"Ma sõidan bussiga Tartust Pärnusse" – The Acquisition of Interdisciplinary Space-Related Knowledge through Multimedia Cartography

Dennis Edler[1], Nils Lammert-Siepmann[2], [1-2]*Ruhr-University Bochum*

***Abstract* – Whenever speakers of the Estonian language express motion events from one place to another, they change the geographic names according to specifically categorised rules of grammar. This fact, which can be confusing for Estonian language learners at the beginning, furthermore bears a high potential for the use of products of geographic visualisation. Therefore, an example of multimedia cartography used to teach linguistic features of Estonian combined with topographical facts about Estonia has been developed in the Geography Department at the Ruhr-University, Germany.**

***Keywords* – acoustic dimension, cartographic communication, Estonian language learning, multimedia cartography**

I. Introduction

Whenever a speaker of the Estonian language says "Ma sõidan bussiga Tartust Pärnusse" he or she is either in the process of travelling by bus from Estonia's higher education capital Tartu to Estonia's summer capital Pärnu or planning to do so in the near future time. If an Estonian-speaking person, though, is sitting in an Irish pub while having a drink and talking about his plans of taking an airplane from Ireland back home to Tallinn, he or she might probably tell, Seanie, Micky, Teddy or Old Paddy "Ma sõidan lennukiga Iirimaalt Tallinna". After another two or three pints of stout – depending on the daily condition – an Estonian might tell them "Ma lendan kosmoselaevega Marssile", a statement which can be translated with "I am flying by spaceship to Mars".

Even though it is slightly doubtful that the Irish 'lads' are able to understand the messages in Estonian, the examples should have shown that the Estonian language is made up of different ways of grammatically treating geographic names whenever motion events are expressed. In other words and linguistically speaking, the study and applied practice of the singular forms of Estonian's "inner locative cases" Illative, Inessive and Elative as well as its "outer locative cases" Allative, Adessive and Ablative [1], may include some difficulties [2]. Native speakers of, for instance, the Germanic languages such as English, German, Dutch, Swedish, Danish, Norwegian and Icelandic might wonder about the fact that, in the Estonian language, the geographic names are supposed to be combined with different suffixes which, however, indicate the same semantic role [3].

The study and applied practice of the inner and outer locative cases are known as significant introductory aspects of grammar learning in Estonian language courses for foreigners. In the fifth chapter of the internationally known Estonian textbook *E nagu Eesti* [4], which is designed for Russian, English, German and Finnish native speakers, students are invited to learn the names of Estonia's major cities in connection to the correct application of the inner and outer locative cases. Although, here, students are only provided with a relatively poor map-like black and white sketch of Estonia, in addition to few written grammatical information, the authors follow the principle of integrating geographical aspects into the curriculum. The importance of involving geographical and cultural topics in foreign language classes is not only mentioned by researchers [5] [6] [7] [8] but also a common practice in the creation of modern language textbooks [9] [10] [11] [12] [13] [14]. Furthermore, topophilia, the human love towards places, [15] [16] also justifies a merging of language and applied geography [17].

Geomatics, as a young academic field covering geodesy, cartography and geoinformatics [18] [19] as well as remote sensing and photogrammetry, yields different types of media of visualised geospatial information representing the spatial reality to humans, such as analogue as well as digital cartographic representations, satellite imagery and digital 3D-models. These products are up-to-date and interesting sources for the education sector [17] [20] [21].

Modern language teaching on a beginner's level refers, amongst other things, to the study of so-called linguistic features. These features are grammar, pronunciation, intonation, vocabulary and orthography [22] [23] [24] [25]. Whereas learning with exercises from analogue textbooks is principally focused on linguistic features that can be visually represented, such as grammar, vocabulary and orthography, products of multimedia learning also allow the inclusion of the rather acoustically based features pronunciation and intonation.

In order to show both the high potential of polysensory language learning through cartographic applications and the technical opportunities of developing animated cartographic screen products, an interactive multimedia cartographic tutorial has been created by the Geomatics/Remote Sensing Group at the Ruhr-University Bochum, Germany. This electronic product of multimedia cartography is based on the multimedia authoring program Adobe® Flash® CS4 including the use of its object-oriented script language called *ActionScript*. Here, Pesti and Ahi's didactical approach of introducing the students to the rules of the inner and outer locative cases in combination with geographic names is further developed. Both the visual and the – in many cases still underestimated – acoustic dimension play an important role to communicate geographical facts and, especially, space-related linguistic knowledge. Here, the acoustic dimension comprises Estonian native speaker recordings, which were mainly recorded during "Urban Outcast", the 2010 international summer school at Riga Technical University (RTU).

Using a selection of references from various academic disciplines, this paper addresses three main objectives. It (i) outlines the didactical concept of the multimedia cartographic application. Based upon new findings in multimedia learning, it should be highlighted how the chosen linguistic example of the Estonian locatives could be studied through multimedia cartographic (e-)learning material. This example of combining linguistic and geographic information – especially relying on the additional use of sound – should indicate the potential of multimedia cartographic models for education in various subjects and disciplines.

