the usage of HISTOGLOBE and the advantages, disadvantages and problems with the software.

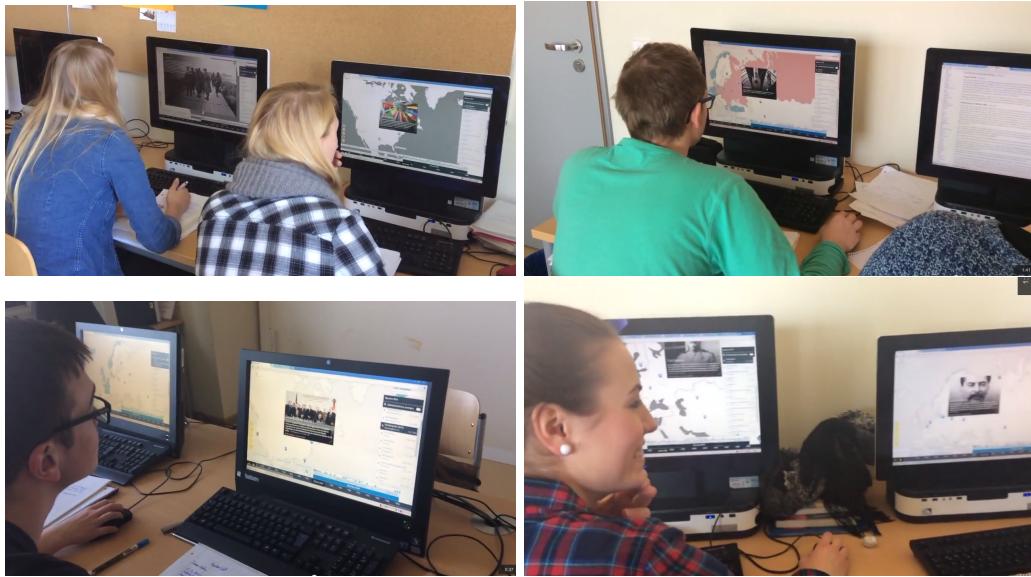


Figure 4.3: The usage of HISTOGLOBE as a learning material for the students

In the same way as in the first field study we only used qualitative methods to evaluate our hypotheses. We observed the students while working, asked specific questions and used the same questionnaire as the week before to measure a difference between the usage of HISTOGLOBE for teaching and for learning purposes.

4.2.2 Results

While observing the students working we registered several interesting things:

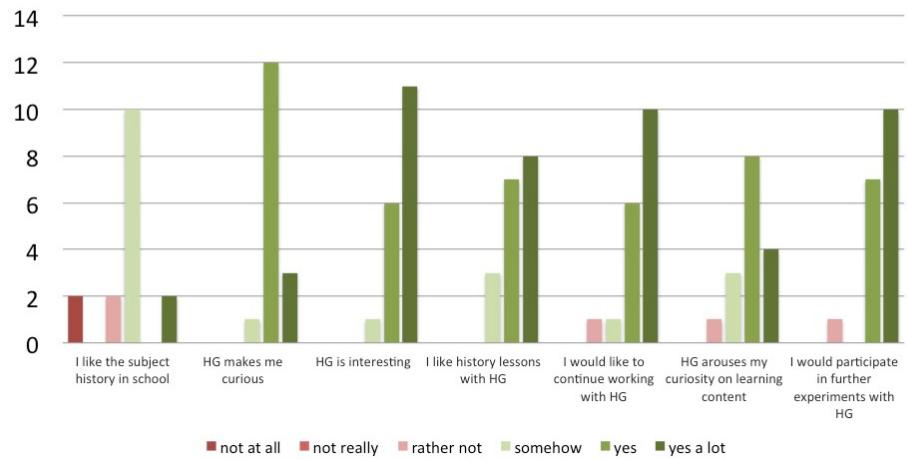
- There were no questions from the students how to use the software, everyone was able to use it from the beginning.
- The software was worked smoothly on the machines.
- The students clicked on the topic “Bipolar World” and clicked on each Hivent in the Hivent List one after the other. They opened the Hivent Box in full screen and read the short article. They did not use either the Timeline nor the Map actively.
- Some students used the Wikipedia link to get to know more about an Hivent. Only one student has searched on Google for additional information.
- One problem for the students was to find out which Hivents are important, because all seem equally relevant.

