Lifelong Learning Programme –Comenius Action
Teacher education

Spatial Citizenship (SPACIT) Comenius Project

D2.1 Competence model for Spatial Citizenship education

**Author(s):** Uwe Schulze, Inga Gryl, Detlef Kanwischer
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**Abstract:** The following report summarizes the development of the Spatial Citizenship Competence Model (SPACIT CoMo). This work is based on the concept and theoretical structure of Spatial Citizenship and integrates different existing competence approaches and catalogues from related domains on the EU and international level. The SPACIT CoMo will serve as the basis for the production of a curriculum for teacher education (WP D2.2, D2.3).

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1. Introduction
The following report of WP2 describes the process of competence modeling for Spatial Citizenship (SPACIT) education (cf. WP D2.1). This work is based on the concept and theoretical structure of SPACIT as represented by Gryl & Jekel (2012) as well as the need of a SPACIT competence model as presented in the project application. Comprising the results of WP1 the formulation of a concept of SPACIT competence is inspired by existing competence models from neighboring fields on EU and international level and extended by referring to additional concepts fitting into the normative basis and objectives of education for Spatial Citizenship.

The formulation of a competence model serves as a basement for the development of a curriculum and is a sensible basis for the implementation of an educational approach into the practice of teaching and learning. Hence, the SPACIT competence model will serve as the basis for the production of a curriculum for teacher education (WP D2.2, D2.3), as teachers whose goal is to educate their pupils with a SPACIT approach need to be trained to do so. Following, WP3 will design corresponding exercises as a program of teacher training. By doing this, the way to bring SPACIT into schools will be paved, answering everyday societal challenges and exploring the opportunities that the new geo-media offers.
2. Theoretical approaches of competence modelling

This section sets the basis for competences modelling for SPACIT education. It provides a comprising review of appropriate competence approaches as well as theoretical aspects of competence modelling from educational research. This section starts with an outline of the current competence discussion from an international perspective. Then, the concept of competence from a European perspective will be summarized, focussing on the European educational policy framework. Finally, the implications for the development of the SPACIT competence model will be synthesized, providing a working definition that serves as the foundation for all of the subsequent work of formulation the SPACIT competence model as well as for curriculum planning.

2.1 Competences in discussion

Besides the fields of psychology and educational research, for many domains and professional fields ‘competence’ has evolved as a key term in recent years, since it “characterize[s] the changing demands of modern life and the working world, as well as the educational goals involved” (Koeppen et al. 2008, p. 62). Nowadays, on the global scale, the changes resulting from an input orientation of educational processes to the emphasis on the learning outcome of the individual is increasingly fundamental for the formulation and measurement of educational goals. Nevertheless, the subsequent regulation of education systems due to the needs of the information-based knowledge society and the increasing mobility of the workforce in global competitive labour markets has been criticized as an ongoing massification and economisation of education (cf. Krautz 2009, Arrowsmith et al. 2011). According to Delemare le Deist & Winterton (2005) there is no common understanding of the ‘fuzzy concept’ of competence yet. Since it is related to a variety of terminological and conceptual approaches and meanings in different social-cultural contexts and educational discourses (ibid., cf. Klieme & Hartig 2007), the term “lacks a clear, standard meaning both in the English language and across European language traditions (…) and there is no way to place a single discipline or definition on it” (Cedefop 2009, p. 18).

From the perspective of pedagogical psychology, ‘competence’ serves as a conceptualisation of complex constructs of learning and acting, comprising different facets, such as knowledge, skills, abilities, understanding, experience, and motivation (Klieme et al. 2004). Following Klieme & Leutner (2006) and Koeppen et al. (2008) competence can be understood as a learnable, context-specific cognitive disposition that enables individuals to deal appropriately and successfully with unfamiliar situations, and particular types of problems in different domains. According to this definition, the process of acquiring knowledge and skills within learning processes should not produce passive knowledge and isolated skills and abilities, but should instead result in applicable knowledge and integrated skills and abilities related to the challenges of real-world situations (Klieme & Hartig 2007, p. 13).

In the field of Vocational Education and Training (VET), competences have been used as a key concept in the field of Human Resource Development (HR) for “strategic management practices of recruiting, selecting, […] and training employees and evaluating employee performance” (Ennis 2008, p.10) for more than two decades. Emphasising personal qualities, the
concept of competence is understood as “ability (…) to adequately and successfully combine and perform necessary activities in any context to achieve specific tasks or objectives” (Stracke 2011, p. 14). In the United States and Great Britain, this definition traditionally has referred to measurable qualifications in terms of functional knowledge and skills, as well as the individual’s underlying behavioural characteristics that enable an individual to perform effectively on the job in line with defined work-based qualifications and nation-wide occupational standards (Winterton et al. 2006). Therefore, competence modelling is geared towards combining the demands of stakeholders in professional fields, politics and society, and transforming them into descriptive learning goals.

In both fields of educational research, and VET, competence development and curriculum planning are founded upon the theoretical description of the interplay of subject-related and generic competences within the form of competence models. Within educational research, competence models are used for modelling and measuring cognitive skills and abilities. Therefore, the development of theoretical models of competence (i.e. formulation of theoretical learning constructs) is the foundation for both the construction of psychometric models as well as the construction of measurement instruments (Koeppen et al. 2008). In this context two groups of theoretical models can be distinguished: First, models of competence structures dealing with the dimensions and relations of the respective competences (Hartig & Klieme 2006). Second, models of competence level dealing with the level grading of competences describe “the specific situational demands that can be mastered by individuals with certain levels or profiles of competences” (Koeppen et al. 2008, p. 64). In contrast, VET-competence models generally serve as a “descriptive tool” that “identifies the competencies needed to operate in a specific role within a(n) job, occupation, organization, or industry” (Ennis 2008, p. 5).

While the identification of professional competences depends on the demands of subject-specific knowledge and skills in specific domains, the redefinition of personal competences is more widespread. Although, well-defined subject-specific competences are a necessary condition for the development of so-called cross-curricular competences or key skills (Klieme et al. 2004). However, within the last years an appreciation of generic skills and abilities in certain learning and working environments is taking place which goes hand in hand with a harmonisation of key competences on an international scale. Related to the rapid developments in the information and communication technology sector (ICT), these so-called twenty-first century skills are commonly referred to as ICT literacy and the aspect of lifelong learning. In summary, they include digital skills and technical mastery; information management; research, strategic planning and problem-solving; reflection and critical thinking; communication and collaboration as well as innovation, creativity and productivity (Pedro et al. 2011).

2.2 The concept of competence from a European perspective
In European higher education, the development of competence-based curricula is mainly influenced by the Bologna Reform and the creation of a common European Higher Educational Area (EHEA) with comparable degrees of undergraduate and graduate study programmes. Based on The Bologna Declaration of 1999 and the aim to create a ‘Europe of Knowledge’,

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nowadays, the Bologna process remarks a fundamental change from a focus solely on qualification and knowledge towards a focus on student-centred, outcomes-based lifelong learning processes (cf. London communiqué 2007). Within this process the major goal is to connect subject-related knowledge and generic competences among students in order to enable them to successfully cope with multiple problem- and application-oriented solutions in different learning and working environments. Therefore, based on *The Dublin Descriptors* by *The Joint Quality Initiative for Higher Education*, five elements denote a competence orientated learning process: acquiring knowledge and understanding; applying knowledge and understanding; making informed judgments and choices; communication knowledge and understanding; and social competence/self-learning capabilities.

To provide the goals of transparency, comparability, and the transferability of qualifications within the EHEA, the ‘learning outcomes approach’ has been emerged as key concept for two reasons (cf. Cedefop 2009; Cedefop 2010, European Union 2011): First, it represents a useful way to express educational standards in terms of competences as coherent statements of knowledge, skills, abilities, or attitudes which individuals have to achieve through specific learning processes. Second, it enables students to actively organize their learning processes, as well as to reflect on their learning needs and effective ways of learning both by constructivist means and from a lifelong learning perspective.