After displaying the didactical peculiarities, this paper (ii) furthermore presents the application's cartographic communication system which relies on intertwined polysensory features – visual / graphic and acoustic / auditory variables, in this article signs and signals are also named. Here, the functionalities and correlations of the visual and acoustic dimensions are highlighted. The aim is to indicate that the opportunity to include the acoustic dimension into multimedia cartographic representations bears a high potential to allow the user an easier cognitive "acquisition of space-related knowledge" [26]. Whereas research in theoretical cartography and, especially, cartosemiotics seems to be almost exclusively focused on the visual dimension – even after the beginning of "the phase of interdisciplinary and global interaction" in 1990 [27] – this article should, at least, hint at the opportunities of the acoustic dimension to be integrated into research in cartographic theory and its practical application.

Whereas the first two objectives are related to the educational and communicative concepts of application, another aim of this article is (iii) to give an impression of the technical opportunities of Adobe® Flash®, in particular, for the creation of multimedia cartographic products. Within this brief description of a part of the application's technical methodology, the functional interaction of the extension language ActionScript and files of the widely spread Extensible Markup Language (XML) are highlighted. The reader should realise that the creation of multimedia (cartographic) teaching material is not to be confined to a community of programming experts.

Prior to the reading of the remaining chapters, the authors recommend the readers to explore the application, which is available here:
http://homepage.rub.de/dennis.edler/geomatika.html

II. The Four Didactical Stages

According to the *Modality Principle* of multimedia learning, it is recommendable to combine pictoral information with spoken text to allow the learner an easier cognitive acquisition – so called *Modality off-loading*. Displaying textual signs simultaneously with other signs of the visual channel may lead to an overload of what requires to be visually taken up by the learner [28] [29] [30] [31] [32] [33].

In other words, researchers propose to "move sound around the user" [34] in order "to offload some of the work from our eyes to our ears" [35]. The reduction of the written text on the screen, furthermore, makes a product of visualisation by far more attractive [36]. Based upon these findings, the learning process in the multimedia cartographic representation of Estonia(n) is made up of four didactical stages in which different information is gradually communicated to the learner. Moreover, the information is not only communicated in four serial stages but also in two different sensory levels, the acoustic dimension and the visual dimension (table 1).

After beginning the tutorial, the user is confronted with the setting illustrated in Figure 1. In order to get the instructions on how to deal with the application, the user is supposed to click on the Intro-button in the upper left corner. Having done this, the instructions are given by an invisible "virtual pedagogical agent [37] [38] [39] [40], an artificially established tutor that communicates with the user through the auditory channel. Here, it should be stressed that the information given through the acoustic agent is focused on the preparation of the user. The acoustic layer, in this case, is not used to acoustically provide the user with any kind of space-related knowledge. This virtual guide is, furthermore, implemented to carry forward the didactical approach of motivating the learner. The enthusiastical intonation of the instructions, as a feature of the audio animation, should arouse the learner's attention [41] and can be reached by only a few implemented acoustic gestures [42]. This audio instruction is given in English, the contemporary lingua franca of international business, science and technology. Since the communication process of sending messages from a sender to a receiver through the auditory channel relies on the "segmentation problem" of combining single phonemes to units [43], both the choice of words and the intonation of the agent require being well-conceived [42]. Apart from the characteristics of the message, it is also recommended to consider the characteristics of the delivery, the listener and the environment [44].

TABLE I

THE DIDACTICAL CONCEPT OF THE MULTIMEDIA APPLICATION

No	name	learner's action	communication	overall teaching aim
1	*pre-stage*	active listening to instructions of pedagogical agent	auditory (English)	**A) Linguistic Features** **1. Grammar** Elative, Illative, Ablative, Allative, Comitative **2. Pronunciation** esp. declension of place names, means of transports **3. Intonation** of statements describing the fictional journey **4. Vocabulary** city names, county names, means of transport **5. Orthography** city names, county names **B) (Applied) Geographical Skills** **1. Estonia's Geospatial relations** Distances within the country, relation of number of inhabitants **C) Cartographical Competence** **1. Map Reading skills** learning to decode auditory and visual signs, to extract / to filter information
2	*orientation stage*	map reading	visual	
3	*testing stage*	a) setting parameters of journey b) activating play button c1) active listening to / processing native speaker recording while c2) watching / processing journey animation with pictogram	visual visual auditory (Estonian) visual	
4	*repetitive application stage*	repeating "action" of testing stage with different parameters	auditory (Estonian) & visual	

Fig. 1. The setting after starting the application

After this *pre-stage*, the second stage (*orientation stage*) is made up of the user's detailed map reading. In other words, the user is asked to decode the system of graphic signs with the aim of becoming aware of the geo-spatial relations and distances between the represented Estonian cities. In addition to the process of gaining topographic information, he or she should especially extract the information represented by the circular symbols having different sizes and colours. The digital map key, which can be activated and deactivated by clicking the button in the bottom left-hand corner of the map surface (figure 1), should be a good help to understand what kind of object categories of the spatial and linguistic reality are represented by the two different graphic variables. Whereas the locations of the circular symbols on the map surface represent real topographic information – in this case the locations and spatial relations of some Estonian cities – the colours of the symbols represent a specific category of grammatical cases of the Estonian language that are applied to the geographic names of these locations. The red colour signifies the respective geographic names blending in with the *Elative* (-st) and the *Illative* (-sse) whereas the green colour indicates a change of the name adding the suffixes of the *Ablative* (-lt) and *Allative* (-le). The complementary contrast of the colours red and green emphasises the morphological and grammatical discrepancy. The two cities Tallinn (from Tallinn: *Tallinnast*; to Tallinn: *Tallinna*) and Narva (from Narva: *Narvast*; to Narva: *Narva*) are classified as *irregular* to the other categories and their representative symbols are accompanied by a white symbol colour. While the colour indicates grammatical phenomena, the size of symbol, as another element of the six graphical variables [45], refers to a (human) geographical fact, which is the approximate number of inhabitants. The general question whether these examples of abstract map symbology [46] are associative and fitting solutions to represent grammatical facts and topographic as well as demographic information at the same time should not be discussed in the present article. This question is, however, an interesting topic for future research on cartosemiotics.

