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SYSTEM COMPETENCE IN GEOGRAPHY EDUCATION DEVELOPMENT OF COMPETENCE MODELS, DIAGNOSING PUPILS' ACHIEVEMENT

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Abstract
In the German educational standards in geography, the system concept is stated as being the fundamental concept for the subject. The first part of the essay explains what system competence means, based on the current theoretical and empirical state of knowledge. A solid system theory foundation which addresses the core concern of geography is offered by a socio-ecological system understanding. It is based on system characteristics that can be applied to physical geographical and human geographical aspects as well as human-environment issues. These characteristics are fundamental to the normative development of a structural and stage model for geographical system competence. This development is illustrated right up to the finished model. The second part of the essay explores the diagnostic tools to be used for the empirical verification of the postulated dimensions and stages of the competence model. A tool based on educational theory for the valid, reliable measurement of system competence is the ultimate objective.

Keywords: *Educational standards in geography, system competence, social ecology, competence modelling.*

1. NATIONWIDE INITIATIVE FOR COMPETENCE RESEARCH

'Are German pupils stupid?' – With this provoking question the popular political magazine DER SPIEGEL headlined in the year 2001. Reason for that were the weak results of German pupils within the first run of the international PISA benchmark study. This so-called PISA-shock evoked an intense, ongoing discussion in Germany about the educational system. After the German results have been compared with other nations which had been successful in the PISA benchmark study the general debate saw reason, that a one-sided input-regulation through curricula is not sufficient. Consequently, an essential paradigm shift towards a more intense output-orientation in Germany has been taking place for several years. Therefore, educational standards for individual subjects are gradually designed. In 2006 the 'Educational Standards in Geography for the Intermediate School Certficate' were completed by the

German Association for Geography (DGfG, [6]2010; English translation: DGfG, 2007). These educational standards define which competences pupils are supposed to have at the end of grade 9. The competences aimed at are to be described precisely within competence models in order to be able to come up with concrete assignments of exercises. So students' competences can be measured within a test (see Klieme et al., 2003). Thus, competence models are the foundation for testing the corresponding educational standards, as well as for the diagnosis and for the improvement of pupils' competences (see Mandl & Kopp, 2005).

At present the design of such competence models is *the* central challenge of German geography education and education in other subjects. At the end of 2008 a nationwide network of geography educators was founded in order to develop competence models for central geographic competences and their empirically validation (see Table 1). This network is supported by the cooperation with psychometric scientists and educational psychologists.

Table 1. Overview of all projects of the network 'competence research in geography education'

Competence	Competence model	Lecturers in Geography Education	Cooperation partners from Educational Psychology
Subject-speficic Knowledge	Geographical system competence I	Prof. Dr. R. Uphues (Uni Erlangen-Nuremberg) Prof. Dr. A.. Rempfler (PHZ Lucerne/Switzerland)	Prof. Dr. J. Hartig (DIPF Frankfurt)
	Geographical system competence II	Dr. S. Hlawatsch (IPN Kiel)	Dr. M. Lücken (IPN Kiel)
Spatial Orientation	Map reading competence	Prof. Dr. I. Hemmer (Uni Eichstätt Ingolstadt) Prof. Dr. M. Hemmer (Uni Münster) Prof. Dr. A. Hüttermann (PH Ludwigsburg)	M. Ullrich (Uni Koblenz –Landau)
	Reflexive map reading competence	Prof. Dr. D. Kanwischer , Dr. M. Horn, I. Gryl (Uni Koblenz-Landau) Prof. Dr. T. Rhode-Jüchtern (Uni Jena)	Prof. Dr. K. Schweitzer (Uni Erlangen-Nuremberg)
	Map sketching competence	Prof. Dr. G. Obermaier (Uni Bayreuth) Prof. Dr. F. Frank (TU Dresden)	Prof. Dr. Carstensen (Uni Bamberg)
	Mapping competence	Dr. A.-K. Lindau (Uni Halle)	N.N.
Acquisition of Knowledge / Methodology	Geographical experimenting competence	Prof. Dr. K.H. Otto, Dr. L. Mönter (Uni Bochum) S. Hof (Uni Gießen)	Prof. Dr. J. Wirth (Uni Bochum)
	Geographical competence on reading pictures	Prof. Dr. H. Jahnke (Uni Flensburg)	N.N.
	Competence on read aerial pictures	Prof. Dr. U. Wieczorek (Uni Augsburg)	N.N.
Communication	Geographical argumentation competence	Prof. Dr. A. Budke (Uni Köln) Prof. Dr. A. Uhlenwinkel (Uni Potsdam)	Prof. Dr. U. Schiefele (Uni Potsdam)
Evaluation	Ethical judgement competence	Prof. Dr. C. Meyer, D. Felzmann , Prof. Dr. D. Horster (Uni Hannover)	Prof. Dr. E. Billmann-Mahecha (Uni Hannover)
Action	Geographical action competence	Prof. Dr. M. Flath, Dr. J. Schockemöhle (Uni Vechta)	Dr. N. Menold, Dr. L. Kaczmirek (GESIS Mannheim)