We collected feedback to each User Interface element during the observation and in a feedback session after the class:

- The Map was almost exclusively used passively. The information on the Map was widely understood, especially the alliances were considered as helpful. Since there were no major border changes between 1945 and 1992, we could not find out if the visualization of border changes were helpful. One requested feature was cities on the map for a better orientation.

- The Timeline was not used, except by some students for the development of the bipolar alliances. Also the topics bar was only used once for selecting Bipolar World. The Hivent markers on the Timeline were not helpful, because there was no visible connection between name of the Hivent and the marker.
- The Hivent List was the main navigation element, the only one that was actively used by all students the whole time. It was considered to be very helpful to know which event happened where and when.
- The Search Bar was not used at all by anybody. This is probably because of the exploratory nature of the task from the teacher.
- The Hivent Boxes were the main source of information. Everybody liked the content and the style of the box, especially the image of the Hivent. The box is very powerful, because most students directly copied the content from the box in their notes.
- Half of the students used the high contrast mode even if it was not necessary with respect to the lighting conditions. It seems like it is visually appealing. For the other control buttons we did not observe anything special.

Satisfaction with HistoGlobe



What did you like most about HistoGlobe?

chronology
productive working
visualization
content: images, facts, videos
visualization on map

What didn't you like about HistoGlobe?

graphic composition
„super idea“
Eventlist
„Warschauer Pakt“ - Bug
missing battle zones
designate events on map
only wikipedia content
map could be more descriptive
confusing timeline
missing explanations
to few colors

Figure 4.4: Results of the second field study with students

From the results of the questionnaire (figure 4.4) it becomes clear that especially the vividness of the visualization, the chronology and the visual impressions of the Hivents were very helpful. While there were smaller problems and feature requests mentioned by particular students, one big problem arose by most: HISTOGLOBE does not answer the *Why*-question: There are no coherences visible.

Overall, most students were satisfied with HISTOGLOBE, because it is easy and fun to use, has a plausible usability and gives a good overview about what happened. Even the teacher said in the end, that for the task he has given the students HISTOGLOBE is very suitable – because it is good for getting an overview, but not for detailed discussions about history.

5 Conclusion

User Centered Design We have implemented a visualization which is usable for the teacher and understandable for the students. We also had valuable feedback throughout the entire development process, which was the basis for the good result of the final field study. We did not strictly follow the ideas of User Centered Design, because we hardly used paper prototypes or think aloud protocols, but implemented most of the design ideas directly to show them to the teacher. Since we threw out some features, there was a waste of time. A problem of the design approach is that we developed the software based on the ideas of only one teacher, so we can not reason on how helpful HISTOGLOBE is to most schools. We also did not show the visualization to students before the final study.

Visualisation Our visualization can be navigated via a Map and Timeline. Historical events can be found through the Hivent List, the Search Bar, or directly on the Map or the Topic Bars represented as markers with supported linking. We are able to visualize area and border changes and to show themes. Our high contrast and minimum UI mode allows the users to customize their view on HistoGlobe. Therefore we are able to visualize *what, where, when* and *how* happened. But we are not yet able to show *why* something happened – the visualization of coherences in history was one main goal of the project which we have not achieved. Another problem was since we developed a solution especially for one teacher, we created the Hivent List, because the teacher wanted it. But actually the element is just a list of Wikipedia articles and if you select an Hivent and open the Box in full screen, you see a nice visualization of that very article. This is just a better visualization of Wikipedia. The students have not used the Timeline and the Map at all, so it remains an open question if this is actually the idea of HISTOGLOBE .

Cooperation with Designer In the User Centered Design approach and for the Interface Design we collaborated with a designer from the Media Arts and Design program, Tobias Westphal. The collaboration was very productive and successful for both sides. Together we developed a concept that is visually appealing, easy to use and realizable for the programmers. He created great designs and it was not for him the meetings with the teacher would have not been so productive. The only negative aspect to name is that this was no common project between Media Art and Design and Computer Science and Media.