After the user has thoroughly studied the map through visual information, the third stage (*testing stage*) particularly involves the processing of auditory information underlined by graphic animation. The learner uses the three graphical user interface widgets, to the left of the map surface, to define the following features for a fictional journey through Estonia: 1. starting place, 2. transport vehicle, 3. destination – from the top to the bottom (figure 1). After clicking the play button, native speaker recordings are played according to the chosen parameters in the combo boxes. While carefully listening to the native speaker recordings of the sentences that were chosen by user interaction, the user is supposed to process the pronunciation – and also intonation – of complete sentences in which the locatives are correctly applied. In other words, the user is primarily confronted with an approach to contextualised grammar learning through the auditory channel. The study of the linguistic features pronunciation and intonation, which also serve as auditory 'tools' used to put across the grammatical knowledge, as well as vocabulary and orthography are subordinate. In the example of figure 2, the user can listen to the following sentence: *Ma sõitsin rongiga Tartust Tallinna* (engl. *I went by train from Tartu to Tallinn*). In addition to the pronunciation, a pictogram of the selected vehicle is automatically moved from the starting to the finishing place of the journey (figure 2); the speed of the movement relies on their distance.

The fourth and final stage of the learning process is the *repetitive application stage*. The user is asked to repeat the process of the third stage as well as to apply it to all cities and grammatical classes respectively. The focus of this stage is the achievement of, especially, the primary and secondary teaching aim, regarding the linguistic features.

Finally, it should also be mentioned that the user should realise the different, conjugated verbs used in the spoken sentences. The application is not focused on verbs. However, interested students will notice the difference and look them up. The different verb forms used are "sõidan" (engl. I go / am going / will go), "sõitsin" (engl. I went / was going) and "lendan" (engl. I fly / am flying / will fly).

III. The Correlations of the Visual and Acoustic Dimensions in the Four Didactical Stages

While the preceding chapter is focused on the learner and, in general, on the didactical concept behind the tutorial, this chapter highlights the communication process. Here, the functionalities and correlations of the visual and acoustic dimensions are displayed. In the course of this, the potential of incorporating aspects of the acoustic dimension into multimedia cartographic applications is indicated.

During the pre-stage, in which the learner is asked to listen to explanations how the tutorial works, the communication – apart from visually identifying the button used to activate the audio instructions – is only based on the user's decoding of audio signals. The audio signals used here make up a first audio unit or rather audio message that works as an impulse to enable and to guide the user's proper decoding of the systems of the graphic signs and audio signals in the upcoming stages. As mentioned above, the intonation of the instructions also has a motivating function.

In contrast to the pre-stage, the orientation stage is characterised by the user's extracting of topographic information as well as his or her proper understanding of the grammatical and demographic information represented by the circular symbols. These steps of map reading solely rely on communication through the visual channel. Having activated the map key, the constellation of the visual sign system on the screen is static and not influenced by any further animated features. Although this stage has the function to give an impulse for activating the auditory messages in the next stage, it is comparable to the reading of a printed thematic map.

Whereas the human's visual perception of the environment requires active and target-oriented focussing, the conscious as well as unconscious processing of auditory signals through the sense of hearing is, effectively, omnipresent. Due to this understanding, which bears a high potential for future cartographic and cartosemiotic research, spatial perception is acoustically dominated [42] [47] [48].

Fig. 2: Sõitma rongiga Tartust Tallinna – Going by train from Tartu to Tallinn

In terms of the functionalities and, especially, correlations of the visual and auditory level in the single didactical stages of the tutorial, the testing stage is more complex than the two preceding ones. Since, at this stage, the user is invited to choose one of the 150 combinations by defining the three aforementioned parameters, he or she has a direct impact on the constellation of the adaptive system of signs and signals that make up the process of audio-visual knowledge transfer. Depending on the user's interest and his or her corresponding interaction, different auditory messages can be activated. These units of signals have the function to put across linguistic knowledge of Estonian grammar, pronunciation and intonation. The knowledge of the other linguistic features, vocabulary and orthography, is contained in graphic or rather textual signs on the map surface and within the combo boxes in the map margin. Furthermore, the auditory messages are backed up by redundant visual animations with the aim of relieving the cognitive learning process.

It is not only common sense but also "a long history of research on verbal learning" that agrees on the fact that presenting the same material twice ensures a higher learning success than just presenting it in one way [33]. Whenever a fictional journey is configurated and activated in the multimedia cartographic model of Estonia(n), the cognitive input for the user takes place in a specific time sequence in which the systems of numerable, geometrically-related graphic signs and unlasting auditory signals are constantly and dynamically changing. Here, the "temporal animations" [49] are used to visually display the motion event that is simultaneously transferred acoustically, which promotes the learning success [31] [50] [51] [52]. It should be stressed that in this example of a multimedia cartographic representation, the acoustic dimension plays a superordinated role to transfer space-related – especially linguistic – knowledge.