The ‘outcome-based’ definition of competences is differently reflected in strategic documents and frameworks for the implementation of the Bologna process on certain countries level as well as on the European level itself. A comprehensive description and discussion can be found in detail in Cedefop (2009; 2010). For the purpose of this study, the following documents are most relevant:


The key document for implementing the EHEA is the *EQF* of 2008 that serves as a meta-framework combining countries’ qualifications systems together by defining eight referencing levels of common standards for vocational and academic education and training (European Commission 2008). These qualitative descriptors of learning outcomes are defined as “statement[s] of what a learner knows, understands and is able to do on completion of a learning process” (ibid., p. 3). Since the *EQF* emphasises the results of learning (i.e., learning outcomes) rather than focusing on inputs (ibid.), in relation to this, ‘competence’ is defined as the ability “to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development” (ibid., p. 11). These elements are subsumed into three major categories of knowledge (body of facts, principles, theories and practices), skills (both cognitive and practical), and competence (i.e. responsibility and autonomy).
(2) *The Recommendation of the European Parliament and Council on Key Competences for Lifelong Learning (2006).*

Focusing on the demands of the knowledge society in terms of flexibility in the labour force, innovation, productivity, and competitiveness, this framework comprises a more holistic connotation of the competence concept as it is stated in the *EQF*. It states that “Competences are [...] a combination of knowledge, skills and attitudes appropriate to the context. Key competences are those which all individuals need for personal fulfilment and development, active citizenship, social inclusion and employment” (European Parliament and Council 2006, p. 6).

On this basis eight key competences have been distinguished: communication in the mother tongue; communication in foreign languages; mathematical competence and basic competences in science and technology; digital competence; learning to learn; social and civic competences; sense of initiative and entrepreneurship; and cultural awareness and expression.

(3) *Tuning Educational Structures in Europe TUNING (2008)*

The *TUNING* project is a university-driven approach to promote the implementation of the Bologna process in the field of higher education (cf. Gonzalez & Wagenaar 2008). Within *TUNING*, the concept of competences is understood as a “dynamic combination of attributes with respect to knowledge and its application, attitudes, skills and responsibilities, that together permit a competent performance” including the triad of knowing and understanding, knowing how to act, and knowing how to be (ibid., p. 28). Beside the definition of subject-specific competences in thirteen subject-areas like business, education or earth science, another major project outcome is the development of a set of thirty generic competences (transferable skills), classified as (cf. ibid., p. 17):

- instrumental competences: i.e., cognitive, methodological, technological and linguistic abilities, e.g. oral and written communication, computing skills, information management skills;
- interpersonal competences: i.e., individual abilities like social skills (social interaction and co-operation) or the ability to communicate with experts in other field, and
- systemic competences i.e., abilities and skills concerning whole systems (combination of understanding, sensibility and knowledge; prior acquisition of instrumental and interpersonal competences required), e.g. capacity to learn, creativity, understanding other cultures.

2.3 Implications for a SPACIT Competence Model (SPACIT CoMo)

Since competence modelling is based on the definition and assembling of knowledge, skills and abilities in a certain fields of learning, an explicit working definition of what is understood as ‘Spatial Citizenship competence’ has to be provided (cf. Hartig 2006). In this context, the formulation of SPACIT competence model comprises the following aspects in detail:

(1) Research question

The development of a SPACIT competence model is grounded in two main research questions:
• Which competences generally have to be taken into account for Spatial Citizenship education?
• How could they be brought together in an appropriate structure in terms of a competence model that serves as foundation for the development of a curriculum for teacher education to support active learning of Spatial Citizenship in the classroom?

(2) Pedagogical approach

The concept of SPACIT competence is based on the definition of competence by Koeppen et al. (2008) and Klieme et al. (2004), resting on ideas from educational theory and pedagogical psychology, and aiming towards enablement in everyday situations. Therefore, this study understands ‘competence’ as learnable and context-specific (cognitive) disposition that enables individuals to deal appropriately and successfully with unfamiliar situations and particular types of problems in different domains, depending on a complex web of (facets of) knowledge and understanding, skills and abilities, action, experience, and motivation.

(3) Educational policy frameworks

The SPACIT project is associated with the EU lifelong learning program and the goals of Europe2020. Hence, in relation to the above represented EU educational policy framework and selected documents, the definition of SPACIT competence focuses on learning outcomes as an integrated perspective of competence. Regarding to the definition of key competences for lifelong learning (European Parliament and Council 2006, p. 13), in this study, ‘competence’ is defined as a combination of knowledge, skills and attitudes appropriate to the context, whereby:

• ‘knowledge’: means the outcome of the assimilation of information through learning. It is the body of facts, principles, theories and practices related to a field of study: Knowledge is described as theoretical and/or factual (European Commission 2008, p. 11).
• ‘skills’: means the ability to apply knowledge and use know-how to complete tasks and to solve problems. Skills are described as cognitive (involving the use of logical, intuitive and creative thinking) and practical (involving manual dexterity and the use of methods, materials, tools and instruments) (European Commission 2008, p. 11).
• ‘attitudes’: are understood as the integration of individual characteristics, personality traits, motivations and values of perceiving, living and interaction with others in a social context, i.e., ‘knowing how to be’ (cf. Council of Europe 2001; Gonzalez & Wagenaar 2008)

(4) SPACIT competence definition

SPACIT competence focuses on the ‘spatial citizen’ and its appropriation of the spatial domain of social life (Gryl & Jekel 2012). Thus, the conceptualization of SPACIT competence is grounded in the individuals’ knowledge, skills and abilities as well as attitudes “to access and make sense of (geo-)information in order to participate in democratic processes and make
decisions, taking into account the situations and circumstances she encounters on a daily basis” (ibid., p.8). Therefore, acquiring SPACIT competences means to enable students to “use the various types of geo-media available to express their own spatial narratives, challenge dominant discourses, contest the dominant meanings and uses of geospatial technology and share alternative perspectives and opinions in their role as emancipated citizens” (Quade & Felgenhauer 2012, p. 11).

In this context SPACIT education is concerned “to enable citizens to competently participate in the public negotiation of individual and collective appropriations of space by emphasizing the importance of reflective and reflexive competences in secondary school curricula” (ibid., p. 6). In concrete terms, education for SPACIT means learning how to navigate everyday life with respect to (cf. Gryl & Jekel 2012):

- the physical world,
- the meanings attached to the physical objects and environment, and
- the power relations involved in the production of meaning, including Geographic Information Systems (GIS) and -instruments to naturalize meaning as well as new forms of collaboration and negotiation of meaning using web 2.0 applications.

(5) Criteria for the formulation of SPACIT competence model

Among the project partners it is consensus that the Spatial Citizenship Competence Model (SPACIT CoMo) conforms with the theoretical construct of Spatial Citizenship as formulated by Gryl & Jekel (2012), which bases on

- an emancipatory citizenship education (c.f. Bennett et al. 2009; Mitchell & Elwood 2012),
- the mature appropriation of space (c.f. Paasi 1986; Werlen 1993; Lefebvre 1993; Massey 1998), and
- the competent utilization of geo-media (abbreviated as GM) in reflexive consumption and production processes (c.f. Harley 1989; MacEachren 1992; Schuurman 2000; Pickles 2006; Crampton 2009).

