TEACHING WITH ANIMATED MAPS – THE USE OF THE GERMAN NATIONAL ATLAS FOR SCHOOLS

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Abstract: *In the process of transformation of the print version of the German National Atlas into its electronic version, a didactical surplus effect has been achieved through the implementation of animated maps. The paper demonstrates how animated maps can be seen as instruments of new media in teaching and as means for improving media competence. Starting from static maps and their increasing complexity when several time levels are to be shown, the presentation demonstrates a variety of visualizations of processes via animated maps. Analytically, four types of spatial processes can be distinguished and will be considered. Special attention is given to the representation of time and of space. Examples are taken from the German National Atlas and can serve for teaching any subject that deals with changes in space and in time, such as history, social sciences, geography or certain aspects of natural sciences. The presentation includes background information on the technical realization of the animation of maps.*

DIDACTICAL OBJECTIVES AND CHALLENGES

Compared with the generation of their parents and grandparents, which is the generation of their teachers and professors, children and young people of today have quite different experiences of information presentation and therefore different patterns of perception and also different practices of learning.

Even though books keep playing a certain role in schools and in leisure entertainment, for many young persons, the most import contact with information is through electronic media. For them, computer games, internet surfing and modern movie aesthetics form pre-shaped modes of perceiving and even more of filtering the overflow of information they are confronted with every day. The simple patterns of video games transport media skills, but not necessarily do they teach abilities of a concentrated and outcome oriented manner of navigating though complex electronic systems of information. As a result, in the 1990ies media competence was added to the principal goals of teaching (Flath/ Fuchs 2000).

Teaching with new media

The development in teaching in general and specifically in teaching geography adapts to new developments of media technology, even though usually with a time lag. This time lag is not only due to the process of learning necessary for the teachers themselves, but is also a result of low financial budgets in schools – at least in public schools – and bad technical equipments.

Modern geography and social science teachers can resort to a broad variety of multi-media instruments and tools, in order to transport knowledge and skills. Among them are electronic dictionaries, textbooks and atlases, databases of geographic information systems (GIS), programs and tools for data visualization, and interactive teaching units (Obermann 2000, pp. 12-14; Herzig 2003).

Since the 1990ies, industry and public science foundations invest in electronic learning and teaching-systems, even though many of these developments are confined to inner-enterprise learning or small segments promising commercial success, such as language learning programs. During the last years though, considerable progress has been achieved with regard to interactive learning programs, both offline and online, in geography and in general teaching. There is something like a European way, producing serious programs with application to certain school learning units, such as ESPERE – an EU-financed internet learning unit for climate geography (SCHLEICHER 2004). Another approach could be titled the American way, or "edutainment". The government supported interactive internet approach to make maps and learn geography for children – MapStats – can serve as an example (www.fedstats.gov/kids/index.html).

Without any doubt, teaching units are highly useful for teachers. They save them a lot of preparatory work and can equip them with materials they normally would not have access to. On the other hand, though, there are some serious practical drawbacks to interactive learning units:

- their development consumes high efforts in terms of time and money
- they only result useful if they fit exactly into a teaching curriculum (in Germany: curriculum definition by the Länder)
- if the user-interactivity is well elaborated, communication between teachers and students is unneeded
- they reduce possibilities for teachers' own class strategy, if they do not dispose of didactic interactivity (Obermann 2000, S. 10)

This paper argues that for teaching geography as well as those topics in history, natural and social sciences which talk about phenomena in time and space, animated maps might serve as an additional and in some cases as an alternative tool with extremely useful didactic characteristics.

Teaching with animated maps

Maps are the prime material of geographers who basically talk about distributions in space and changes of distributions in time and space. This corresponds with the analytical categorization of maps into static and animated maps. While static maps are adequate for representing topography and thematic distributions of locations or of data, animated maps serve for showing processes.