In this essay the project of the authors, which is one of several projects about competences in the nationwide network, is presented. The authors currently develop a model for system competence.

2. SYSTEM COMPETENCE AS A BASIC CONCEPT FOR GEOGRAPHY EDUCATION

The development of the national educational standards forced lecturers in geography education to intensely rethink and discuss fundamental structures of their subject. The focus centres on the question how geographical education should be like in 21st century. In this process system competence turned out to be the basic concept for geographic education. In this concept earth is seen as a human-environment-system from a spatial perspective. Interaction between human geographical and physical geographical (sub-)systems becomes central (see Figure 1; DGfG, 2007, 11). For a deep understanding of the complexity of geospatial issues neither a structural nor a process-related view is sufficient. This is due to the fact that within one and also within several regional issues numerous interactions take place, which are not linear one-dimensional but multilateral and regenerative. Therefore if you analyse and think through geospatial issues, taking into account higher principles of systems seems to be the only adequate approach to achieve the central aim of geographic education which is the qualification for a future-oriented spatial behaviour (Köck, 1993, 1997, 1999; Klaus, 1998; Köck & Rempfler, 2004).

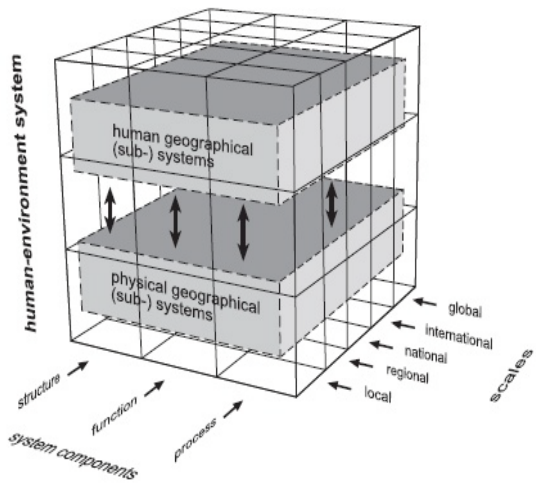


Figure 1. Basic concepts in the analysis of space in geography (DGfG, 2007)

In addition to that various authors make a case for system competence being essential for Education for Sustainable Development. Lecher (1997), co-founder of the psychological concept of ‘ecological thinking’, does not measure environmental awareness based on theoretical knowledge or verbally confirmed behaviour, but based on the extent of a person’s systemic reasoning powers. Bayrhuber et al. (w/o year), Riess & Mischo (2010) as well as Rost et al. (2003) assume, that learners can only actively participate in sustainable development if they recognise and understand complex and global relationships. The SysDene research group consisting of Swiss and German scientists in various fields, aims to explore ‘systems thinking for sustainable development’ and implement it at the elementary school level (Frischknecht-Tobler, Nagel & Seybold, 2008).