To describe the “web of requirements” (cf. Klieme 2004, p. 66) which learners are expected to master in the field of SPACIT, the essential knowledge, skills and attitudes have to be integrated into a model of competence structure dealing with dimensions and relations of SPACIT competences (cf. Klieme, Maag-Merki & Hartig 2007). Hence, SPACIT CoMo is not serving for competence assessment and measurement (cf. Hartig & Klieme 2007), but for consistent and sound orientation in curriculum development.
3. Summarizing the method

Since the SPACIT approach (Gryl & Jekel 2012) serves as a reliable backbone for development of the SPACIT CoMo, with this, not only certain domain-specific reference points are set (among others, GIScience and Technology, geography, philosophy and citizenship education), but also the normative cornerstones and educational objectives of the following competence model are given (namely maturity in a geospatial society under the influence of power relations). Based on this assumption the following methodological steps are conducted to formulate competences with the result of the SPACIT CoMo (Fig. 1).

![Diagram](image)

**Figure 1: Summary of the used methods to develop the structure of the Spatial Citizenship Competence Model**

**Step 1: Identification of SPACIT competence dimensions**

The first step in competence modeling includes the identification and development of major categories, and, wherever possible, the formulation of sub-categories of SPACIT competence. According to the theory of competence modeling, the resulting main categories are referred to as competence dimensions. Each dimension is enriched with categories resulting from content analysis and preparing the later attachment of competences to the structure (cf. step 2 and 3).

We adapted qualitative content analysis by Mayring (2000; 2008) in order to carry out a systematic text analysis (data sampling) with the goal of inductive category construction (cf. Fig. 2.). The material to be analyzed comprises the reference paper of Gryl & Jekel (2012) as well as a working paper resulting from WP1 by Quade & Felgenhauer (2012) which summarizes major aspects of social theory for the development of SPACIT competence. Chapter 4 summarizes the resulting main competence dimensions of SPACIT CoMo.
Step 2: Construction of the SPACIT competence matrix

In a second step an additional transverse structure of categories of competences consisting of elements of ‘knowledge’, ‘skills’, and ‘attitudes’ (abbreviated as KSA) has been added to the competence dimension worked out before. The resulting matrix of ‘competence dimensions’ and ‘competence elements’ (cf. Fig. 3) was systematically filled with the text data from content analysis (i.e., text samples) while re-formulating them as learning outcomes (i.e. different facets of SPACIT competences). To avoid redundancies, within the competence matrix the previously extracted competence dimensions and sub-categories were iteratively revised and re-organized throughout the working process (feedback loops).

Figure 2: Example for category development of SPACIT competence resulting from qualitative content analysis

Step 3: Adding categories and competences from additional sources

Throughout the first two steps of competence modelling neither all dimensions of SPACIT competence could be subdivided adequately in sub-categories nor could all fields of the com-

Figure 3: Example for the creation of SPACIT competence matrix and definition of learning outcomes. The grey colored boxes within the KSA matrix mark information from different sources.
petence matrix be filled with content resulting from the analysed material. Therefore, it was necessary to complete the gaps with data from additional material, and, thus further refine the structure of the competence dimensions once again (Fig. 4).

The grey colored boxes within the KSA matrix mark information from additional sources.

Additional competences result from two main sources:

- **Competence catalogues**: A reference on influential competence catalogues is essential to link to competence development in neighboring fields and to harmonize practical teaching and learning in different areas while avoiding redundancies. The catalogues are selected according to their partial overlapping with the categories and according to their status within EU- and international educational discourses (see ch. 5). The selection of competences from these catalogues contributing to SPACIT CoMo is conducted with the help of the categories identified in the first step and their semantic field around (anchor points). The latter is developed out of the material of the additional catalogues themselves with reference to the categories, hence following a mixture of theoretical heuristics and grounded theory (Blumer 1954; Glaser & Strauss 1998). Competences selected are refined according to the chosen characteristics and definition of competence formulated above (see ch. 2) and the educational aims of SPACIT. Competences are subsequently harmonized towards a congruent language.

- **Neighboring domains**: Additional references are involved as the basis for competence formulation where the matrix was not yet or not sufficiently filled. Those references deepen the SPACIT approach in order to make it conveyable in the shape of competences. These sources are chosen from neighboring domains in the semantic field around SPACIT. Categories are associated with one or more domain fields, and the formulation of corresponding competences founds on the SPACIT competence approach and categories described above.
4. Structure and keywords from the content analysis of the Spatial Citizenship approach

Resulting from the content analysis and category development the following six competence dimensions will structure the SPACIT CoMo (cf. Fig. 5).

- **Geo-media Technology and Methodology Domain:** This area targets the utilization of geo-(web2.0-)media concerning consumption, production and communication processes, while being aware of the semantic field around geo-media as powerful instruments of everyday social constructions. This includes technological maturity. The dimension also refers to handling spatial data as well as to technical GI skills in the field of consumption, analysis, production, prosumption, and communication with respect to the increased usability of everyday geo-media. Altogether, these competences open up the factual spectrum of possibilities, create awareness of the variety of tools, and support creativity.

- **Reflection on the use of geo-media:** This dimension relates to the ‘consumption’ aspect of handling geo-media. It focuses on the extension of classical map consumption skills: Firstly, geo-media as social constructions with limited representation of the world need to be deconstructed and meaning to be reflected on critically in order to extend insights and perspectives (Harley 1989). Secondly, the user needs to be reflexive towards her/his own geo-media consumption by being conscious of her/his own hypothesis construction (MacEachren 1992). This area involves awareness of the influence of geo-media on one’s own and people’s everyday action in general. It also includes thinking in alternatives of spatial constructions eventually being represented in geo-media as well.

- **Communication with geo-media:** Basing this dimension in the tradition of counter mapping (Turnbull 1998), the web2.0 reference opens up new challenges, e.g. the ability to express alternative spatial visions and constructions with own visualizations, communicating them, and negotiation them with others with the help of geo-media. A strong reference on communication theory is needed regarding argumentation and negotiation as nonlinear processes serving interest representation and challenging societal discourses.

- **Spatial Domain:** This dimension refers to relative concepts of space as main cornerstone of SPACIT. This involves the social construction of spaces by the attachment of meaning to physical matter. This physical space is referred to with absolute concepts of space. These also relate to spatial representations and the spatial thinking approach (cf. NRC 2006). Mature appropriation of space involves the awareness of relational concepts of space and its consequences for action in spaces.

- **Citizenship Education Domain:** This dimension refers to emancipatory concepts of citizenship education and the normative background of the approach in democratic negotiation processes and human rights. It pays special attention to the role of fluent institutions and communities, to power relations in society, and participation. It links space and citizenship by implementing the term of the ‘spatial citizen’.
• **Implementation strategies:** This dimension needs to be added when it comes to teaching SPACIT, including the creation of suitable learning environments as well as the aspect of professional growth from the perspective of teacher education and training.

![Diagram of the Spatial Citizenship Competence Model](image)

**Figure 5: Main structure of the Spatial Citizenship Competence Model following from content analysis**

At this point the structure of SPACIT competence can be best represented as a conglomerate of the single competences dimension. The categories of ‘GM Technology and Methodology Domain’, ‘Reflection on the use of GM’, and ‘Communication with GM’ are equivalent with the structure of the SPACIT concept provided in Gryl & Jekel (2012). It has to be mentioned that within this dimensions the focus is not any longer on ‘spatial representations’ (as originally stated in ibid.), but has changed to use of ‘geo-media’ (GM). Thus, they establish the center of SPACIT CoMo in the sense of core competences. Basically, these dimensions are related to the more practical application of knowledge and skills as well as attitudes in the field of generic competences, above all instrumental competence (e.g. communication skills, information management skills, problem-solving and decision making) and interpersonal competences (e.g. social interaction, collaboration and teamwork skills). Here, the emphasis is on the reflective/reflective use of geo-(web2.0-) media for the purpose of self-active as well as collaborative communication for sharing discursive environments.