Processes, of course, also can be shown by static maps, using sequential series of maps, but since animation is technically possible, it is the preferred tool for process documentation, demonstration and simulation.

Perception psychologists argue that shape and color – the traditional dimensions of cartographic information – are processed by the human mind in quite a different way from movements. Analytically, the perception of movement takes place on three levels, each involving specific dimensions of the perception process. In the perception of movements, direction, velocity and final shape are perceived on a first level, moving shape and color on a second level, basic shape and starting shape on a third level. There is a fourth level of perception, referring to dimension, but in this paper we will concentrate on two-dimensional representation, only, and exclude 3D-maps. The distinction of the different perception levels is important for realizing that the focus of animated maps has to be different from that of static maps.

These dimensions of the perception of movement have to be considered when constructing animated maps:

Basic shape: In animated maps the base map receives little attention. When animation starts, the base map moves towards the back and easily is forgotten. Students might not even realize where the process they are observing takes place.

Direction: The human eye is not able to follow movement in different directions. It should be possible to dissect multi-directional processes such as concentric expansion into distinct sequences.

Velocity: The rate of changes in animated maps can be proportional to real time, as indicated in a time scale. If it is not possible to accelerate or to slow down, fixed velocity has to be adjusted to perceptive abilities of a person who does not know the map. Easy repetition is indispensable.

Final shape: At the end of the process, changing the map from status A via status B to status N, a perfect static map should appear. In most cases, though, for teaching it would be useful that process navigation allows to stop and to follow in any instant of the process, rendering a static map in every instant.

Moving shape: Movement can be symbolized by continuously moving arrows, arrows proportional in size or by moving signatures. Movement also is suggested by sequences of maps with changing points or lines.

TECHNICAL DEVELOPMENT OF 2-D ANIMATION PRODUCTION

Until the mid 1990ies, cartographic animation was mainly achieved by frame-by-frame techniques, using animated GIFs in the realm of Windows, and using the Macromedia product Director in the realm of Mac. At the end of the decade, Java applets came up for use in the internet browser. Even though they are highly suited for cartographic application, programming inputs have to be quite extensive, and the application was not accepted as standard. For the same reason, the highly sophisticated simulation and animation tools derived from automobile and airplane construction, creating virtual realities, could not be established as common practice.

New incentives came as a result of establishing internet browser technology. Software developers started to produce new products for this market segment and developed user friendly tools. Macromedia offered an internet compatible spin-off product of Director, Flash. During the following years, with SVG a second tool, almost equal to Flash, was added to HTML-standard.

Since then, animation software has developed progressively. In 1993, Dransch still saw the main advantage of animated maps in the time dimension of their presentation. By now, the graphical elements point, line, and polygon can be addressed and animated separately. As the most recent feature, databases can be integrated, which amplifies the possibilities of navigation. The graphical elements are now variable in shape and form. This variability means that the elements will not simply be present or absent on a map – as it used to be in the early times of animated maps. The elements now are always available vectors, even if invisible. A line is not dotted or dashed or solidly drawn, a line can be constructed and deconstructed, can appear dotted or dashed or solidly drawn, one after the other, or the line can flash or disappear. Even when not present, it can serve as an invisible motion path for another moving object.

Due to its earlier launching on the market, Flash is far more widely spread than SVG, especially in the commercial sector. The National Atlas of Germany also uses Flash, for one because of its user friendliness, but also because of the early date of beginning of the project, when SVG did not yet exist.

DIDACTICAL APPLICATIONS OF ANIMATIONS

From a didactical point of view, animations should be distinguished according to their contents, rather than to categorize them formally, in temporal or non-temporal animations as suggested by Dransch (1993) and Kraak/Klomp (1995). Five types of animated maps can be distinguished: animated static maps and four contextual types of animated processes.

