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Using the Geographies of Learning. An Exploratory Categorization for Spatially Enabled Learning

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Abstract

In a discussion spanning close to three decades, a variety of approaches for the use of geomedia in secondary education have been developed, roughly following technical/ workforce, spatial thinking, and spatial citizenship arguments. However, these approaches have mainly supported teaching within the subject of geography, or adjacent school subjects with a distinctly spatial outlook. Spatially Enabled Learning looks into a completely different domain, discussing how spatio-temporal contextualization might support learning processes across subjects. This contribution explores the possibilities of supporting learning processes using the example of German language education and suggests a model for support structures.

Keywords:

Spatially Enabled Learning, geomedia, education, geography education, learning

1 Introduction: Spatially Enabled Learning

'To organize the world's information and make it universally accessible and useful' is the well-known mission statement of one of the largest tech innovation players in the 21st century, namely Google. Following that logic, one could expect the Google Maps mission statement to focus on the accessibility of geographic information. But, almost to the contrary, it is not about organizing geographic information but "to geographically organize the world's information and make it universally accessible and useful" [1]. This small but significant difference ('organize geographic information' vs. 'geographically organize information') is one of the most powerful examples of cartography's shifting paradigm in the digital era: from representing spatial information towards serving as a spatial platform to (spatially) link user and information (Strobl, 2009). One could say that Google Maps are not maps but rather Google on maps. Using the same kind of paradigm for education, Vogler et al. introduced the term 'Spatially Enabled Learning', which, in a nutshell, can be summed up as 'to geographically organize learning contents and make them (universally) accessible and useful' (Vogler, Hennig, Jekel, & Donert, 2012). This idea will be discussed briefly below.

[1] Michael Jones (former Google Earth CTO); presentation at eDay 2006 in Rotterdam, NL

Many authors (e.g. Enemark & Rajabifard, 2011; Thielmann, van der Velden, Fischer, & Vogler, 2012; Vogler et al., 2012) state that we live in a 'spatially enabled society': spatial representations are omnipresent and provide information layers for everyday information and decision-making. While the availability of mobile devices, the mobile web, social web applications and globalization outcomes in general seem to support de-location in everyday understanding and action, the combination of these aspects with geolocation technologies leads to a renaissance of place (Schroll, Rodenhäuser, & Neef, 2007) which utilizes in particular information that is linked to a geographical reference. Information for many purposes in life is georeferenced, for instance information on everyday transportation, consumption and leisure activities.

Spatially Enabled Learning is an approach that utilizes the omnipresence of digital spatial information in order to improve learning while taking into account the communicative and collaborative potential of the geoinformation society. Inspired by the variety of content to which georeferences have been added in everyday life enabled by geolocation technologies, from political issues to sustainable consumption to spatialized documentation of leisure activities, Vogler et al. (2012) coined the term Spatially Enabled Learning. They identified learning that uses spatial representations as added value for several subjects beyond purely geographical topics. Typical learning examples within this approach are learning about places mentioned in novels, about statistics concerning countries and regions, and about cartographic narrations on product chains.

Spatially Enabled Learning environments may 'bridge the gap between everyday social geocommunication and collaborative learning environments in education' (Vogler et al., 2012, p. 209). The approach 'aims at the integration of communication and geo-technological tools into a state-of-the-art (e-)learning framework' (Vogler et al., 2012, p. 205). It involves learning content being spatialized/georeferenced not only by teachers, but also by learners, possibly also in collaboration with each other. At the same time, spatial contextualization may be considered a further trigger for learning processes. For this purpose, we suggest the use of simple analogue and digital representations and mapping tools, such as those used in the Spatial Citizenship approach (Gryl & Jekel, 2012), supported by everyday technology (mobile devices) in particular. In sum,

Spatially Enabled Learning makes use of web-based spatial representations to support interaction, communication and document learning outcomes in educational contexts by connecting complex learning content to a spatial dimension. This can be achieved by contextualization, by cartographic support of arguments in communication processes or simply as a spatialized portfolio that may be either individual or collective or both. (Vogler et al., 2012, p. 206).