The dimensions of ‘Spatial Domain’ and ‘Citizenship Education Domain’ can be understood as horizontal layers underpinning the core dimensions overall. They are connected to theoretical aspects in respective knowledge areas and, thus, are related to subject-specific knowledge, skills and abilities.
Finally, the ‘Implementation Strategies’ of SPACIT are not incorporated within the other dimensions, but functions as an interconnected dimension necessary to link them to the aspect of SPACIT education (see ch. 2.3). According to Quade & Felgenhauer (2012), the relevance to implement this competence dimension within the SPACIT CoMo is justified in the creation of reflective and reflexive learning situations combining various aspects of digital competence and geo-media use (i.e., critical engagement with geo-information and geo-spatial representations).
5. Contributions from neighboring domains and competence approaches
To arrive at an elaborated sub-structure of the dimensions of the SPACIT CoMo additional input from related domains and competence catalogues have been processed, based on the determination of the main categories of SPACIT competence (Fig. 6). The following contributions are relevant with regards to the SPACIT competences modeling process.

5.1 Digital media competence
Authors Gryl & Jekel (2012) and Quade & Felgenhauer (2012) highlight the particular importance of digital media competence within the framework of SPACIT education. In detail this is on the one hand connected to the informed appropriation of space (Gryl & Jekel 2012), and on the other in conjunction with communicative skills and internet literacy (Quade & Felgenhauer 2012).

As aforementioned (ch. 2.2) digital competence has been determined as one major skill area within the *Key Competences for Lifelong Learning* by the EU in 2006. In order to contribute to a better understanding and the development of digital competence throughout Europe the project ‘Digital Competence: Identification and European-wide validation of its key components for all levels of learners (DIGCOMP)’ is designed, in order to (cf. [http://is.jrc.ec.europa.eu/pages/EAP/DIGCOMP.html%202012](http://is.jrc.ec.europa.eu/pages/EAP/DIGCOMP.html%202012)) identify the key components

![Figure 6: SPACIT Competence Model and related domains](image)
of Digital Competence (DC) in terms of the knowledge, skills and attitudes needed to be digitally competent;

- develop a DC framework/guidelines that can be validated at European level, taking into account relevant frameworks currently available;
- propose a roadmap for the possible use and revision of a DC framework for all levels of learners.

For SPACIT competences modelling the outcomes of two current reports of the DIGCOMP are relevant. The first report (cf. Ala-Mutka 2011) develops a conceptual model of digital competence as part of an overlapping field of multiple literacies like internet literacy, ICT literacy, media literacy, and information literacy. Within DIGCOMP digital competence is mapped as multi-layered competence construct that is considered “as a higher level concept than simply being able to use digital tools and media”, and, therefore, the “(…) development of safe and productive attitudes should be integrated in learning all levels of skills” (ibid., p. 53). The model of Digital Competence is structured by the following elements:

- **instrumental knowledge and skills** for tool and media usage (i.e., operational, and medium related); which functions as a precondition for developing or using more advanced skills,
- **advanced skills and knowledge** for communication and collaboration, information management, learning and problem-solving and meaningful participation, and
- **attitudes** described as intercultural, critical, creative, responsible and autonomous attitudes.

Based on this conceptual approach the second report aims to develop descriptors for creating a conceptual framework by analysing fifteen international documents (case studies) focusing on digital competence (cf. Ferrari 2012). From this analysis a competence definition as well as a set of components of digital competence result which are both crucial for the development of SPACIT CoMo, and are summarized as follows:

In contrast to the comprehensive definition of digital competence within the Key Competences for Lifelong Learning (2006), DIGCOMP provides a more detailed definition that focus on the use of Information and Communication Technology (ICT) and digital media. Therefore, digital competence is understood as:

“the set of knowledge, skills, attitudes, abilities, strategies, and awareness that are required when using ICT and digital media to perform tasks; solve problems; communicate; manage information; collaborate; create and share content; and build knowledge effectively, efficiently, appropriately, critically, creatively, autonomously, flexibly, ethically, reflectively for work, leisure, participation, learning, and socialising, consuming, and empowerment” (Ferrari 2012, p. 30).

As this definition in particular gives reference to the learning domains (i.e., the set of knowledge, skills, attitudes, abilities, strategies, and awareness), tools (i.e., ICT and digital
media), a comprehensive list of modes (i.e., effectively, efficiently, appropriately, critically, creatively, autonomously etc.) as well as the purposes for using ICT and digital media (i.e., work, leisure, participation, learning, etc.) it also includes major competence areas of digital competence which are listed in Table 1 in detail. According to ibid. it should be noted that the area of ‘technical operation’ is suggested as being an equivalent part of all of the seven components of digital competence.

<table>
<thead>
<tr>
<th>Competence Components</th>
<th>Description of Knowledge, skills, and attitudes (KSA)</th>
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<tbody>
<tr>
<td>Information management</td>
<td>Refers to the KSA needed to identify, locate, access, retrieve, store and organise information</td>
</tr>
<tr>
<td>Collaboration</td>
<td>Refers to the KAS for linking with other users, participate in networks and online communities, and interact with others constructively and with a sense of responsibility</td>
</tr>
<tr>
<td>Communication</td>
<td>Refers to the KAS for communicating through online tools, taking into account privacy, safety and netiquette</td>
</tr>
<tr>
<td>Creation of content and knowledge</td>
<td>Refers to the expression of creativity and the construction of new knowledge through technology and media, and also to the integration and re-elaboration of previous knowledge and content and its dissemination through online means</td>
</tr>
<tr>
<td>Ethics and responsibility</td>
<td>Is understood as the KSA needed to behave in an ethical and responsible way, aware of legal frames</td>
</tr>
<tr>
<td>Evaluation and Problem-solving</td>
<td>Is understood in more than one case study as the identification of the right technology and or media to solve the identified problem or to complete a task and also as the assessment of information retrieved or the media product consulted.</td>
</tr>
<tr>
<td>Technical operation</td>
<td>Is the area that refers to the KAS one needs for effective, efficient, safe and correct use of technology and media.</td>
</tr>
</tbody>
</table>

Table 1: Components and description of digital competence as defined in DIGCOMP 2012. Descriptions are cited from the given source. Source: Ferrari (2012, p. 44)

5.2 Communication competence

As shown above, besides the major aspect of digital media competence, the second most important aspect within the concept of SPACIT is communication competence. Within SPACIT communication is a multi-layered dimension with different meanings, and, it is closely interconnected with the other competence dimensions. Based on Gryl & Jekel (2012) communication competence for SPACIT education is related to three strands:

(1) **Communication as discursive processes**: to share ideas and meanings with others in an interactive and nonlinear way using online and off-line communication paths or producing one’s own using the power of emerging communities on the Web2.0 in order to contribute or to challenge societal discourses founded on the principles of democracy. This includes aspects of expression, argumentation, negotiation, and participation.

(2) **Communication with spatial representations**: to express one’s own spatial narratives as well as to share (alternative) spatial visions and constructions with the help of maps (printed or digital), geo-visualizations (analog or digital), or Geographic Information Systems (GIS).

(3) **Communication with digital geo-media**: integrating the aforementioned aspects of SPACIT communication, this strand follows the idea of counter mapping supplemented with the possibilities of the Web2.0. It focuses on the ability to express spatial construc-
tions with the help of (one’s own) digital geo-media to store and represent geographical information (GI). For this purpose, geo-media comprises different kinds of Geo-ICT, for instance, GPS-based technology and applications (e.g. handhelds, on smartphones), online mapping tools (e.g. scribble maps), collaborative mapping environments (e.g. Open Street Map), digital globes (e.g. GoogleEarth), or GIS and Web-GIS application. Furthermore, geo-media are understood as multi-media communication environments combining both cartographic representations and various types of media formats like texts, pictures and photographs as well as audio and video streams.