> ***Animated static maps:***
> Successive build-up of a (static) map
> ***Four types of processes***
> 1. Changes in space and time
> 2. Diffusions
> 3. Shift or relocation processes
> 4. Spatial relations

Animations as used and implemented by teachers usually are limited to the successive build-up of a (static) map and to sequences of "changes in space and time", joining a series of maps with the same phenomenon in n stages with exact overlays. These maps can be individually created thematic maps or – as frequently used for the demonstration of climatological processes – satellite photographs.

The different types of processes focus on different elements of movements, thus different demands can be formulated for programming the maps. The electronic version of the National Atlas of Germany has maps of all four types and some subtypes. It implements navigation according to contextual necessities, as can be shown with a series of examples:

Four types of processes with examples from the National Atlas of Germany

1. Changes in space and time

> Sequential changes:
> • Unemployment 1996-2003 – each year can be addressed individually in the legend
> • Professional life of great German composers – the individual elements can be activated in the legend as well as on the map; corresponding map and legend elements are linked to each other.
> Continuous changes:
> • Sunrise and sunset in Germany – no further interactivity; example for spatial representation of complex geophysical model.
> Hybrid type of changes (continuous change with discontinuous data):
> • Successive move of the north shore coast line (North Sea) – each point of time with available data can be addressed individually in the legend.

2. Diffusions

- Social diffusion: Expansion of Shopping Centers – each phase can be addressed individually in the legend.
- Natural diffusion: The diffusion of the red beech from southern towards northern Europe – each point of time can be addressed individually in the legend.

3. Shift or relocation processes

Shifts:
- The production of an Opel car seat – this animation relies on two different navigation systems. Firstly, the standard start/stop button which initiates the animation sequentially, component after component (see fig. 1). Secondly, the individual component supply systems can be visualized statically or animated, or all components can be shown cumulatively, using the cascade model (see fig. 2). In total, there are four different approaches to visualize the process.

Relocations:
- Inner-German migration between Länder (1995-98) – In this example, not the contents of the map is animated – the flow of persons moving within Germany in a three year period. Instead, a content sensitive map was created, which in each spatial unit presents the information related to this unit only. The positive aspect is here that the user focuses on the relevant information. On the contrary, the negative aspect is, that the content as a whole is not available.
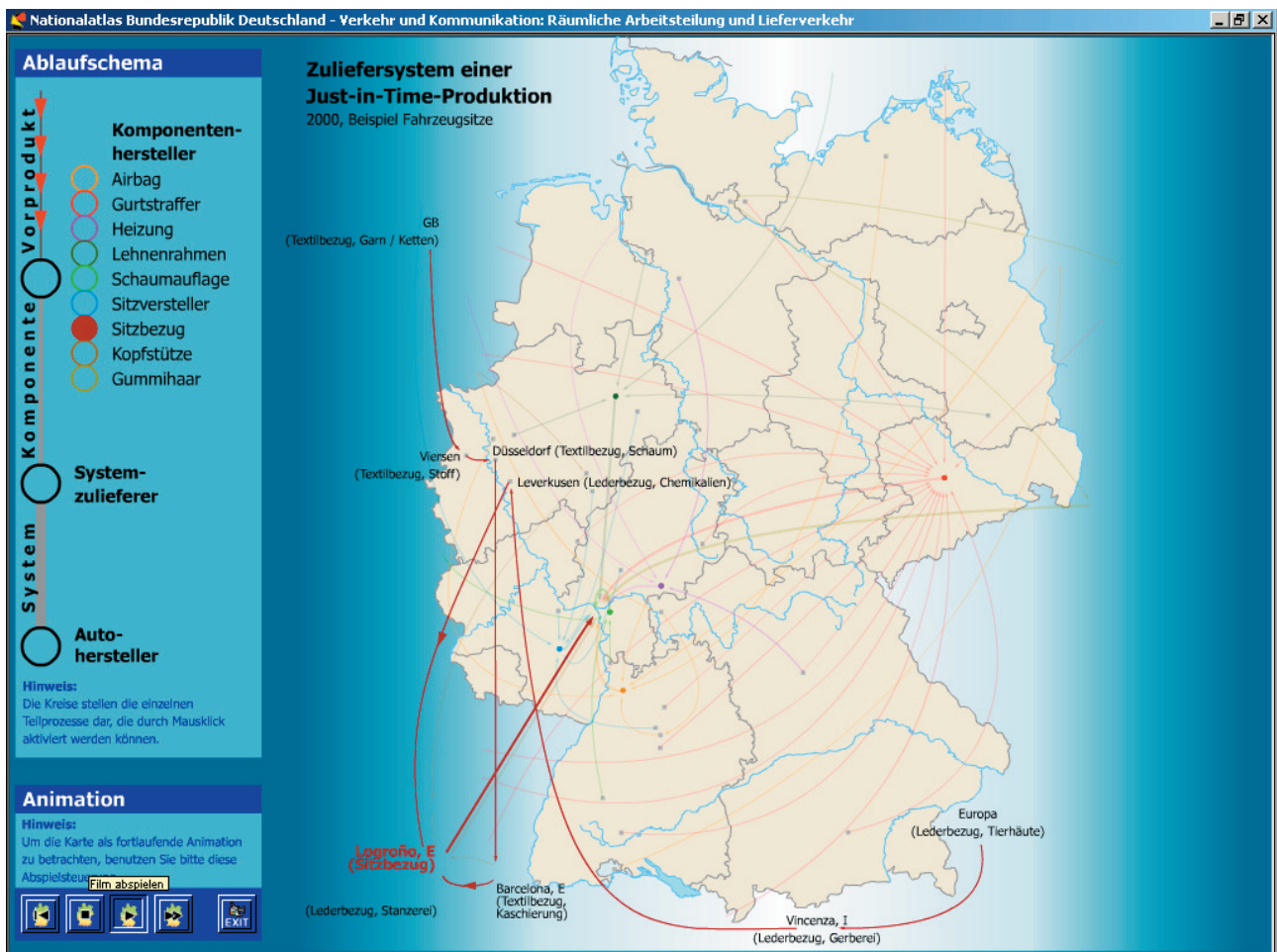