3. DEVELOPMENT OF A COMPETENCE MODEL ON GEOGRAPHICAL SYSTEM COMPETENCE

Based on didactic concepts competence models are supposed to name different aspects of each competence, to identify single stages of quality and to testify under which influences individual competences are developed. In order to design a competence model three criteria must be taken into account (see Figure 2): Firstly it must be based on normative educational theory. Secondly it must prove to be practically applicable at school and thirdly it must be empirically provable. Therefore it makes no sense to divide up the model into small stages, as teachers would be unable with making diagnoses. Likewise it would not be sufficient to derive stages from a theoretical perspective only, as students' results may show different in empirical testing.

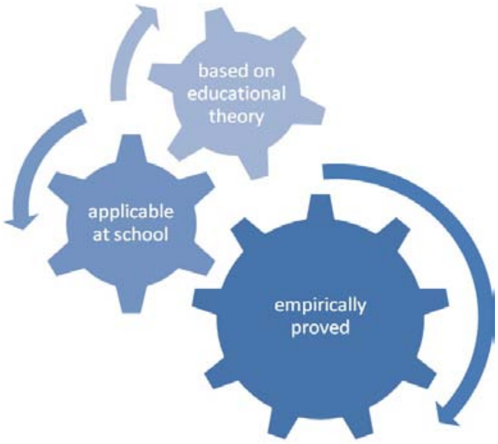


Figure 2. Three essential criteria of competence models

3.1. Foundation in educational theory

At the beginning of the project the foundation in educational theory had to be examined. As shown above the understanding of geographical systems is characterised by a connection between physical-material and social systems (Figure 1). Consequently we chose the system understanding of 'social ecology' (a young, interdisciplinary branch of science) as a basis (Becker & Jahn, 2006; Fischer-Kowalski & Weisz, 1999; Fischer-Kowalski & Erb, 2006). In social ecology an understanding of systems is used which proves to be well suitable because it overcomes the dichotomy between the natural and the social system. That is due to the fact that in this concept the network of relationships between society and nature is seen as a system in its overall context (Liehr, Becker & Keil, 2006). In contrast, the epistemological way of interpreting society and nature as two separate, almost autonomic (sub-)systems, which are only connected by outer relations, shows clear disadvantages. The geo-ecological system theory (Leser 1991, 2007) or the sociological system theory according to Luhmann (1984) come up against limitating factors because the natural sciences interpret social influences as external disturbances of the examined systems (and vice versa). Fundamental principles of systems according to the socio-ecological aspect are openness, autopoiesis, exemplariness, complexity, non-linearity, dynamics, emergence, delineation (by the intensity of a relational context), self-organised criticality (SOC), limited predictability and regulation (detailed explanations see in Rempfler & Uphues, 2010).

Table 2 shows the model for geographical system competence (derived from normative educational theory) which is based on the development of those social-ecological principles. The model consists of four competence dimensions which are ‘system organisation’, ‘system behaviour’, ‘system-adequate intention to act’ and ‘system-adequate action’. The two dimensions ‘system organisation’ and ‘system behaviour’ follow the empirical understanding of Sommer (2005, 252). ‘System organisation’ means the ability and competence to identify a complex section of reality as an organised system and to portray and describe its essential elements within a model. ‘System behaviour’ can be defined as the functions and the behaviour of a system. Based on theoretical reflection, the model includes two further dimensions, which comprise the ability to system adequate action (Köck, 1985; Lecher, 1997; Ossimitz, 2000; Rost et al., 2003; Köck, 2004a; Riess & Mischo, 2008; Frischknecht-Tobler, Kunz & Nagel, 2008). While dimension one and two emphasize knowledge acquisition, the system-adequate intention to act (dimension three) and system-adequate action (dimension four) focus on the application of knowledge. The distinction between ‘knowledge acquisition’ and ‘knowledge application’ is based on Funke (2003, 157). Whereas ‘knowledge acquisition’ refers to the identification of a system and includes a complex understanding of relationships and dynamics, ‘knowledge application’ means the process of controlling the system: Existing or acquired knowledge is put into an application framework and is used to behave adequate to the system and to help rectifying or avoiding system disturbances. The application of knowledge may occur mentally or in real actions. Mental application manifests itself through system-adequate actions in virtual space while active application includes concrete action in the real world (Köck, 1989). Since the valid assessment of dimension four can only take place in a real world setting, this dimension will not be taken into consideration within the further development of the model. For the remaining three competence dimensions stages had to be defined in a next step. These stages were derived mainly based on studies which are largely empirically proved (Lecher, 1997; Wilensky & Resnick, 1999; Sweeney & Sterman, 2000; Jacobson, 2001; Hmelo-Silver & Pfeffer, 2004; Assaraf & Orion, 2005; Sommer, 2005; Talanquer, 2009) and which theoretically as well empirically support the characteristics (Ossimitz, 2000; Sterman, 2000; Rost et al., 2003; Köck, 1984, 1998, 2004b; Frischknecht-Tobler, Kunz & Nagel, 2008). The division into three stages is intended to be a preliminary hypothetical model. However, an adaption due to the pursued empirical proof remains necessary.