In order to emphasise multi-layered communication processes within geo-media practices and the idea to support (spatial) argumentation with these practices as one major goal of SPACIT education, competence modeling must not just include technical aspects related to digital media competence alone, but has to be fundamentally connected to the general concepts and models of communication competence (cf. Bagarić & Mihaljević Djigunović 2007). Therefore, modeling SPACIT communication competence can be related to the Common European Framework of Reference for Languages (CEFR) by Council of Europe (2001). Within the last decade the CEFR has become a key reference document (framework) for language qualifications, learning programs and certification, and for the comparison of language certificates across Europe. It comprehensively describes the competences and knowledge and skills necessary for communication as well as the situations and domains of communication (cf. http://www.coe.int/t/dg4/linguistic/Cadre1_en.asp).

The CEFR provides an elaborated approach to structure and formulate the activities and competences necessary for all strands of SPACIT communication in terms of (spatial) language use and competence. The following summarizes the major aspects crucial for modeling SPACIT communication competence.

The CEFR follows an ‘action-oriented’ approach. This means that the users (and learners) of a language are understood “as ‘social agents’, i.e. members of society who have tasks (not exclusively language-related) to accomplish in a given set of circumstances, in a specific environment and within a particular field of action. (...)We speak of ‘tasks’ in so far as the actions are performed by one or more individuals strategically using their own specific competences to achieve a given result.” (Council of Europe 2001, p.9)

According to this conceptual approach the CEFR is made up by two important meta-categories of interrelated ‘communicative language activity’ and ‘communicative language competences’ (cf. also Hodel, 2007).

• **Communicative language activity** is understood as a set of parameters and categories describing what a person (language use/ learner) is able to do with a language and what he/she should know in order to be able to act (Council of Europe 2001, p. 43).
  This dimension includes different elements:
  o **Context of language use**, i.e. domains, situations, conditions and constraints, the user’s mental context
  o **Communication themes**, e.g. personal identification; house and home, environment; daily life; travel; places
  o **Communicative tasks and purposes**
Communicative language activities and strategies, i.e., receptive-, productive-, interactive- and mediating activities and strategies.

Communication language process, i.e. speaking, writing, listing, reading.

Texts, i.e. text and media; text and activities.

- **Communicative language competences** comprise several elements of linguistic-, sociolinguistic- and pragmatic competence (see Tab. 5), whereas each of which is made up of knowledge and skills and know-how (Council of Europe 2001, p. 13, and in more detail ch. 5). From the perspective of SPACIT, communicative language competences are crucial due to the fact that they allow the individual “to carry out the tasks and activities required to deal with the communicative situations in which they are involved” (Council of Europe 2001, p. 101).

<table>
<thead>
<tr>
<th>Competence Components</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linguistic competences</td>
<td>Include lexical, phonological, syntactical knowledge and skills and other dimensions of language as system, independently of the sociolinguistic value of its variations and the pragmatic functions of its realisations.</td>
</tr>
<tr>
<td>Sociolinguistic competences</td>
<td>Is concerned with the knowledge and skills required to deal with the social dimension of language use.</td>
</tr>
<tr>
<td>Pragmatic competences</td>
<td>Are concerned with the functional use of linguistic resources drawing on scenarios or scripts of interactional exchanges. It also concerns the mastery of discourse, cohesion and coherence, the identification of text types and forms, irony, and parody. Pragmatic competences are concerned with the user/learner’s knowledge of the principles according to which messages are: (a) organised, structured and arranged, i.e., ‘discourse competence’; (b) used to perform communicative functions, i.e., ‘functional competence’; (c) sequenced according to interactional and transactional schemata, i.e., ‘design competence’</td>
</tr>
</tbody>
</table>

Table 2: Components and description of communicative language competence as defined in CEFR 2001. Descriptions are cited from the given source. Source: Council of Europe (2001, p. 13, see also p. 102ff)

5.3 Teacher competences and twenty first century skills

The SPACIT CoMo will constitute as the basis for education for SPACIT, in terms of both teacher education and creation of innovative and (geo-)media centered learning environments that allow for a critical engagement with geo-information and geo-spatial representations (cf. Quade & Felgenhauer 2012).

Therefore, the formulation of the SPACIT CoMo also incorporates the findings of the project ‘Innovative Technologies for Engaging Classrooms’ (iTEC). The major goal of this EU-funded project undertaken by European Schoolnet in association with education ministries from 14 EU countries, technology providers and research organizations is “to bring about transformation in learning and teaching through the strategic application of learning technology” and, hence, “to design and take to scale 21st century learning and teaching scenarios” in the future classroom (http://itec.eun.org/web/guest/about)

In particular the outcomes of work package D4.1 ‘Teacher skills and competence development for classrooms of the future’ (cf. Pedro et al. 2011) are relevant to the sub-structuring
process of the SPACIT competence dimensions because they “presents a framework for the 21st century skills and competences on the use of ICT to be developed by teachers in order to be able to manage the future classroom” (Pedro et al. 2011, p. 2).

On the basis of a content analysis of thirteen major documents of twenty first century skills-related frameworks (cf. ibid., Annex 1) a set of nine core competences has been identified which are considered to play an important role in tomorrow’s teachers’ education, for instance, digital skills and technical mastery, information management, reflection and critical thinking, effective communication skills, collaboration and interpersonal skills; social responsibility and multicultural literacy. Subsequently, these core competences were condensed into five major domains of teachers’ digital literacy (i.e., technical-pedagogical competences) (ibid.). These five domains are summarized in Table 3. For SPACIT CoMo the categories ‘Planning & Management’, ‘Classroom practices’, and ‘Professional Growth’ will be adapted and integrated within the dimensions’ sub-structure while the remainder are already part of other SPACIT (sub-)categories.

In addition, iTEC also provides a vertical competence structure in terms of a level grading of skills and competences for teaching in the future classroom, hierarchically organized in three stages (Pedro et al. 2011, p. 11f):

- **functional-use level**: using technologies as ‘functional tools’ that should be naturalised and incorporated into the various dimensions of teachers’ practices, which means that ICT and digital content will be inherently integrated as a teaching resource.

- **pedagogical enhancive-use level**: to see ICT both as a pedagogical enhancer of teaching strategies and as support for students’ learning activities, clearly identifying advantages and constraints of ICT use and its potential for transformation.

- **innovative-use level**: allowing technologies to undertake an innovative role on their own teaching practices, contributing to stimulate (i) teachers’ habits of collaboration and experiences-sharing with peers and other agents of the educational community (in a local, regional, national and international level), and (ii) teachers’ professional responsibility and school commitment (through a reflective and investigative perspective.

These competence levels are not incorporated into the SPACIT CoMo because it has been consensus among the project partners that SPACIT competence is not considered to have different levels or degrees of performance. In this context it is rather formulated as a one-dimensional competence construct. However, the three-stage competence structure described above may provide a useful approach for the implementation of the SAPCIT CoMo into it a curriculum teacher education for SPACIT education; cf. SPACIT WP 2.2 and 2.3.
<table>
<thead>
<tr>
<th>Competence Domain</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Knowledge</td>
<td>This domain is related to teachers’ level of ICT proficiency and knowledge about new learning theories and ICT integration models. Teachers need to demonstrate a reasonable level of proficiency in managing virtual systems, online applications, digital tools and online educational resources and also be able to transfer current knowledge into new technologies and situations. It also comprises the knowledge of current theoretical models of learning and ICT integration in education-related frameworks.</td>
</tr>
<tr>
<td>Planning &amp; Management</td>
<td>This domain is related to teachers needs to plan, manage teaching activities and monitor students’ specific progresses and general performance. Teachers have to critically evaluate and select tools and resources to facilitate planning, developing and managing inspiring activities/projects that will promote students’ curiosity, creativity and productivity. It integrates the design of innovative and engaging learning experiences (which inherently incorporates digital tools and resources) and its evaluation through diversified and updated forms of assessment (which will require the identification of new potential for assessment beyond its role as an accountability instrument and the exploration of new assessment methods, but within the constraints of national and local requirements).</td>
</tr>
<tr>
<td>Classroom practices</td>
<td>This domain refers to the activity of the teacher in the classroom while orchestrating students’ actions, initiatives and discourses. It includes class management, content covering, support to student specific needs and engagement promotion. Teachers should mobilise technologies in order to: (i) design learning scenarios that contribute to promote to all students the required skills for a fully informed and active participation in societal issues; (ii) personalise learning activities – methods, content, activities and dynamics – and to address students’ diverse learning styles and interests, pursuing students’ engagement, success and development; (iii) consider the learning standards for the different curriculum subject areas, at least as long as the ‘curricula-logic’ persists (…).</td>
</tr>
<tr>
<td>Professional Growth</td>
<td>This domain is related to teacher responsibility to evolve as a qualified professional and is consequently associated with attending the required teachers’ training initiatives but it also integrates the need to get involved in informal learning opportunities for professional development. Teachers will have to develop independent efforts to pursue continuous professional development and to keep updating their knowledge of new teaching methodologies and ICT integration into classrooms activities especially the way they can be mobilised to support better collaboration with pupils, their families and the community.</td>
</tr>
<tr>
<td>Social &amp; Ethical</td>
<td>This domain relates to teachers’ sense of awareness about socio-economic, environmental, ethical and legal aspects regarding the triadic relation between technologies, education and society. Teachers will have to understand local and global societal issues and responsibilities in an evolving digital culture and exhibit safe, legal and ethical behaviour in their professional practices. The development of reflection about digital identity and digital citizenship will also be required.</td>
</tr>
</tbody>
</table>