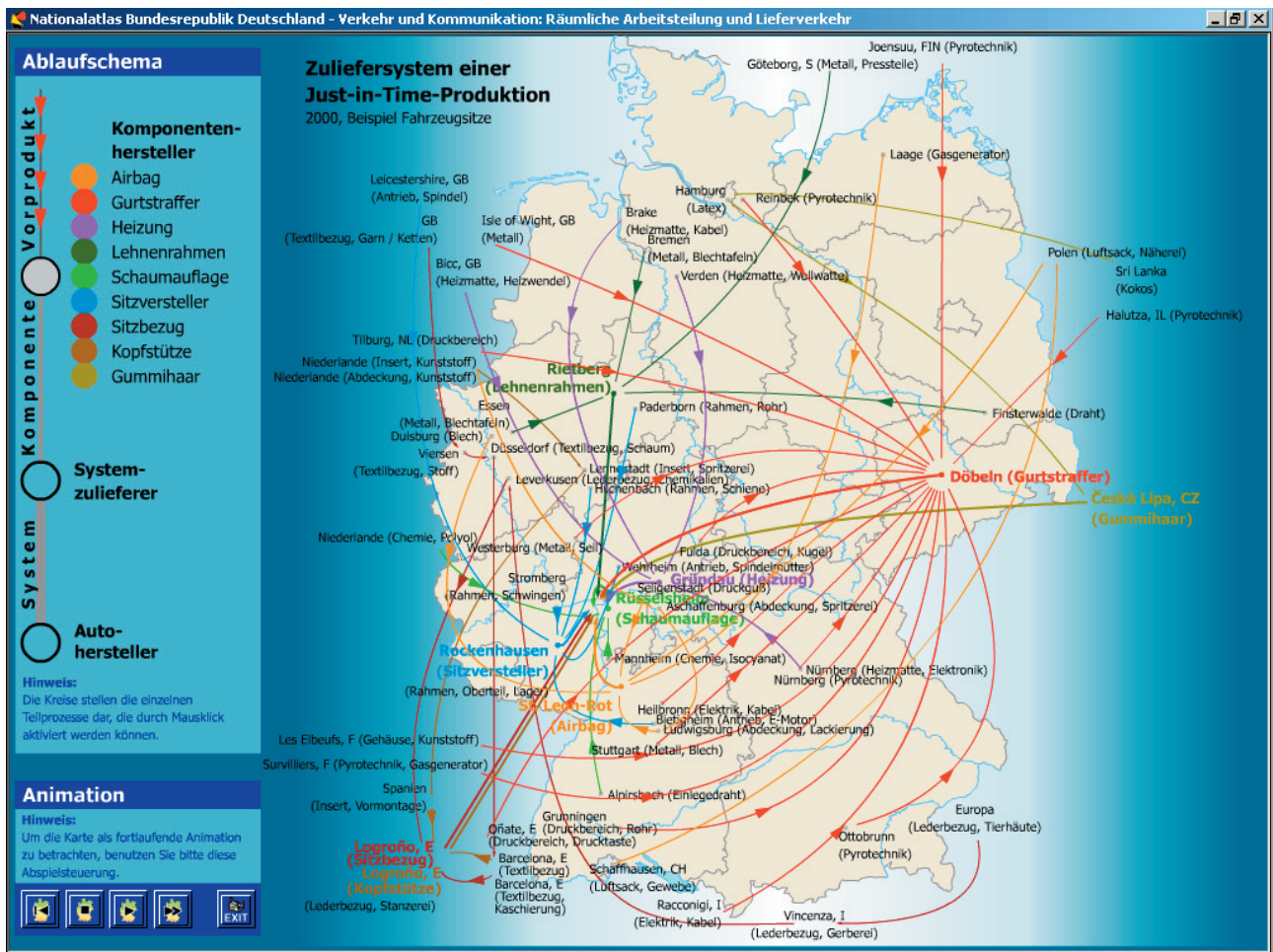Figure 1: Sequential navigation – each component is shown individually