Table 2. Fundamental theoretical model of geographical system competence

	Dimension 1: **System Organisation** *(Acquisition of knowledge)*		**Dimension 2:** **System Behaviour** *(Acquisition of knowledge)*			**Dimension 3:** **System-Adequate Intention to Act** *(Mental application of knowledge)*		**Dimension 4:** **System-Adequate Action** *(Active application of knowledge)*
	System Structure	**System Limit**	**System Emergence**	**System Interaction**	**System Dynamics**	**System Prognosis**	**System Regulation**	
Stage 1	- A small number of elements and relations is largely identified in an isolated manner - Low level of complexity - Monocausal thinking dominates	- Very vague delineation of a set of relationships - Elements and relations are not viewed as part of a whole	- Focus on concrete, perceptible system components - Characteristics of the components are perceived as identical to the characteristics of the system as a whole	- Interaction is the result of contact in time and space - Concept of causality has a monocausal focus - Simple stock and flow relationships are not identified to a significant extent	- The phenomenon or system is viewed as static-stable - Development progressions are only considered from a monocausal perspective - Awareness of the temporal dimension is largely lacking	- Effects of system behaviour are perceived vaguely and incidentally - Prognoses are based on direct and monocausal explanations - No awareness of limited predictability	- Regulative measures are implemented based on the monocausal analysis of effects - Effects of the intended measures are vaguely anticipated - Weakly defined reduction of complexity - System dynamics are not taken into account	
Stage 2	- A moderate number of elements and relations is increasingly identified together - Moderate level of complexity - Linear thinking dominates	- Moderately differentiated delineation of a set of relationships - Integrated perspective is lacking, but elements and relations are no longer viewed exclusively in isolation	Concrete, perceptible system components are combined at a higher level as part of a more general class with identical or similar characteristics	- Cause and effect are strictly separated - Interrelationships, series and parallel coupling are recognised - Simple stock and flow relationships are identified	- Longer linear relationships are also recognised - Causative explanation of movement and change - Developments are considered reversible	- Effects of system behaviour are perceived systematically - Prognosis take a monofinal or multifinal direction - Vague awareness of limited predictability	- Regulative measures are implemented based on the linear analysis of effects - Effects of the intended measures are systematically anticipated - Moderately defined reduction of complexity - System dynamics are sporadically taken into account	
Stage 3	- A large number of elements and relations is identified comprehensively and networked - High level of complexity - System is viewed as part of nested systems	- Clear delineation of a set of relationships - Integrated perspective - Difference between neighbouring systems is recognised	Understanding that the interrelationship of system components results in new structures with new characteristics at a higher level (emergence)	- Strict separation between cause and effect is eliminated - Feedback and cycles are recognised - Differentiation between internal system and external interaction - Complex stock and flow relationships are identified	- Non-linear (exponential and logistical) developments are also considered - The fact that developments are irreversible is recognised	- Effects of system behaviour are recognised as interrelationship structures and taken into account in the prognosis - Differentiated awareness of limited predictability	- Regulative measures are implemented based on the complex analysis of effects - Effects of the intended measures are anticipated and measures are modified if applicable - Highly defined reduction of complexity - System dynamics are continuously taken into account	