Table 3: Domains of teachers’ digital literacy as defined in iTEC 2011. Descriptions are cited from the given source. 
Source: Pedro et al. (2011, p. 12f)
5.4 Contribution from Citizenship Education (CSE)

The represented theoretical concepts of CSE as well as of SPACIT as introduced by Gryl & Jekel (2012) and further discussed by Quade & Felgenhauer (2012) already form an elaborated foundation to the further structuring of the categories and competence components related to the dimension of ‘citizenship education’ within the SPACIT CoMo. In this context the ‘civic learning dimension’ by Bennett et al. (2009) provides five general competence categories of:

- Knowledge (i.e. information),
- Communication (i.e. expression),
- Organization (i.e. membership),
- Action (i.e. participation), and
- Orientations (i.e. attitudes)

Beside that theoretical approach of CSE, additional contributions should also take into account the actual outcomes of CSE from the European perspective for two reasons: First, to make the SPACIT approach generally linkable to the development of civic competences in terms of participation in the social and political life and active citizenship on the European level. Second, to try to integrate the SPACIT education approach into the EU Member States national CSE frameworks to get implemented into curricula development, teacher education and training programs as well as active learning in school education wherever possible.


In this context, the current study on ‘Citizenship Education in Europe’ (EACEA 2012) “aims to capture how policies and measures relating to citizenship education have evolved over recent years in European countries” (ibid., p. 8). Some outcomes of this report show that CSE is integrated into the national curricula of primary and secondary school of all EU Member States. Furthermore, CSE is of a multi-dimensional nature taking place inside as well as outside the classroom through informal learning covering a wide range of topics, for instance human rights, democratic values, sustainable development or European history, culture and literature. Finally, the report indicates that more efforts are needed in order to strengthen teachers’ competences in teaching CSE, and that CSE should aim to develop not only theoretical knowledge but also critical thinking and analytical skills, and attitudes to foster active participation in school and society (cf. http://ec.europa.eu/citizenship/about-the-europe-for-citizens-programme/index_en.htm).

<table>
<thead>
<tr>
<th>Skill areas</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civic-related skills</td>
<td>Participating in society through, for example, volunteering, and influencing public policy through voting and petitioning</td>
</tr>
<tr>
<td>Social skills</td>
<td>Living and working with others, resolving conflicts</td>
</tr>
<tr>
<td>Communication skills</td>
<td>Listening, understanding and engaging in discussion</td>
</tr>
<tr>
<td>Intercultural skills</td>
<td>Establishing intercultural dialogue and appreciating cultural differences</td>
</tr>
</tbody>
</table>

Table 4: Skills that students should acquire in Citizenship Education, as recommended in the national curriculum as defined by EACEA (2012). Descriptions are cited from the given source. Source: EACEA (2012, p. 32)
CSE in European countries cover a wide and comprehensive range of objectives, knowledge and skill areas (cf. EACEA 2012). For the purpose of this study, especially the following four skill areas of CSE are most relevant which are defined as being essential for pupils and students to acquire for to become active and responsible citizens (EACEA 2012), see Table 4.

5.5 Contribution from the Geographic Information Science and Technology (GIS&T) Domain
The GIS&T domain represents a most comprehensive knowledge domain that integrates even extensive sub-domains of (i) Geographic Information Science (GIScience), (ii) Geospatial Technology, and (iii) Applications of GIS&T in public, professional as well as private areas (cf. DiBiase et al. 2006). On the international scale, the discussion about standards of GIS&T competence is currently taking place on three different levels of VET, higher education, and for GIS education in schools.

(1) **GIS&T competences in VET**: Generally, the formulation of GIS&T competences mainly derives from curricular development within the GIS&T industry sector, originally starting in the U.S. in the early 1990s (cf. Kemp & Goodchild 1992; Marble 1998; Gaudet et al. 2001; Gaudet et al. 2003; Kemp 2012). Two major documents which define the relevant knowledge, skills and abilities derive from this development path. The first one is the so-called Geographic Information Science & Technology Body of Knowledge (GIS&T BoK) – a model curriculum that defines educational standards for GIS&T learning fields in the form of ten major knowledge areas and more than 1600 learning objectives (DiBiase et al. 2006; DeMers 2009; Prager & Plewe 2009). The second document is The Geospatial Technology Competency Model (GTCM) that lists the relevant professional competences as well as generic skills crucial for working in the GIS&T-sector (in the U.S. job market) in the form of ‘foundational’, ‘industry-related’, and ‘occupation-related competencies’ (cf. [http://www.careeronestop.org/CompetencyModel/pyramid.aspx?geo=Y](http://www.careeronestop.org/CompetencyModel/pyramid.aspx?geo=Y)).

(2) **GIS&T competences in higher education**: The development of GIS&T competences has also become increasingly important in the context of higher education for different reasons (cf. Sinton 2012). On the one side this is related to the demand for a well-educated GIS&T workforce with an academic background, of course. One the other side the rapid development of the Geo-ICT within the last decade and the increasing availability of (integrated) geo-spatial tools, -data and -services has led to a new focus on “the role of location in science” (Scholten et al. 2009). Hence, GIS&T offers new opportunities for (spatial) research and teaching in the form of data analysis, geo-visualisation, -modelling and –mapping in different science areas like geography, earth sciences, historical and social science, economics, or transportation (ibid.). Here, GIS&T competence is not only concerned with technical aspects for instance data management and software use (and the use of Geo-ICT respectively). Since GIS also serves as methodological tool to investigate spatial related problems, thus, its solution-oriented application requires both a broad range of domain expertise as well as generic skills – above all spatial thinking skills, and problem-solving skills (cf. Schulze et al. 2013).