2 Basic concepts of Spatially Enabled Learning

Spatially Enabled Learning is a concept designed primarily to provide added value to learning through spatial contextualization. In contrast to the Spatial Thinking (National Research Council, 2006) and Spatial Citizenship (Gryl & Jekel, 2012) approaches, the main aim is individual and collective knowledge generation and documentation (as well as spatial analysis

in a broader sense), rather than public communication and convincing others. However, Spatially Enabled Learning is a valuable basis for understanding problems through adding a spatial context, and it provides a starting point for acting as a Spatial Citizen: competences developed as Spatially Enabled Learners are fruitful for societal participation as well.

The approach uses two main theoretical references: 1) relational spaces and a supportive spatial contextualization, and 2) dual coding.

1) Spatially Enabled Learning is based clearly on the idea of the attachment of meaning to mainly physical matter by communication through spatial representations. The meanings represented by learning content can be georeferenced in a variety of ways. Currently, this approach refers to representations of geographical spaces (for instance, a map of places that shows indicators/results of climate change, or fictional events in novels taking place in actual cities), but additionally, all representations that use spatial relations, including fictional landscapes (e.g. the map in *The Lord of the Rings*), are useable. The main aspect is that meaning/content and therefore spaces are regarded as socially constructed. The 'appropriation of the world' is mediated through these social constructions and the power to make them collectively viable.

   In addition, the combination of information with location – a spatial contextualization – supports learning as well as methods in memory training (Krämer & Walter, 2006). Map information supports the understanding of complex, non-linear relations (Wood, 1993). Furthermore, current spatial representations on the web combine the duality of the individual and the social construction of meaning.

2) Maps address the dual coding functionality (Paivio, 1990) through a combination of pictorial elements (maps as picture) and symbolic ones (maps as text) that target different modes of information processing in the learners' reception, as described in mapping theory (Wood, 1993). The use of two channels at the same time is the added value for memory and learning that pedagogical psychology notices when text and pictures are combined (multimedia principle; see e.g.Schnotz, 1995; Weidenmann, 2006). On the web, mashups lead to the combination of several sources of information and modes of representation, so that dual coding functionalities are nowadays transformed into multi-coding. We combine the power of visualization when communicating geographic information as described by Enemark and Rajabifard (2011) with Dual Coding Theory (Paivio, 1990), considering the link between analogue codes (here: learning contents) and symbolic codes (here: spatial representations) to generate a positive effect on the memory and understanding of complex information.

Combining these two underlying concepts, one could say that these effects are not new and are already well known in education: we already frequently use spatial representations to support learning processes in education, even beyond geography (e.g. maps in history textbooks). As geovisualization and mapping modes changed as they became transferred into the digital sphere, completely new possibilities arose. This is in line with the above-mentioned paradigm shift in cartography in which digital maps increasingly serve as a platform and, consequently, location serves as an interface linking users and information. What turned out to be very successful in everyday life can now also be implemented in the

education domain by using location as an interface to link action and attention to learning content. The 'new' idea would be to implement this by using digital geomedia and web-mapping technologies. By analogy with the notion that Google Maps can be understood as Google on maps, for learning environments this could mean using a mapping platform to deliver learning materials according to their spatial context.

If this is done by using digital geomedia, at least two advantages can be expected. Firstly, the platform logic itself goes way beyond just representing and/or spatially visualizing learning content; it also serves as an interactive spatial interface and therefore delivers an additional context. Secondly, the user interface of digital geomedia – compared to traditional maps – has a very immediate design: information does not necessarily have to be coded and re-coded via signatures but can be delivered just by clicking/tapping on a location. This could minimize the so-called 'Split Attention Effect' (Mayer & Moreno, 1998) (an effect describing distraction from learning while being challenged cognitively by the design of the learning material[2]) and could therefore enhance the actual learning process.