3.2. Application at school

The theoretical foundation is only one part in the process of developing a competence model. In addition to that the model must prove to be applicable in a real school context. This means a teacher must be able to understand it and be able to diagnose students' results with its help in everyday teaching. However, the model presented above (see Table 2), turned out to be too complex for that. Therefore, the next step was to simplify the model. The differentiation into sub-dimensions was given up because of that (see Table 3). In this process the core content was abstracted to the dimension level as well. Basis of this reduction was an analysis of complexity-generating characteristics. In this respect it was especially important which characteristics (independent from its related competence dimension) make a problem easier or more difficult. In context of this question two complexity-generating characteristics could be identified within the system competence framework: a) The number of elements and relationships (low, moderate, high) and b) the type of networking (monocausal, linear, complex). Therefore, these two characteristics were constitutive for the definition of stages.

Table 3. Competence and stage model for geographical system competence – subject to empirical validation

	Competence Dimensions		
	System Organisation **System Structure and Limit**	**System Behaviour** **System Emergence, Interaction and Dynamics**	**System-Adequate Intention to Act** **System Prognosis and Regulation**
Stage 1	The student identifies a low number of elements and relations, mainly isolated or monocausal and as a vague set of relationships.	The student analysis monocausal developments based on a weakly developed functional and process understanding.	The student develops prognoses and regulative measures based on the monocausal analysis of effects, vague anticipation of effects and weakly defined reduction of complexity.
Stage 2	The student identifies a moderate number of elements and relations, mainly linear and as a moderately differentiated set of relationships.	The student analyses linear developments based on an understanding of interrelationships, series and parallel coupling as well as simple stock and flow relationships.	The student develops prognoses and regulative measures based on the linear analysis of effects, anticipation of effects and moderately defined reduction of complexity.
Stage 3	The student identifies a high number of elements and relations, mainly complex and as a highly differentiated set of relationships, and as part of nested systems.	The student analyses linear and non-linear developments based on an understanding of feedback and cycles as well as demanding stock and flow relationships, irreversibility and emergence.	The student develops prognoses and regulative measures based on the complex analysis of effects, the anticipation of effects and highly defined reduction of complexity as well as awareness of limited predictability.

3.3. Empirical validation

The foundation in educational theory of the model has already been completed. Right now its practical applicability at school is being verified. This is true not only for our project about geographical system competence but also for most of all other projects within the network for geographic competence (see Meyer & Felzmann, 2010; Otto et al., 2010; Flath & Schockemöhle, 2010; Hemmer et al., 2010; Gryl et al., 2010; Budke et al., 2010; Frank et al., 2010). So the empirical verification of those normatively defined models has yet to take place in all of those projects. As such a validation needs a lot of resources the network has applied for funding through the German Research Association (DFG). The design of the research project on validating the model for geographic system competence includes three phases (see Figure 3).