According to the fact that the final repetitive application stage features the didactical role of being the iterative application of the testing stage to deepen the learner's knowledge about the spatio-linguistic objectives, the communicative situation does not arouse new topics to be analysed here.

IV. The Technical Structure of the Application

As already mentioned in the introductory chapter, this application has been created with Adobe® Flash® CS4. While this software offers a diversity of desktop-based tools, the opportunities of its script language ActionScript offer various options to animate (cartographic) screen products [53]. Since the multimedia platform supports bidirectional streaming of video and audio, mapmakers have many options to animate their maps visually and, at the same time, acoustically. In order to create a result that can be easily extended, the ActionScript programming code is linked to a file of the Extensible Markup Language (XML). XML is a textual data format and is widely used whenever arbitrary data structures, such as web services, are represented. In this example, nine different parameters are defined for each visual representation of an Estonian city. The first five paramenters belong to the representation of the labelling of each city whereas the last four parameters make up systematic characteristics of the circular symbols representing the chosen Estonian cities. The single parameters are explained with a reference to the following extract from the used XML-file:

```
<?xml version="1.0"?>
  <CITIES>
    <CITY INTERN="parnu">
    <LABEL>Pärnu</LABEL>
    <COORDINATELABELX>363.9</COORDINATELABELX>
    <COORDINATELABELY>391.9</COORDINATELABELY>
    <TEXTSIZE>13</TEXTSIZE>
    <WEIGHT></WEIGHT>

    <POPULATION>43528</POPULATION>
    <GRAMMARTYPE>Illative</GRAMMARTYPE>
    <COORDINATESYMBOLX>416.2</COORDINATESYMBOLX >
    <COORDINATESYMBOLY >410.75</COORDINATESYMBOLY >

    </CITY>
    <CITY INTERN="viljandi">
    [...]
    </CITY>
  </CITIES>
```

The first thing which is defined using *XML* is the name of a label of a certain point of interest. If the name – in this case Pärnu – is changed and saved, this change automatically appears in the application when it has been restarted. Secondly and thirdly, the cartographer sets the x- and y-coordinates of the label. These coordinates do not have any kind of reference to a common map projection. Their values are related to the *Adobe Flash*'s graphical *stage*, whose area is made up the horizontal and vertical expansion of the pre-defined number of pixels. Another parameter which belongs to the label is the size of the font in the unit points. If the font weight is defined as "true", the respective city is labelled in bold letters. The other option – like in this example – is a representation in normal weight.

As mentioned above, the other four parameters refer to the representation of the cities by specific circular symbols. Here, the two graphic variables size and colour as well as position of the symbols on the map surface are defined. The number of inhabitants is integrated into a specific mathematical formula which is further calculated by *ActionScript*. In this way, the radiance can be automatically and proportionally configurated. The variable grammartype specifies the colour of the symbols. "Illative" ensures a red colour and "Allative" a green one. Whenever "Shortillative" is typed in, the outcome is a white symbol colour. The allocation of the right colour is performed in *ActionScript* by an *if*-statement, a conditional (programming) construct, and not in the *XML*-file itself. Comparable to the positioning of the label, the location of the respective symbol can be arranged by defining the x- and y-coordinates.

In Flash-based multimedia cartography, *XML* can be used to establish a set of standards which are applied to specific objects in the cartographic representation. Furthermore, the integration of *XML*-files into the *ActionScript* code allows an easier handling when Flash-applications are extended. To give a very simple example, the integration of the fictional town "Geomatika", situated on Estonia's largest island Saaremaa, can be done by simply adding the following code sample into the existing *XML*-document. After saving the file and restarting the application, the town automatically appears on the map and can be selected using the combo boxes (Figure 3).

```
<CITY INTERN="geomatika">
<LABEL>Geomatika</LABEL>
< COORDINATELABELX >206.0</ COORDINATELABELX >
< COORDINATELABELY >389.0</ COORDINATELABELY >
<TEXTSIZE>10</TEXTSIZE>
<WEIGHT>true</WEIGHT>

<POPULATION>25000</POPULATION>
<GRAMMARTYPE>Allative</GRAMMARTYPE>
<COORDINATESYMBOLX>200.0</COORDINATESYMBOLX>
<COORDINATESYMBOLY>389.0</COORDINATESYMBOLY>

</CITY>
```

Adding another feature using *XML* is nothing but a matter of a few minutes. Having programmed the framework once, people without any knowledge about programming, can be easily trained to enlarge the number of cities in the application. The steadily changing numbers of inhabitants can also be regularly updated in an understandable and straightforward way.

Another feature of the application which is automatically adjusted by the programming code used in *XML* and *ActionScript* is the version of the signatures representing a fictional car, bus, train, airplane or – to bare with the inebriated Estonian pub mate from the introduction – a spaceship. Depending on the mathematical relation of the x-coordinates between starting place and destination the signature is turned with the front either to the left or right. In any case, the front of the represented mean of transport is always directed towards the finish of the fictional journey. New data of sound recordings can be added by simply copying them into the respective folder on the server; new signatures representing additional vehicles of transport require being implemented into the *Adobe® Flash®* data library.