(3) **GIS competences in secondary school**: During the last decade, GIS has also reached a prominent place in the secondary school education around the world. Within their publica-
tion ‘Perspectives on Teaching and Learning GIS in Secondary Schools’, Milson et al. (2012) identify GIS education in schools in 33 countries as “relatively recent phenomenon” (ibid., p. 315), and the authors provide a “partial snapshot” (ibid., p. 5) of a heterogeneous field of different technological, didactical, and social opportunities to GIS learning in the classroom. On the European level efforts were made to reach comparable minimum standards for GIS education as well as geo-media use in secondary schools in recent years. In 2009 the HERODOT Network published ‘The Benchmark Statements for GIS in Geography Education’. In line with the Dublin Descriptors and the TUNING approach, these statements, for example, define consecutive level descriptors and learning outcomes for GIS in geography education in secondary schools (but also for the undergraduate and graduate level) (cf. Donert 2009; Herodot Network 2009). Although these standards does not use competence modeling for defining some major dimensions, according to Schulze et al. (2013), the following competences can be extracted from this document (cf. Tab. 5)

<table>
<thead>
<tr>
<th>Competence areas</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical Thinking</td>
<td>Apply GIS critically and independently; use GI technologies as appropriate within applied context; identify effective application of GIS.</td>
</tr>
<tr>
<td>Geography</td>
<td>Geographic knowledge and understanding of the nature of geographic relationships, including changes, patterns, and processes.</td>
</tr>
<tr>
<td>GIS Knowledge and Skills</td>
<td>Acquire, manage, handle, manipulate, analyse and model; visualize and communicate spatial data and geographic information; knowledge of the concepts of GIScience.</td>
</tr>
<tr>
<td>Problem-Solving</td>
<td>Deal with real world problems applying geographic knowledge and understanding; develop problem-oriented knowledge and skills in GIScience.</td>
</tr>
<tr>
<td>Spatial Thinking</td>
<td>Fundamentals of spatial understanding, spatial analysis and application; performance of complex spatial analysis and modelling; present complex spatial information.</td>
</tr>
<tr>
<td>Teamwork and Collaboration</td>
<td>Participate in and use GIS within multidisciplinary teams and environments; cooperate with other specialists; manage and coordinate GIS projects.</td>
</tr>
<tr>
<td>Visualization and Communication</td>
<td>Represent and visualize of (geo)spatial data; effectively communicate geographic information to different target groups such as researchers, decision-makers, and the general public.</td>
</tr>
</tbody>
</table>

Table 5: Competence dimensions of the GIS Benchmark Statements (2009). Structure and descriptions are cited from the given source. Source: Schulze et al. 2013, Appendix E

Another recent approach for benchmarking geo-media use in schools form the perspective of teacher education and training is provided by the Digital-Earth.EU network (cf. https://sites.google.com/site/digitaleartheu/About/sigs/sig-3). Based on a survey in 2011 among 65 educators in 20 EU-countries, the survey “show that there is a strong interest in using geo-media, and that number of teachers have already developed experience in using geo-media at school” but there is still “a lack of suitable training and education opportunities, including accreditation and career models” (Lindner-Fally & Zwartjes 2012); its proposed benchmark statements for teacher training and education in Europe comprise a first set of different competences as depicted in Table 6.
<table>
<thead>
<tr>
<th>Competence areas</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial thinking</td>
<td>To know concepts of spatial thinking (examples); to be able to use tools of spatial representation; to apply processes of reasoning.</td>
</tr>
<tr>
<td>Problem-solving</td>
<td>e.g. to be able to use spatial skills in real world problem-solving context; understand the basic purpose and application of digital earth to real world problems.</td>
</tr>
<tr>
<td>Understanding complex and changing interrelationships</td>
<td>-/-</td>
</tr>
</tbody>
</table>
| Awareness for and understanding of the digital earth concept | e.g. understand the construction of digital maps as a representation of the real world:  
- The power of maps (reliability of data, classification and colour schemes)  
- Topology: points, lines, polygons  
- Database                                                                                                                                 |
| Pedagogic and didactical skills for the use of digital earth tools in school | e.g. use advanced digital earth tools for learning (starting with Web-GIS, GIS viewers to GIS software)                                                                                                        |
| Ability to use digital earth tools (also technological skills) | e.g. gather information from data resources or through field-work activities (use GPS devices, mobile applications)                                                                                         |
| Lifelong learning competences                             | Ability to find training opportunities, time management, planning competency, communication competencies                                                                                                  |
| Being able to identify and evaluate resources             | -/-                                                                                                                                                                                                        |
| Social learning                                           | Being able to work with others – teamwork; use professional social networks (virtual and face-to-face)                                                                                                     |

Table 6: Competences for teacher training and education in secondary school in Europe as provided by the Digital Earth.EU Benchmark Statements (2012). Descriptions are cited from the given source.  
Source: Lindner-Falley & Zwantjes (2012, p. 279f.)

According to Gryl & Jekel (2012), within SPACIT the GIS&T domain is even less developed which is mainly due to the requirement of low technical requirements to access and utilize geo-media on the web2.0. Following Quade & Felgenhauer (2012) this argument is also be supported by the central aspect of the integration of Geo-ICT in everyday practises of non-experts – lay persons which have no formal qualification or professional experience with the use of geospatial technologies. However, aspects such as the wide variety of options to present geo-media and the hidden potential of non-visualized geo-media (Fischer, forthcoming) clearly expand challenges beyond classical critical map reading ideas and make a basic knowledge in GIS&T recommendable as well. Therefore, SPACIT competence modeling draw on less complex structured approaches of the GIS&T competence to arrive at an appropriate sub-structure especially of the instrumental GIS&T skills. As already introduced in Gryl & Jekel (2012) the concept of the Digital Earth Brainware Framework by Strobl (2008) (cf. Tab. 7) is hence implemented in SPACIT CoMo. Based on the benchmarking qualifications of the profile of the ‘Digital Earth Citizen’, SPACIT CoMo utilizes the structure and the existing “levels of intensity of exposure” to topics in the areas of spatial communication, -analysis, and –systems (Strobl 2008, p.4) as scaffold for the formulation of the dimension of ‘GM Technology and Methodology Domain’ (in detail: C1 to C3, A1, T/A). Finally, the
benchmark statements by HERODOT network as well as the Digital-Earth.EU network will be used to come to an elaborated design of the needed knowledge, skills and attitudes within this competence dimension.

<table>
<thead>
<tr>
<th>Competence areas</th>
<th>Description</th>
</tr>
</thead>
</table>
| Spatial communication       | (C1) ‘Consumer’: map reading, orientation and navigation, finding one’s place and identifying a destination.  
                               (C2) ‘Prosumer’: ability to participate by labelling a feature, mark up (‘redlining’) and rate a place or feature of interest and comment on alternative spatial scenarios, like a zoning proposal.  
                               (C3) ‘Producer’: contribute one’s own data like a GPS-recorded hiking track, a geocoded photograph and perhaps even a draft proposal map for a conservation measure. |
| Spatial analysis            | (A1) ‘Applying tools’ by competently using existing functionality to answer simple questions and fulfil single-step tasks.  
                               (A2) ‘Design analytical workflows’ by creatively using established methods and existing functionality to solve complex problems requiring multiple transformations and operations.  
                               (A3) ‘Develop methods’ for new problems or conceptualise new solutions or complex workflows, and implement them for general use. |
| Spatial systems             | (S1) ‘System setup’ and maintenance for out-of-the-box installation of well-documented system components.  
                               (S2) ‘Architecture design’ – competence to orchestrate multiple components, set up complex interfaces and profiles and link to external services.  
                               (S3) ‘Server / service development’ – implement specifications and design and develop new services. |

<table>
<thead>
<tr>
<th>Complementary Qualifications</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>G/R</td>
<td>Competence in establishing, using and transforming Spatial Reference Systems (SRS), ‘measuring space’ and advanced geocoding. This geodetic / surveying engineering qualification is an essential prerequisite for setting up DE frameworks and to guarantee high quality operations.</td>
</tr>
<tr>
<td>T/A</td>
<td>Technician qualification mostly for data acquisition and data conversion. As a profession this can be implemented from a vocational angle, or in other cases from a technologist or sensor specialist viewpoint</td>
</tr>
<tr>
<td>P/M</td>
<td>Project management and organisation is a generic skill and frequently implemented as a standalone (e.g. consulting) career path, critically important to cover business perspectives and for managing complex projects and implementations.</td>
</tr>
</tbody>
</table>

Table 7: Qualifications for ‘digital earth brain ware’ as set of suggested competences (C-A-S framework). Descriptions are cited from the given source. Source: Strobl (2008, p. 2ff.)