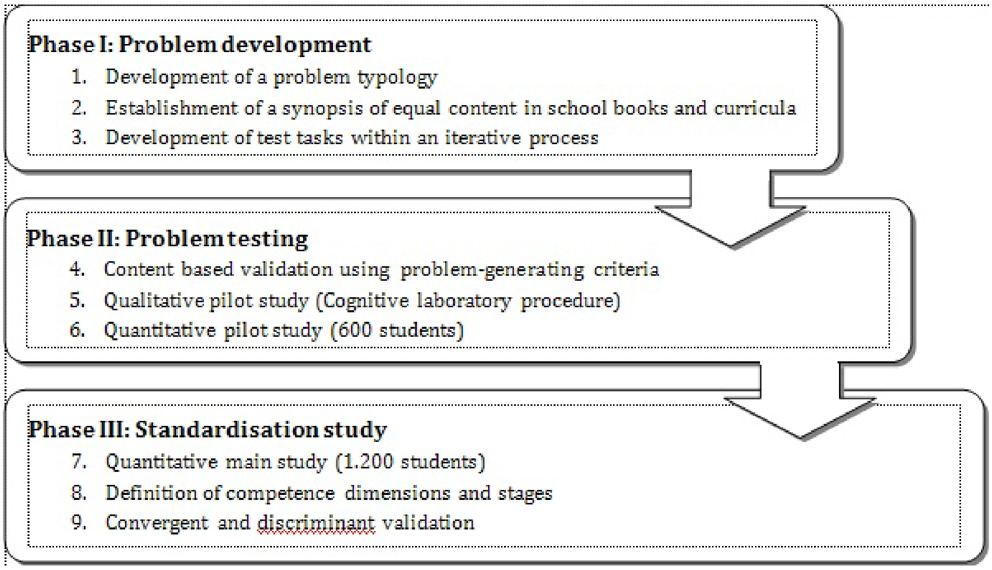


Figure 3. Planned research design for the empirical validation of the competence model on geographical system competence

Phase I – Problem development

In order to develop problems literature has been researched for all empirical studies on system competence especially for collecting different types of test questions. Then these problems were systemized and organised in a typology. In this context our preliminary studies delivered valuable findings as well (Rempfler 2010, 2011). The resulting typology includes adequate test exercises for each competence dimension (see Table 4).

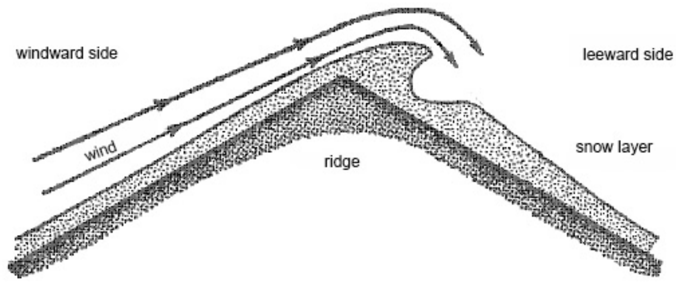
Table 4. Problem typology based on the competence dimensions

Competence Dimensions		
System Organisation (SO)	**System Behaviour (SB)**	**System-Adequate Intention to Act (SA)**
SO 1: An incomplete graphical representation (linear cause-effect chain [monocausal / series coupling], tree and network diagram) is provided based on a set of problems with background information. The student adds the missing elements and / or relations. Sommer, 2005	**SB 1:** Based on a specified system representation, individual system components are isolated, removed or added. The student analyses the resulting changes in regards to system emergence. Sommer, 2005	**SA 1:** One or more flow diagrams plus selective additional information are provided. The student develops the flow diagram further (prognostic and regulative). Sweeney & Sterman, 2000
SO 2: A system description in text form (without the course of developments) is provided with all relevant elements and relations. The student transfers this to a graphical representation (e.g. concept map). Klieme & Maichle, 1994; Ossimitz, 2000; Schecker et al., 1997; Bollmann-Zuberbühler, 2008	**SB 2:** One or more flow diagrams including a set of problems with background information are provided. The student answers related questions on the course of developments from a retrospective perspective. Sweeney & Sterman, 2000	**SA 2:** A set of problems with all system development information is provided. The student formulates questions to an expert regarding problems which are developing. Assaraf & Orion, 2005
SO 3: A graphical system representation (e.g. concept map) is provided. The student discusses the system and / or answers questions about the system structure & limit. Schecker et al., 1997	**SB 3:** A set of problems with all system development information is provided. The student answers questions about changes over the course of time from a retrospective perspective. Sommer, 2005	**SA 3:** A set of problems with all system development information is provided. The student answers questions about changes from a prospective perspective (prognostic and regulative). Klieme & Maichle, 1994; Sommer, 2005
SO 4: Individual information components for a system are provided (e.g. isolated if-then relationships). The student conceives system relationships in the form of a graphical representation. PISA-Konsortium, 2003	**SB 4:** A set of problems with all system development information is provided. The student answers retrospective 'what if' questions with regard to system irreversibility. Ossimitz, 2000	**SA 4:** A set of problems with all system development information is provided. The student answers prospective 'what if' questions. Ossimitz, 2000
		SA 5: Alternative scenarios and regulative measures are provided based on a set of problems with all system development information. The student evaluates the alternatives (also based on limited predictability). Sommer, 2005