Fig.3: The setting after adding "Geomatika" via *XML*

V. Multimedia Cartography: A Space-Related Tool for Interdisciplinary Applications

Three particular aspects should be indicated in the presentation of the 'grammappical' application of Estonia(n).

The first significant point is that the use of cartographic products in an educational context is not solely restricted to subjects in which teachers deal with geographical facts, such as geography, history and – sometimes – religion, social science and biology. The technical opportunity to implement sound into multimedia cartographic models yields a high potential to bring in additional information from various, at first sight, non-geographical disciplines. "Our sense of hearing, which has […] been unappreciated as a means of representing data, can be used to expand the representational repertoire of cartographic design. At the same time, it is important to realize that the ideas and phenomena geographers wish to represent not always may be best represented by static, two-dimensional visual displays"[54]. This quotation derives from a pioneering article in theoretical cartography, in which the author highlights the importance of paying attention to sound and sonification in representing the objects of the complex reality we permanently experience. By now, just a few scientific approaches were made by cartographic researchers to categorise the conceivable applications of the acoustic dimension in theoretical cartography. Therefore, it is not surprising that in the latest research agenda of the *International Cartographic Association* (ICA), more research on the acoustic dimension in cartography is claimed [55] [56]. In response, a catalogue of potential research questions was already published in *meta-carto-semiotics*, the *Journal for Theoretical Cartography* [17]. To give a selection of scientists that have already published their approaches to categorise the use of sound in cartographic theory, the names Krygier [54], Bidoshi [57], Scharlach [58], and Théberge [59] should be mentioned. In addition to the, by now, published approaches, sound can also act as a thematic layer that incorporates knowledge of a discipline which, at first sight, is not related to the representation of (geo)spatial data and information. The example of combining linguistic features originating in (foreign) language teaching with topographic information of the country in which the language is spoken just opens one of many gates leading to a new way of interdisciplinary educational applications for products of multimedia cartography.

In order to audio-visually transfer interdisciplinary space-related knowledge to the user, findings in multimedia learning, as an interdisciplinary discipline of both educational and communication sciences, play an important role in the planning, creation and implementation of educational multimedia applications. The principle to combine visual and auditory information to allow the user a processing of a 'digestible' amount of knowledge input is a vastly important aspect that must be taken into consideration when new applications are invented. Furthermore, from this aspect it follows that the integration of the acoustic dimension should become a standard feature for the creation of digital cartographic – and also non-cartographic – teaching material.

The third main aspect which is indicated in this paper is the point that the creation of multimedia (cartographic) applications is not only a matter of a limited community of digital natives and 'programming freaks' but is open to everyone interested . The opportunities of *Adobe® Flash®* allow the establishment of a framework for the handling of the application's content. New features of a cartographic model can be easily added by modifying an *XML*-document which is accessed by programming code written in *ActionScript*. In other words, having once established a basic framework using *ActionScript* and *XML*, a (cartographic) Flash-application can be managed by changing the *XML*-file, a so-called "information container" [60] whose structure supports usability, simplicity and generality.

ACKNOWLEDGEMENTS

The authors are grateful to Ms. Triin Orav, *Eesti Maaülikool* (*The Estonian University of Applied Life Sciences*), and Ms. Sirle Kruse, *Ruhr-University Bochum (Germany)*, for their Estonian native speaker recordings. Their volunteering should be regarded as an honourable piece of work that helps students interested in the Estonian language to make a progress in their studies.