Spatially Enabled Learning consequently also refers to an inclusive component: the code system for mapping that uses pictorial elements. Particularly in simple web mapping, a quite consistent and broadly used design supports communication beyond cultural, language and literacy barriers (Hall & Jones, 2012). 'Communicating via spatial representations may bridge learning contents beyond learners' verbal skills and (dis)advantages' (Vogler et al., 2012, p. 206). Therefore, Vogler et al. link this approach closely to social geocommunication, i.e. communication with the help of spatial representations that may be utilized for learning purposes, concerning both information and hypothesis construction for the individual learner, and the joint production of content for learning teams.

3 Spatially Enabled Learning – technologies and (non)available content

As outlined, using digital geomedia is the core of Spatially Enabled Learning. Therefore, technology is one of the key issues in this approach, and the first question to arise is the one of availability. While (professional) GIS systems and tools used to be barely available (and usable) in secondary education (see e.g. Höhnle, Schubert, & Uphues, 2013), this is no longer a problem. There is now a huge variety of freely available online tools and platforms suiting almost every user requirement, ranging from simple mapping tools to professional platforms like ArcGIS Online (see e.g. Vogler, 2015). ArcGIS Online is especially interesting in this framework because of education and school initiatives like 'connectED'[3] , or the 'GIS School Program Europe'[4] , which deliver tools, an online community and in-service training material.

[2] This is described as 'extraneous cognitive load' in 'Cognitive Load Theory' (see Sweller, 1994)
[3] https://www.esri.com/en-us/industries/education/schools/our-story
[4] https://www.esri.com/en-us/school-program-europe/overview

If we look at current debates in the pedagogies of a variety of subjects, we find a bewildering range of learning environments, initiatives and even rough concepts that use digital geomedia actively, and a host of others that could be considered spatially enhanced. There are geomedia-based environments for virtually all school subjects, not just Geography and environmental education. (See e.g. Leite, Dourado, Afonso, & Morgado (2017) for an overview; MaKinster, Trautmann, & Barnett, 2014; Muniz-Solari, Demirci, & van der Schee, 2015) Hosts of additional learning environments circulate in the field, produced or at least supported by industry initiatives, local, national and international teachers associations, projects and journals.

Things become a little less clear in other (non-geographic) secondary education subjects. However, initiatives are known from language studies (e.g. Straights, 2017); Mathematics (e.g. Trigonometry, vector analysis), Biology (ecosystems), Physics (waves) and History (e.g. Jekel, Lehner & Vogler, 2017; Schellenbacher, 2017). While there is some common ground in the use of spatial technologies (especially in the STEM subjects, where spatial thinking may be assumed to be an explicit or implicit element), a general concept and coherent structure are conspicuous by their absences.

What is currently available is (a) the theoretical background of the concept of Spatially Enabled Learning; (b) the technology to sustainably implement Spatially Enabled Learning environments in secondary education (e.g. ArcGIS Online), and (c) numerous concrete use cases that directly or indirectly enhance learning processes through the use of geomedia platforms. What is missing is a conceptual link between these three areas delivering guidelines on how to spatially enhance which types of learning contents, in order, among other things, to empower teachers to use Spatially Enabled Learning in their own teaching beyond just adapting use cases. To deliver this conceptual framework, it is necessary to develop a typology of learning contents regarding their (potential) spatial reference. What types of spatialities are involved, what content is to be contextualized, and how might this contextualization help both teachers and learners? These questions will be addressed in what follows.

4 Exploratory categorization of spatialities: examples from a German language class

The question of the different types of spatialities of learning contents across subjects in secondary education can only be answered empirically based on actual teaching practices. We therefore decided not to analyze different curricula or textbooks. This could deliver a wide range of learning goals and materials, but at the same time would lack authenticity: no curriculum or textbook can show what is actually being taught in school lessons. We thus focused on teachers themselves and interviewed them about their authentic real-world annual curriculum planning. This combination of analyzing the curriculum planning and simultaneously interviewing the teacher is important because of their professional background and judgement regarding the link between learning goals and identified spatialities.