5.6 Contribution from Geography

Regarding significant aspects for SPACIT, the domain of geography is already well-accessed due to theories of the production of space linked to the relational concepts of space as part of research by partners within the SPACIT project (cf. Gryl & Jekel 2012), but especially by WP
1 (cf. Felgenhauer & Quade 2012). Therefore, the following additional remarks are kept to a minimum.

Within the SPACIT CoMo, aspects of the mature appropriation of geographical space are meant to involve both the awareness of relational concepts of space and its consequences for action in physical spaces. It should be pointed out that the domain of geography in this context is neither accessed through its different epistemological approaches and various academic disciplines within the fields of physical and human geography nor through its various implementations at the school level on the European scale. Looking at the most widely-spread research fields and content areas of geography such an undertaking for SPACIT competence modeling cannot be reasonable as well as successful. Instead, relations to the field of geography are explicitly made through the construction of the competence dimension ‘spatial domain’ and its partition into the strands of (i) ‘relative concepts of space’, and (ii) ‘absolute concepts of space’. Hence, relative spatial concepts are primarily based on the social construction of spaces by the attachment of meaning to physical matter. Here the approaches by Paasi (1986), Werlen (1993), Lefebvre (1993), and Massey (1998) are taken into consideration. Contributions to the sub-category of absolute space are mainly based on the spatial thinking approach by the NRC (2006) and its three-fold division of (i) concepts of space, (ii) tools of representation, and (iii) processes of reasoning, in conjunction with the ‘Taxonomy of Spatial Thinking’ (cf. Jo & Bednarz 2009). Both strands of relative and absolute concepts of space have to be filled more in-depth when it comes to the detailed creating of the curriculum content (cf. WP 2.2., 2.3).
6. The SPACIT Competence Model

Based on the structure of the SPACIT competence dimensions which results from content analysis and category development (cf. ch. 4) Figure 7 shows the SPACIT CoMo in complete. In this tabular scheme the columns represent the SPACIT competence dimensions, its single components as well as the particular knowledge, skills and attitude are summarized and further clustered into groups. The latter will serve at the starting point for the formulation of the connecting SPACIT curriculum (i.e. learning outcomes and objectives). The rows mark the affiliation of the single SPACIT competence dimensions within the competence model based on their distinctive function and, hence, can be described as ‘SPACIT Core Competences’ (i.e., instrumental and interpersonal competences); ‘Subject-specific Competences’; and ‘Framing Competences for SPACIT Implementation’ (i.e. systemic competence).

Each competence dimension is sub-divided at least into two competence components. The first one is labeled as ‘Meta-level’. It gives the rationale for each dimension in the context of the SPACIT concept, describing the overarching KSA fundamental to all other sub-categories of the particular dimension. Besides that coherent competence element each dimension further contains a number of individual components in order to structure SPACIT competences in more detail, described as the following:

SPACIT Core Competences

- **Geo-media information processing**: This area contains the KSA necessary for the mature handling of geo-data within Web2.0-based geo-media based on technical as well as methodological GIS&T skills concerning activities as well as processes of consumption, production and prosumption of GM, analysis carried out using GM as well as aspects of technical communication in the form of social networking.

- **Reflective consumption of geo-media**: Referring to the dimension of ‘Reflection on the use of GM’, this component describes the KSA fundamental to think about the role and the impact of geo-media as social constructions with limited representation of the world need to be deconstructed, and meaning to be reflected on critically in order to extend one’s own and others insights and perspectives.

- **Reflexive consumption of geo-media**: Referring to the dimension of ‘Reflection on the use of GM’ this areas contain the KSA the user needs to be reflexive towards her/his own geo-media consumption by being conscious of her/his own hypothesis construction. This involves awareness of the influence of geo-media on one’s own and people’s everyday action in general and also provides the anchor point for thinking about alternatives of spatial constructions potentially being represented in geo-media as well.

- **Communicative activities and strategies**: Within the field of ‘Communication with GM’ and its relation to the tradition of counter mapping strategic communication competence contains the KSA needed to carry out tasks and to perform certain activities/ actions in order to achieve or avoid successfully an intended objective within a (spatial) problem solving as well as a discourse process (e.g. spatial planning). This is understood as to organize and purposefully express and share one’s own and others (alternative) spatial visions and constructions within communication processes using spatial and non-spatial visualizations.
as well as various media like text, pictures, and drawing etc. embedded into discursive geo-media environment, involving communicative activities of reception, production, interaction, and mediation.

- **Socio-linguistic competence:** Within the field of ‘Communication with GM’ and its relation to the tradition of counter mapping socio-linguistic communication competence describes the KSA needed to appropriately communicate between representatives of different (cultural) communities or institutional groups sticking to the social conventions, norm and rules. Above all, this is connected to intercultural competence to be able to reflexively compare one’s own position/ membership in a particular community with the one of members of a certain target community, and, hence, to avoid misunderstandings and conflicts.

- **Pragmatic competence:** Within the field of ‘Communication with GM’ and its relation to the tradition of counter mapping pragmatic communication competence contains the KSA necessary for the individual to effectively perform (spatial) communicative functions in an (non-)linear interactive and discursive way, discerning the principles according to which messages are organized, structured and arranged.

### Subject-specific Competences

- **Relative concepts of space:** Referring to the ‘Spatial Domain’, this competence contains the KSA that work as a basis to understand and apply the efficacy of geodata as instruments to structure action in space by the construction of spaces. It refers to the fundamental principle of the attachment of meanings to physical matter, closely linked to the concept of the construction of spaces that bases on relative concepts of space. This competence concludes with the concept of the appropriation of spaces that connects the constructions of spaces with societal power relations and social action and in spaces.

- **Absolute concept of space:** As second component in the ‘Spatial Domain’, this competence contains the KSA basing on absolute concepts of space which are crucial for working with geodata and understanding spatial relations. It links to the approach of Spatial Thinking including KSA for tools of representation as well as processes of reasoning. As further aspect of an absolute understanding of spaces this competence refers to physical matter and its non-determinist influence on spatial structures beyond the attachment of meaning.

- **Concepts of citizenship:** Basing on emancipatory concepts of citizenship, this competence links to pivotal values for Spatial Citizenship, namely democratic principles and fundamental human rights, as well as to the KSA necessary for participation in society against the background of considering societal rules as fundamentally negotiable. ‘Concepts of citizenship’ also includes KSA to act as Spatial Citizen basing on an understanding of the role of institutions and fluent (new media) communities.

### Framing Competences for SPACIT Implementation

- **Creating learning environments:** This competence links to the KSA essential to plan and manage learning environments (pedagogical approach) and to design and act in class-
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- **Professional Growth:** This competence outlines the need of each teacher’s efforts to develop competences in the areas linked to Spatial Citizenship. Related KSA include the abilities and willingness to use (online) learning tools, to frequent related learning environments, and to reflect on own competences and competence development.

While the first approach refers to a meta level of situational action as teaching professional, the second relates to concrete and didactical approach. While the first approach refers to a meta level of situational action as teaching professional.
7. Outlook and following tasks
The SPACIT CoMo serves as the basis for the development of a curriculum for SPACIT education teacher training. In this context, the next tasks will be:

1. **Connecting curriculum (D2.2):** Creating a curriculum structure and appropriate measures which can be used to reach the competences suggested in the SPACIT CoMo. It also provides planned workloads according to the European Credit Transfer System (ECTS) for each part of the curriculum, for easier inclusion in various national initial teacher training and in-service training activities.

2. **Curriculum Plan and Framework (D2.3):** This is a curriculum plan and framework for SPACIT CoMo, provided for national and local initial teacher training and in-service teacher education. It will be based on the ECTS, and deals with aspects such as learning outcomes, qualification and credits, and aspects of quality assurance.
References