Organisation We have worked with Git which was very productive. We also had a Masterplan, so everyone of us could see what to do next and which priority the particular feature to implement had. We learned how to collaboratively work on a project and solve problems together.

Goal for the semester Finally we created a visualization that both teachers and students were able to use without any problems. We are proud that the students understood the goal of HISTOGLOBE and were able to solve their task in the second field study. Because of the successful field study we can conclude that we reached our goal for the semester.

5.1 Future Work

User Centered Design The current concept is based on only on the cooperation with one teacher. In order to reason about the usage of HISTOGLOBE as a teaching material we have to talk to more teachers and get their ideas and requirements into the concept. The same applies to the students: While 18 students is already a solid basis, more students from different schools and different background will increase the certainty if HISTOGLOBE is a helpful tool for understanding history. In the next project we would change the User Centered Design focus from teachers to students, because we believe that there is the real potential of HISTOGLOBE , to learn history from anywhere, not just in school.

Frontend: User Interface Elements We have to come up with an idea how to reanimate the original idea of an interplay between the Timeline and the Map and to rethink the Hivent List to not reduce it to a bare list of Wikipedia articles.

Frontend: Dynamics and animated transitions While testing HISTOGLOBE we found out that the students wanted a better visualization of historical connectivity, in the form of more dynamic display of the data with better respect to the context of historical events. We think one should try to show the flow of history with more detail and animation.

Backend: Content Generation For our studies we used a self generated, wikipedia.org based database, which was sufficient for our first study. Nevertheless it would be great if a teacher or students could compile lessons and homework with a tool. This tool should be able to create, modify and delete Hivents easily, and to add them in arbitrary form to categories. Another helpful functionality would be the automatic generation of an Hivent from a given wikipedia article.

Backend: Country Generation For the future, an editor for storing, managing and analyzing historic changes would be desirable, because the data acquisition part took a large share of the projects time. This task includes the improvement of the data model as described in section 3.2.

Mobile Version HISTOGLOBE was designed, on the UI and software level, to be usable on tablets and phones. But at this point, optimization is sub-optimal. Further tuning to style and usability are necessary.

Appendix

Questionnaires

	trifft nicht zu	trifft zu
Ich mag das Fach Geschichte	<input type="radio"/>	
HistoGlobe macht mich neugierig	<input type="radio"/>	
HistoGlobe ist interessant	<input type="radio"/>	
Unterricht mit HistoGlobe macht mir Spaß	<input type="radio"/>	
Ich würde gerne weiter mit HistoGlobe arbeiten	<input type="radio"/>	
HistoGlobe weckt meine Neugier am Lerninhalt	<input type="radio"/>	
Ich würde gerne an weiteren Experimenten mit HistoGlobe teilnehmen	<input type="radio"/>	

An HistoGlobe hat mir besonders gut gefallen:

An HistoGlobe hat mir nicht gut gefallen:

Geschlecht: männlich weiblich

Figure 5.1: The questionnaire for the students

Work division

5.1.1 Marcus

- Organization
 - Administration of the Masterplan (Figure 5.2)
 - Responsibility for GIT branching and merging
 - Email communication with the team members, the teachers, and project supervisors
- Research Presentation
 - The Browser (history, sandbox, components, flow, JS memory management)
- User Centered Design:
 - Throughout the project – every two weeks
 - * Meeting the teacher in Jena
 - * Testing the current concept and implemented functionality
 - * Deriving new requirements
 - * Update the concept
 - End of the project: planning, designing, conducting and analyzing two field studies
- Implementation
 - Data Acquisition: Hivents
 - Data Acquisition: Historial Countries and Changes
 - Data Acquisition: Historical Topics and Theme “Alliances” in Bipolar World
 - Preprocessing: areas, labels, transitions and changes
 - Time-dependent areas on the map (geometry, labels, animated transitions)
 - Theme- and time-dependent styling of the areas on the map
- Final Documentation
 - 1 Introduction
 - 2 User Centered Design
 - 3 User Interface Elements
 - 3.2 Map
 - 4 Field Study
 - 5 Conclusion