This setting can be understood as a loose adaption of the Grounded Theory logic (Strauss & Corbin, 1990) for developing a theory (in this case: a typology of spatialities) based on qualitative data (in this case: the interview and the curriculum planning). Together with the teacher, we go through the planning step by step, ask what has actually been taught, and then try to identify and document potential spatial references in an open dialogue. This has to be understood as an iterative process. Types of spatialities identified in one topic serve as the basis for the next topic. Either the same type can be identified in the new context or, if not, a new type or sub-category has to be developed (see the following examples for details). In the next step, the types of spatial references identified are generalized and summed up. Using this approach, it is also possible to identify difficulties that teachers experience when 'spatializing' their curriculum.

This procedure was tested in a first prototype interview with a German language teacher, based on one annual curriculum planning schedule. [5] What we present below are the first results of this exploratory interview.

In Austria, the main categories for German language education according to the curriculum for High School education are literature education, text analysis and text production (BMfB, 2016). Within text production, there is a finer differentiation of up to nine categories (reduced to seven in new curricula). Only a few of these are relevant for the school year which we present below. We will illustrate the iterative process of identifying spatial references in two exemplary cases (literature analysis and text production) before presenting an overview of the (sub)categories identified in this exploratory micro-study.

Example 1 - Literature analysis: Georg Trakl, 'Grodek' (1914)

Just reading Georg Trakl's (1887–1914) poem might be a pleasure or lead to despair, but any real interpretation needs a spatio-temporal context. The references to World War I, and the tensions between the idyllic settings of rural landscapes and suffering only become clear in that context. The poem was one of the last that Trakl wrote, after the battle of Grodek in August and early September 1914.

A variety of spatio-temporal references are found in the poem. Firstly, there is the direct referencing of events and landscape(s), related to an actual place (= explicit spatial reference). Secondly, we have the wider context of the military events across Eastern Europe, for which a variety of map data exists – in addition, of course, verbal and pictorial data. The poem would not have come into existence had Georg Trakl's life not intersected spatio-temporally with the battle: he was a military pharmacist, working in actual places (= multiple explicit spatial references). The third spatial contextualization therefore leads to the places of Trakl's life, the social interactions and drug experiences the poet had, and his early death in late 1914, related to place/places of origin (= implicit spatial reference). There is no need for further detail to demonstrate the value of contextualizing the poem spatio-temporally: such contextualizing allows linking up history, literary education and geography content, a structure of learning that is not widely followed.

[5] School: Werkschulheim Felbertal, Austria, 8th form (age 17-18).

At evening the autumn woodlands ring
With deadly weapons. Over the golden plains
And lakes of blue, the sun
More darkly rolls. The night surrounds
Warriors dying and the wild lament
Of their fragmented mouths.
Yet silently there gather in the willow combe
Red clouds inhabited by an angry god,
Shed blood, and the chill of the moon.
All roads lead to black decay.
Under golden branching of the night and stars
A sister's shadow sways through the still grove
To greet the heroes' spirits, the bloodied heads.
And softly in the reeds Autumn's dark flutes resound.
O prouder mourning! - You brazen altars,
The spirit's hot flame is fed now by a tremendous pain:
The grandsons, unborn.