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Figure 2: Cumulative visualization of component production

4. Spatial relations

      • Automotive industry and its suppliers – a non-temporal animation, which can also be considered an example for the successive build-up of a (static) map. The animated map visualizes the relationships between factories and suppliers. The navigation can be addressed exclusively through the legend. The objects information is stored in a database.

CONCLUSIONS AND PERSPECTIVES

Summarizing, animated maps prove very useful and instructive when they dispose of a flexible navigation, adjusted to each map contents and the teaching necessity of each topic. There are no standard solutions. Technical standards offer a broad range of possibilities for varying elements and combinations of movements on maps.

There are several advantages to classroom work with animated maps:

      • they transmit media competence
      • they sharpen the understanding of processes
      • they allow to distinguish temporal and spatial dimensions of processes
      • they make it possible to visualize complex relations step by step
      • they promote students' and teachers' interaction with the map

In order to make use of these advantages and to integrate more animated maps into teaching, some prerequisites should be met. To provide classrooms with technical media is only one of them. The other consists of an adjustment of teaching contents to the new technical possibilities.

Geographers, social scientists or historians have to learn, that their subjects in many cases include processes; often not the distribution of a phenomenon as such is the focus of interest, but its change. Similarly as in physics or chemistry, animations should be part of the standard repertoire of social science and geo science teachers. With animations they can visualize these processes, or they can simulate future or possible developments, changing one or two parameters. Teaching with simulation animation has been established in natural sciences for quite a while. Cartographers, then, will have to adapt to a rising need of these animations. They can contribute to the success of teaching if they provide teachers not only with good maps, but also with animated maps, individually or integrated in interactive teaching units.

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