5.1.2 Max Weber

- Research Presentation
 - asm.js
 - emscripten
- Implementation
 - Search Bar module (together with Chris Hirnischer)
 - Search Bar and Hivent Box interaction

- Hivent List: positioning
- Hivent List: structure
- Hivent List: activation and deactivation of hivents
- Hivent List: behavior
- Final Documentation
 - 1 Introduction
 - 3.3 Timeline
 - 3.5 Hivent List
 - 3.4 Search Bar

5.1.3 Chris Hornischer

- Research Presentation
 - JavaScript Performance
- Implementation
 - Search Bar module (together with Max Weber)
 - Hivent Box: positioning
 - Hivent Box: drag and drop
 - Hivent Box: content generation
 - Hivent Box: big version
 - Hivent Box: multimedia slide
- Final Documentation
 - 3.4 Search Bar
 - 3.6 Hivent Boxes
 - 3.7 Control Buttons
 - 5 Conclusion

5.1.4 Sebastian Köpsel

- Research Presentation
 - JavaScript Engine(s)
 - Mixin + Delegation Pattern
- implementation
 - JS Script for Polygon operations
 - Hivent Regions
 - Hivent Marker + Cluster Labels
 - Hivent Label positioning
 - Hivent Behavior implementation in the Hivent List
 - Hivent Marker Placement adjustment
 - Hivent Marker Behavior adjustment

- Final Documentation
- Final Documentation
 - 3.1 Hivents
 - 5.1 Future Work

5.1.5 Masterplan

Masterplan star comment

Datei Bearbeiten Ansicht Einfügen Format Daten Tools Add-ons Hilfe Alle Änderungen in Drive gespeichert

Kommentare Freigeben

Name	Description	Prio	Respon-sibility	Status			Comment
				E Design	F Implem.	G Test	
Global							
search bar - hivent list - interaction	2 modi: searching and topic navigation => initial: hivent list cold, result list in if start typing in search bar => modus "search" => result list down (out), hivent list down (in) if done with searching => modus "navigation" => result list up (in), hivent list up (out) -> animated transitions	1	MW	:(:)		
map information limit	limit number of labels on the map (hivent markers, country and city names) to X [5, 10] + non-overlapping information on the map (both country labels and hivent marker)	3	SK	:)	:)		
active hivent	make possible to active hivent on all UI elements (map, timeline, hivent list and search bar) highlight active hivent on all UI elements	1	SK	:)	:)	:)	
highContrast Version	implement complete high contrast version of UI, including the map tiles	1	MK	:)	:)	:)	
imprint	create link to imprint and fill with legal and source information	2	MK	:)	:)	:)	
Hivents							
numHiventsOnTl	A: show all + all labels B: show only important hivents + labels, indicate rest	2	SK	:)	:)	:)	
HiventsOnTlLabels	app	4	MK	:)	:)	:)	labels finally removed from timeline activate future, only active hivent
numHiventsOnMap	A: show all hivents from current topic B: show only X hivent (clusters) from current topic	2	SK	:)	:)	:)	all hivents from topic are fine
hiventRegionsOnMap	A: show hivent region of hivents close, make opacity invariant B: show hivent region only for active hivent	2	SK	:)	:)	:)	teacher did not appreciate this mode => too much on the map this version won the race! hivent regions are only shown if hivent is active
hiventClusterLabels	A: show all hivent labels B: show only two hivents + "show XY more", show labels only from zoom level 4 on	2	SK	:)	:)	:)	teacher appreciated this mode => reduces information on the map
label positioning on map	non-overlapping labels on the map	1	SK	:)	:)	:)	