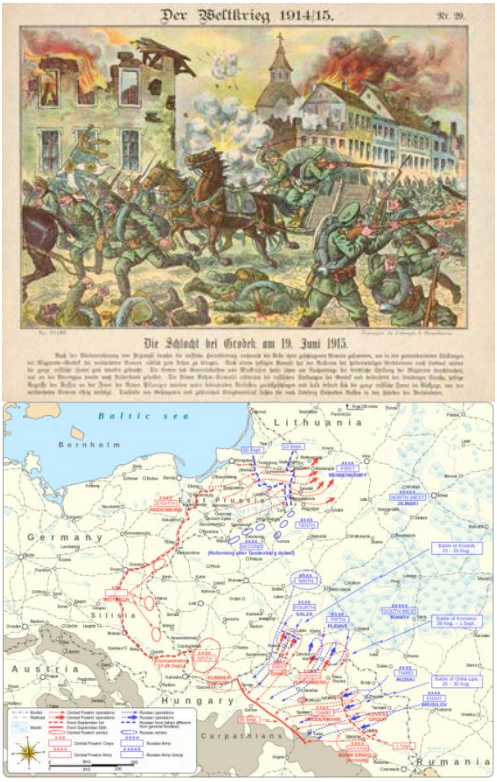

Figure 1: Trakl, 'Grodek' (1914) (free English translation found at: https://www.poemhunter.com/poem/grodek), Collage Grodek Google maps / Wikipedia
https://commons.wikimedia.org/wiki/File:01915_Die_Schlacht_bei_Grodek_am_19._Juni_1915.jpg
https://commons.wikimedia.org/wiki/File:MapOfWWIEasternFrontAutumn1914.svg

Example 2 - Text analysis and production

Text production is a little more complicated than providing the more or less explicit spatial referencing of a piece of literature. Three exemplary texts were looked at (see Table 1): a philosophical text on technology and ecology by Jonas (1979), which was used for journalistic text analysis; a text on optimism and pessimism in images of the future by 'trend scout' Matthias Horx (NN, 2011) to train in writing short essays; an editorial on the

automobile society (Rainer, 2012), published in a magazine, that was used as a basis for writing letters to the editor.

None of these texts included any explicit spatial references (except for one reference to China). However, in all texts it was very clear that examples of the phenomena described did of course have a spatial context. These exemplary spatial references could be derived from the texts by students working together with the teacher within a very short time span (10–15' each), but it has to be said that this required some help from spatially aware experts.

Exemplary spatial references, then, might include translating / transferring phenomena to specific places where they exist. They could point to rules and laws of specific administrative entities, places of origin of styles of writing, or of speech or dialects. These types of referencing therefore include the explicit and individualized writing of geographies of learning, and thus an active geography-making by learners. The contextualization here is not provided by the text, but by learners comparing content either with a spatialized pre-knowledge, or through search routines. The main question is, where would a particular phenomenon or practice referenced in a text exist, and does it exist elsewhere in a similar way? We consider this second perspective fruitful as well.

Table 1: Spatial references identified in text analysis and production

Type of text	**text analysis (journalistic)**	**comment**	**letters to the editor**
aims	steps of interpretation	comment on a scientific text	structure of argument
topic/ example	technology & ecology (Jonas, 1979)	images of the future: optimism and pessimism (NN, 2011)	the car and the end of the world (Rainer, 2012)
spatial details	biosphere regional examples global solidarity	spatial crisis: finance, environmental issues, spatial shifts in economy, demographic change, corruption, regional prosperity, urbanization	public space; energy consumption, sustainability, climate change; noise; regional job markets; commerce
type of spatial reference	can be spatially illustrated with an example (= exemplary spatial reference)	can be spatially illustrated with an example (= exemplary spatial reference)	can be spatially illustrated with an example (= exemplary spatial reference)

Overview of types of spatialities identified

Following the same associative procedure as the one illustrated in Sections 'Example 1 - Literature analysis' and 'Example 2 - Text analysis and production ' above, the complete annual curriculum planning schedule was interpreted together with the teacher. As mentioned, this happened iteratively. When for example one topic showed a link to an actual

place (like Trakl's 'Grodek'), this type (=explicit spatial reference) served as the basis for the interpretive association of the next topic: either the same type of spatial reference can be found again, or a new type has to be defined (e.g. implicit spatial reference). A third possibility is that an already defined type is found but has to be defined further by a sub-category – for example, when a topic is related to not just one, but to multiple actual places (=explicit (multiple) spatial reference).[6]

At the end of this exploratory process, the following 4 types of spatialities had been identified in this one annual curriculum planning schedule of one German language class: 1) single explicit spatial references, 2) multiple explicit spatial references, 3) implicit spatial references, and 4) exemplary spatial reference. Table 2 shows a detailed overview, with an example of each.