REFERENCES

1. **Tuldava, J.** *Estonian Textbook. Grammar. Exercises, Conversation*, Bloomington: Indiana University Press, 1994, 379 p.
2. The Encoding of Motion Events in Estonian. Pajusalu, R., Kahusk, N., Orav H., Veismann, A., Vider, K., Õim, H. *In:* Dimitrova-Vulchanova, M., van der Zee, E. (eds.): *Motion Encoding in Language and Space, Explorations in Language and Space*, Oxford: OUP, 2008, p.1-30.
3. **Beavers, J., Levin, B., Tham, S. W.** A Morphosyntactic Basis for Variation in the Encoding of Motion Events. *Journal of Linguistics*, 2010, vol. *46*, p. 331-377.
4. **Pesti, M., Ahi, H.** *E nagu Eesti. Eesti keele õpik algajaile*. Tallinn: Tea, 2002, 267 p.
5. **Celce-Murcia, M.** Rethinking the Role of Communicative Competence in Language Teaching. *In:* Soler, E.A., Jordà, M. P .S. (eds.): *Intercultural Language Use and Learning*, New York: Springer, 2007, p. 41-58.
6. **Erdmenger, M.** *Landeskunde im Fremdsprachenunterricht*. Ismaning: Hueber, 1996. 146 p.
7. **Maijala, M.** Integration und Vermittlung landeskundlicher Inhalte im Fremdsprachenunterricht. PhD-Thesis. Turku: University of Turku, 2010, 113 p.
8. **Simon-Pelanda, H.** Landeskundlicher Ansatz. *In:* Helbig, G., Götze, L., Henrici, G., Krumm, H.-J. (eds.): *Deutsch als Fremdsprache. Ein internationales Handbuch*, Berlin, New York: Gruyter, 2001, p.41-55.
9. **Forssman, B.** *Labdien! Lettisch für Deutschsprachige – Teil 1*. Bremen: Hempen, 2008. 406 p.
10. **Manne, G., Nilsen, G.** *Ny i Norge. Tekstbok.* Bergen: Fag og Kultur, 2008, 248 p.
11. **Marin, T., Magnelli, S.** *Progetto Italiano. Corso multimediale di lingua e civiltà italiana. Libro dello studente*. Florence: Edilingua, 2008, 198 p.
12. **Ní Ghallchobhair, É.** *Enjoy Irish. A Foundation Course in the Irish Language*. Oideas Geal: Gleann Cholm Cille, 2009, 112 p.
13. **Paulsson, M.** *Välkomna!. Schwedisch. Lehrbuch mit 2 Audio-CDs.* Stuttgart: Klett, 2008, 144 p.
14. **Scherrer, P., Lindemalm, K.** *Rivstart A1 + A2. Textbok*. Stockholm: Natur & Kultur, 2007, 372 p.
15. **Bachelard, G.** *La poétique de l'espace*, Paris: Presses Universitaires de France, 1957. 224 p.
16. **Tuan, Y.-F.** Place: An Experimental Perspective. *The Geographical Review*, 1975, vol. 65, p.151-165.
17. **Edler, D., Lammert-Siepmann, N.** Approaching the Acoustic Dimension in Cartographic Theory and Practice: An Example of Mapping Estonia(n). *meta-carto-semiotics – Journal for Theoretical Cartography*, 2010, vol. 3, Nr 1, p. 1-15.
18. *Ģeomātikas terminu skaidrojošā vārdnīca*. Štrauhmanis J., Auziņš A., Štūrmanis E., Vanags V., Rīga: RTU Izdevniecība, 2009, 128 p.
19. **Štrauhmanis J.** Ģeomātikas terminoloģijas attīstība Latvijā. *Scientific Journal of RTU. 11. series., Ģeomātika*., 2009, vol. 6, p. 80-85.
20. **Edler, D.** 'Native' Sound Maps, 3D-Modelling and Remote Sensing in an Interactive Tutorial for Teaching Modern Irish as a Foreign Language. *In: Proceedings of the 2010 RSPSoc Annual Conference with Irish Earth Observation Symposium*, Cork, Ireland, 2010.
21. **Edler, D., Dodt, J.** Eine audio-visuelle Flash-Applikation als Lehrmittel zur Fremdsprachenvermittlung. *Kartographische Nachrichten,* 2010, vol. 60, Nr 5, p. 276-278.
22. **Neuner, G.** Zur Rolle des Englischen in einem europäischen Kontext von Mehrsprachigkeit. *In:* Duxa, S., Hu, A., Schmenk, B. (eds.): *Grenzen überschreiten. Menschen, Sprachen, Kulturen. Festschrift für Inge Christine Schwerdtfeger zum 60. Geburtstag.* Tübingen: Narr, 2005, p.163-178.
23. **Köller, O.** Von Kompetenzbereichsmodellen zu Kompetenzstufen-modellen und ihrer Validierung – Herausforderungen im Spannungsfeld zwischen Fachdidaktiken und empirischer Bildungsforschung. *In:* Theuerkauf, W.; Meschenmoser, H.; Meier, B. and Zöllner, H. (eds.): *Qualität technischer Bildung. Kompetenzmodelle und Kompetenzdiagnostik*. Berlin: Machmit, 2009, p. 38-55.
24. **Köller, O.** Bildungsstandards. *In:* Tippelt, R. and Schmidt, B. (eds.): *Handbuch Bildungsforschung*. Wiesbaden: VS Verlag für Sozialwissenschaften, vol. 2, 2009, p..529-548.
25. **Schaffrath, C.** *Mündliche Prüfungen als Ersatz für eine schriftliche Klassenarbeit: Förderung der Mündlichkeit mit Hilfe einer neuen Prüfungsform*. München: Grin, 2009, 72 p.
26. **Wolodtschenko, A.** Cartography and Cartosemiotics: Interaction and Competition. In: *Proceedings of the 21st International Cartographic Conference (ICC) 'Cartographic Renaissance'*, Durban, South Africa, 2003.
27. **Freitag, U.** Von der Physiographik zur kartographischen Kommunikation – 100 Jahre wissenschaftliche Kartographie. *Kartographische Nachrichten*, 2008, vol. 58, Nr 2, p. 59-67.
28. **Brünken, R., Leutner, D.** Attention Splitting or Attention Focussing? Empirical Results Concerning the 'Split-Attention Hypothesis' in Learning with Multimedia. *In: Unterrichtswissenschaft*, 2001, vol. 29, p. 357-366.
29. **Penney, C.G.** Modality Effects and the Structure of Short-term Verbal Memory. *Memory & Cognition*, 1989, vol. 17, p.398-422.
30. **Moreno, R., Mayer, R. E.** Cognitive Principles of Multimedia Learning: The Role of Modality and Contiguity. *Journal of Educational Psychology*, 1999, vol. 91, p. 358-368.
31. **Mayer, R. E., Moreno, R.** Nine Ways to Reduce Cognitive Load in Multimedia Learning. *Educational Psychologist*, 2003, vol. 38, p.43-52.
32. **Mousavi, S., Low, R., Sweller, J.** Reducing Cognitive Load by Mixing Auditory and Visual Presentation Modes. *Journal of Educational Psychology*, 1995, vol. 87, p. .319-334.
33. **Mayer, R. E**. Multimedia Learning. 2nd ed., Cambridge: CUP, 2009, 318 p.
34. **Mitbø, T.** Perception of Time Variables on Dynamic Maps. In: *Proceedings of the 20th International Cartographic Conference*, Beijing:, China, 2001.
35. **Harrower, M.** The Cognitive Limits of Animated Maps. *Cartographica*, 2007, vol. 42, Nr 4, p. 269-277.
36. **Müller, J.-C., Scharlach, H.** Noise abatement planning: Using animated maps and sound to visualize traffic flows and noise pollution. *In: Proceedings of the 20th International Cartographic Conference*, Beijing, China, 2001.
37. **Kritzenberger, H.** *Multimediale und interaktive Lernräume*. München: Oldenbourg, 2004, 206 p.