Figure 5.2: Extraction from the Masterplan of the project

5.1.6 GIT

Oct 20, 2014 – Apr 30, 2015

Contributions to develop, excluding merge commits

Contributions: **Commits** ▾

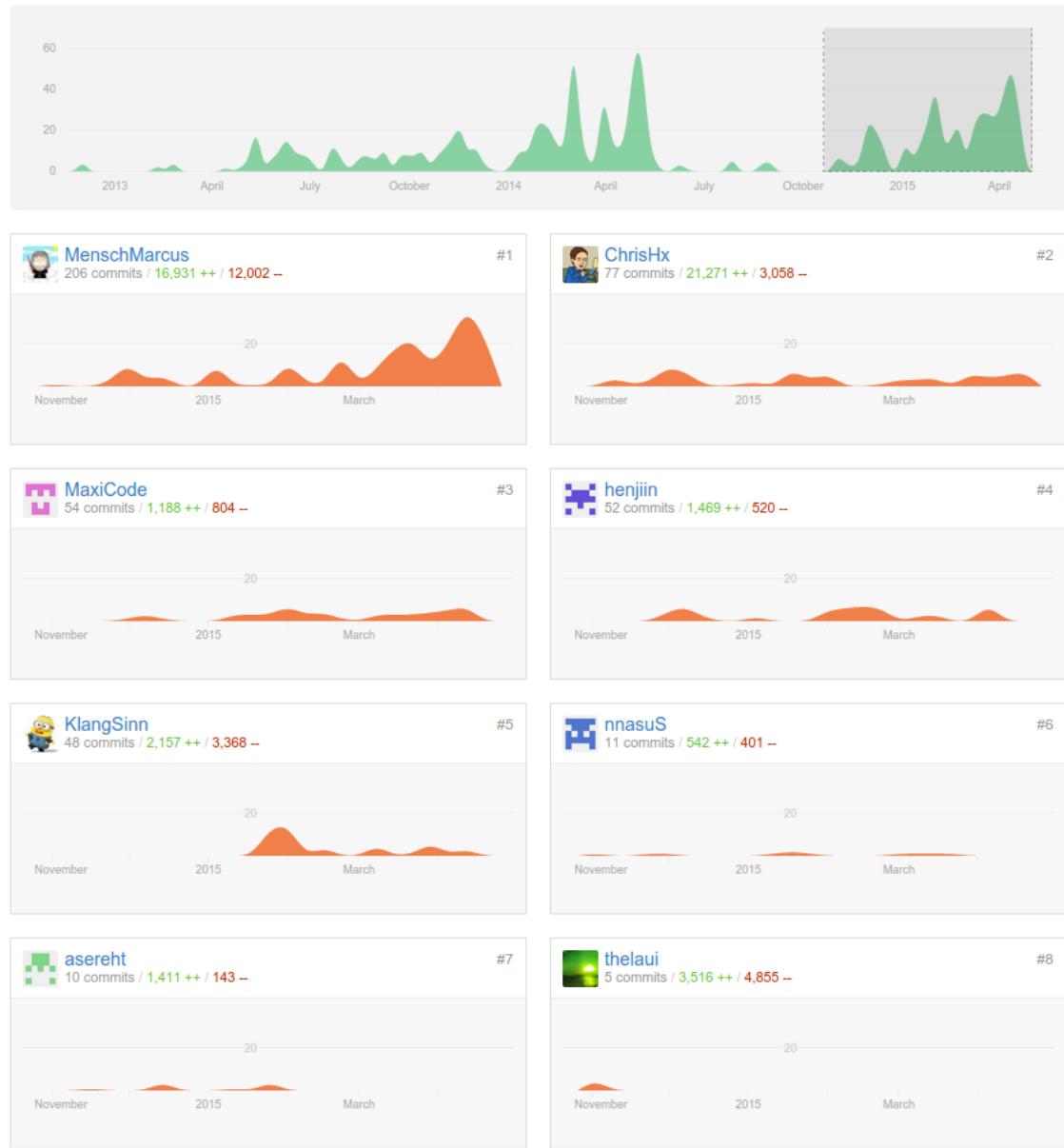


Figure 5.3: Collaborators of the git project HistoGlobeAtSchool

MenschMarcus: Marcus Kossatz, **ChrisHx:** Chris Hornischer,

MaxiCode: Max Weber, **henjiin:** Sebastian Koepsel