Table 2: Suggestions for types of spatial references identified in one annual curriculum planning schedule of a German class (the categories marked * are considered fruitful for learning processes)

concrete type of spatial reference	**general type of spatial reference**	**description of spatial reference**	**example from curriculum planning schedule**
*single explicit spatial reference	explicit spatial reference	related to one actual place	Georg Trakl: 'Grodek' (expressionist poem)
*multiple explicit spatial references	explicit spatial reference	related to multiple actual places in Vienna	Arhur Schnitzler: 'Traumnovelle' (novel – 'Wiener Moderne')
explicit spatial reference; no relation to learning goal[7]	explicit spatial reference	related to actual places (e.g. company address)	text production: writing an application
*implicit spatial reference	implicit spatial reference	historic background, related to actual place	era 'Wiener Moderne' introduction
implicit spatial reference; no relation to learning goal[8]	implicit spatial reference	related to place of origin (but no relation to learning goals)	Alfred Lichtenstein: 'Punkt' (expressionist poem)
*exemplary spatial reference	exemplary spatial reference	can or could be related to an actual place	Georg Heym: 'Die Stadt' (expressionist poem)
(no spatial reference)[9]	/	/	/

[6] A fourth possibility is, of course, that a topic does not show any spatial references. However, this was not true for any topic interpreted in this case.

[7] The interpretation suggested the possibility of an explicit spatial reference (in this case the place of the company referred to in the text), but the teacher stated that there was no link to the learning goal (the writing process itself).

[8] The interpretation suggested the possibility of an implicit spatial reference (in this case the place of origin), but the teacher stated that there was no link to the learning goal (in this case the understanding of an abstract poem).

5 Conclusion and Outlook

To make this point quite clear: the exploratory categorization and the – by now – 4 identified types of possible spatial references of learning contents beyond geography education are not final results, but rather a starting point for future research. What has been presented so far is (a) a manageable toolset to identify different types of spatialities in an open, informal interview setting, and (b) an initial sketch of a category system defining different qualities of spatial references.

In the future the database should be expanded with further interviews using the approach presented here. These interviews should cover different subjects and different age groups in order to obtain a more holistic picture, beyond the exploratory approach presented here. The types of spatialities identified here are expected to be confirmed in other subjects, and new categories and sub-categories are also expected to be found. Once this categorization is saturated (i.e. now new types can be identified in additional interviews), the typology of spatialities in secondary education contents can be finalized.

This final typology will serve as a basis to develop guidelines addressing which kinds of geomedia use can be used to support which kinds of spatiality. If Spatially Enabled Learning is to succeed, we need to develop a strategy that moves away from many different learning environments based on a wide variety of technical solutions with their known constraints. These suit a rather small percentage of very competent technophile teachers but fail to reach and support interested teachers from many other subjects and backgrounds. It is such interested teachers especially who are the core target group of the Spatially Enabled Learning approach, which aims to empower teachers, across subjects, in their daily teaching, through the use of geomedia.

To make this vision attainable, over and above the future research we have just outlined, we propose the need for specific teacher education across subjects. As geography teachers and teacher trainers, we may be used to spatial contextualization. However, first qualitative interviews with teachers from other subjects show that there is little awareness regarding contextualization, and teachers need quite some help to find the spatial connotations that are actually present in their teaching materials.

[9] The analysis presented in this paper did not show any topic without any possible spatial reference. However, it is obvious that there are explicitly non-spatial topics in German language classes (e.g. grammar or sentence structure). Therefore, this category is still listed here.

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