38. Development of an Intelligent Tutorial System to Enhance Students' Mathematical Competence and Problem Solving. El-Khoury, S.;,Aïmeur, E., Richard, P. R., Fortuny, J.M. *In: Actes de la E-Learn 2005 World Conference of Association for the Advancement of Computing in Education*. Vancouver, Canada, 2005.
39. Système Tutoriel pour le Développement des Compétences lors de Problèmes de Preuve. Richard, P.R.; El-Khoury, S.; Fortuny, J.M., Aïmeur, E. *In: Actes de l'Espace Mathématique Francophone 2006*, Sherbrooke, Canada, 2006.
40. **Haake, M., Gulz, A.** Visual Stereotypes and Virtual Pedagogical Agents. *Educational Technology & Society*, 2008, vol. 11, Nr 4, p. 1-15.
41. **Dransch, D.** Designing Suitable Cartographic Multimedia Presentations. *In:* Cartwright, W.; Peterson, M.P., Gartner, G. (eds.): *Multimedia Cartography*, Berlin et al. : Springer, 2007, p. 75-87.
42. **Raffaseder, H.** *Audiodesign*. München: Hanser, 2010, 313 p.
43. **Goldstein, B.** Auditive Sprachwahrnehmung. *In:* Ritter, M. (ed.): *Wahrnehmungspsychologie*, Heidelberg, Berlin: Spektrum, 2002, p. 465-498.
44. **Wilson, J. J.** *How to Teach Listening*. Edinburgh: Pearson Longman, 2008, 192 p.
45. **Bollmann, J., Koch, W.** *Lexikon der Kartographie und Geomatik. A bis Karti*. Heidelberg: Spektrum, 2002. 453 p.
46. **Hüttermann, A.** *Kartenlesen – (k)eine Kunst. Einführung in die Didaktik der Schulkartographie*. München: Oldenbourg, 1998, 148 p.
47. **Ackerman, D.** Hearing. In: *A Natural History of the Senses*. Random House, New York, 1990, p. 173-226.
48. **Tuan, Y.-F.** Voices, Sounds and Heavenly Music. *In: Passing Strange and Wonderful: Aesthetics, Nature, and Culture*, Washington, D.C.: Island Press, 1993, p.70-95.
49. **Kraak, M.-J.** Cartography and the Use of Animation. *In:* Cartwright, W.; Peterson, M.P., Gartner, G. (eds.), *Multimedia Cartography*, Berlin et al. : Springer, vol. 2, 2007, p. 317-325.
50. **van Dijk, T., Kintsch, W.** *Strategies of Discourse Comprehension*. San Diego: Academic Press, 1983, 418 p.
51. **Baggett, P.** (1989): Understanding Visual and Verbal Messages. In: *Knowledge Acquisition from Text and Pictures*. Elsevier, Amsterdam, 1989, p. 101-124.
52. **Rey, G. D.** *E-Learning*. *Theorien, Gestaltungsempfehlungen und Forschung*. Bern: Huber, 2009, 240 p.
53. **Dickmann, F., Kollecker, C.** Möglichkeiten des barrierefreien Web-Kartenentwurfs mit dem Autorensystem Adobe Flash. In: Kartographische Nachrichten, 2011, vol. 61, Nr. 1, p. 25-32
54. **Krygier, J. B.** Sound and Geographic Visualization. *In:* MacEachren, A. M., Taylor, D. R. F. (eds.): *Visualization in Modern Cartography*. Oxford: Elsevier, 1994, p.149-166.
55. **Virrantaus, K.; Fairbairn, D., Kraak, J.-M.** ICA Research Agenda on Cartography and GI Science. *Cartography and Geographic Information Science*, 2009, vol. 36, Nr 2, p.209-222.
56. Die Forschungsagenda der Internationalen Kartographischen Vereinigung IKV. Derman, V., Ortag, F., Schmidt, M., Gartner, G. *In: Kartographische Nachrichten*, 2010, vol. 60, Nr 6, p. 334-343.
57. **Bidoshi, K., Ramirez, J.R., Caelli, T.** Multimedia Visualization for Maps of the Future. *In: Proceedings of the 19th International Cartographic Conference*, Ottawa, Canada, 1999.
58. **Scharlach, H.** Lärmkarten – kartographische Grundlagen und audiovisuelle Realisierung. Ph.D.-Thesis, Bochum: Ruhr-University Bochum, 2002, 151 p.
59. **Théberge, P.** Sound Maps: Music and Sound in Cybercartography. *In:* Taylor, D. R. F. (ed.): *Cybercartography: Theory and Practice*. Amsterdam: Elsevier, 2005, p. 389-410.
60. **Ray, E. T.** *Learning XML*. Sebastopol: O'Reilly, 2003, 350 p.

Dennis Edler, B.A.
Research Assistant
Ruhr-University Bochum (Germany), Geography Department
Geomatics / Remote Sensing Group
Universitätsstr. 150, D-44780 Bochum, Germany
Room: NA 7/134, Phone: +49 (0)234-24791
e-mail: dennis.edler@rub.de

Nils Lammert-Siepmann, B.Sc.
Research Assistant
Ruhr-University Bochum (Germany), Geography Department
Geomatics / Remote Sensing Group
Universitätsstr. 150, D-44780 Bochum, Germany
Room: NA 5/171, Phone: +49(0234)-23380
e-mail: nils.lammert-siepmann@rub.de

Dennis Edler, Nils Lammert-Siepmann. Starpdisciplināro ģeotelpisko zināšanu ieguve ar multimediju kartogrāfijas palīdzību
Šajā pētījumā pirmoreiz analizētas un izvērtētas teorētiskās kartogrāfijas jaunākās nozares – multimediju kartogrāfijas iespējas. Autori izmantojuši Igaunijā iegūtos materiālus un veikuši oriģinālu, pamatotu analīzi. Balstoties uz šiem atradumiem, izglītības process Igaunijas multimediju kartogrāfijas prezentācijā tiek veidots no četriem didaktiskiem posmiem. Tajos dažādu informāciju sadalīti novirza apmācamajam. Turklāt informāciju novirza ne tikai četros posmos, bet arī divos dažādos sensoru līmeņos akustiskā un vizuālā dimensijā. Kad vien igauņi ierosina notikumu pārcelšanu no vienas vietas uz citu, viņi maina ģeogrāfiskos nosaukumus atbilstoši savas gramatikas likumiem. Šis telpiski lingvistiskais fakts var apmulsināt igauņu valodas apguvējus sākotnējā periodā, turklāt satur lielu potenciālu ģeoattēlu lietošanai reālajā un virtuālajā valodu klasē. Tāpēc multimediju kartogrāfijas izmantošana igauņu valodas apmācībā Rūras universitātes (Vācija) Ģeogrāfijas nodaļā tiek kombinēta ar topogrāfiskiem faktiem par Igauniju. Šo valodas apmācību attīstīja ar iespējām autorizēt *Adobe®Flash®*. Šī oriģinālā valoda *Action Script* dod iespējas vieglāk aptvert tematiskos datus ar failiem *XML*. Ar atsaucēm uz atšķirīgām disciplīnām šajā rakstā sniegts didaktisko, komunikatīvo un tehnisko jēdzienu pielietojums. Īpaši uzsverot, ka multimediju kartogrāfijā parasti nepietiekami novērtē to, ka akustiskā dimensija var kalpot kā papildus slānis starpdisciplināro telpisko zinību pārnesei, turklāt *Action Script* lietotājs tiek iesaistīts viegli uztveramā *XML* failu izmantošanā. Šajā pētījumā izmantotās pieejas autori droši var ieteikt izmantot, tas paver jaunu virzienu tematiskās kartosemiotikas nozarē.

Денис Эдлер, Ныл Ламмерт–Сиепманн. Получение междисциплинарных геопространственных знаний посредством мультимедийной картографии
В данном исследовании впервые проведены анализ и оценка иозможностей новейшей отрасли теоретической картографии - мультимедийной картографии. Авторы использовали материалы, полученные в Эстонии и провели оригинальный обоснованный анализ. На основе данного исследования учебный процесс состоит из четырех дидактических ступеней., когда различную информацию раздельно направляют обучаемому. К тому же информацию направляют не только на четыре ступени, но и на два различных сенсорных уровня в акустической и визуальной димеснсиях. В случаях, когда эстонцы предлагают перенос событий с одного места на другое, они меняют географические названия по законам своей грамматики. Этот пространственно лингвистический факт может озадачить тех, кто начал учить эстонский язык. Причем, данный факт имеет большой потенциал при употреблении геоизображений в реальном и виртуальном языковом классе. Поэтому использование примеров мультимедийной картографии при обучении эстонскому языку на Географическом отделении Рурского университета (Германия) комбинируется с топографическими фактами об Эстонии. Данное обучение развивалось, используя возможности Adobe®Flash. Оригинальный язык Action Script содержит потенциал более легкого соединения тематических данных с файлами XML. Со ссылкой на различные дисциплины в данной статье описано приложение дидактических комуникационных и технических определений. Особо подчеркнуто, что в мультимедийной картографии обычно недооценивается то, что акустическая димеснсия может служить как дополнительный слой при переносе междисциплинарных пространственных знаний. К тому же пользователь включен в использование просто усвоиваемых файлов XML. Авторы подхода рекомендуют его использовать. Это открывает новое направление в картосемиотике.