One of the central problems we face while testing system competence is the high correlation with geographical subject knowledge. Geographical system competence can only be shown on the basis of knowledge specific to the subject. This means that if a student has little geographical knowledge on a certain topic he will not be able to show geographic system competence. Therefore, it must be guaranteed that all students are familiar with the geographical knowledge needed for the problems. Creating a synopsis of equal content and geographical terms, which will appear in all school books and curricula, can guarantee that.

The third step of phase I is the development of specific questions. Based on the compiled synopsis and considering the problem typology, problems which correspond with each field of the competence model matrix have to be developed. If the student is able to solve the problem, he belongs to this stage at least which is corresponding with the related competence level. Figure 4 shows an exemplary problem on the topic of ‘avalanches’, which helps to examine dimension one (system organisation).

Windward and leeward slopes



In winter there is sometimes a lot of new snow falling in the mountains. If the snow falls while there is no wind, it stays in one place. If, however, the wind is blowing hard, large amounts of snow are moved (see picture). Mountain slopes which are heavily exposed to the wind (windward) can become snow free due to snow drifts. On the other hand slopes which are averted from the wind (leeward) get a strong accumulation of snow. In the process of snow drift snow crystals are damaged and spilt into smaller particles. This has the effect that the snow gets compressed. As a result a new, slab-like layer of snow is formed. As long as this new layer does not bond with older layers, the likelihood of an avalanche is high.

Task

Illustrate all relationships as shown above in a concept map. Start with the given nouns, think of how they are connected and show this connection by drawing arrows. Don’t forget to label these arrows with a suitable verb. Make sure you have checked the direction of the arrows.

new snow

windward side

light wind / breeze

leeward side

strong wind

little particles

on-the-spot

slab-like snow

avalanche risk

Result

Concept maps help to determine different indices (see Bollmann-Zuberbühler, 2008; Rempfler, 2010, 2011).

Figure 4. Sample problem to diagnose geographical system competence (Rempfler & Künzle 2010, unpublished study)

The development of the problems is realised by an iterative problem-development-process (see Schnotz et al., 2008): A group of problem developers first creates initial problem prototypes which are validated by experts. Some of these experts are members of the international scientific research group SysDene (Frischknecht-Tobler, Nagel & Seybold, 2008). The experts give their feedback about the problems. After that the developers revise and enhance the exercises and send them back to the experts again. This process is repeated up to four times per problem. On the whole many problems have to be created in order be able to remove some of them after the pilot study in case they are not suitable.

Phase II - Problem testing

In the process of calibrating the content the developed problems are validated by experts who have not been involved in problem development before. These experts are supposed to assign each problem to one field in the matrix of the competence model (Table 3). For the purpose of content-related validation they have to go through the procedure the reverse way which is to derive the competence dimensions and stages from the problems.

Afterwards the qualitative preliminary testing of problems will be conducted. This testing follows the cognitive laboratory procedure (Alavi, 2005; Cohen, 2000; Long & Bourg, 1996) which had been used in PISA in order to detect potential problems in question designs. Therefore, students from the target population are asked to solve the problems within a test setting. While working on the problems the students have to think aloud. This setting is being filmed because it is supposed to give information about the text apprehension concerning the problems as well as about solution strategies and students' difficulties (especially against the setting of PISA-results in the category 'reading comprehension'; see Prüfer & Rexroth, 2000).

After that the quantitative pilot study takes place. The problems are now being solved by a sufficiently large and heterogeneous sample of about 600 9th graders. The goal of the pilot study is to determine the amount of time required to solve the problems and to analyse the items intensely (e.g. specification of selectivity, distractor analysis), as well as to obtain an initial assessment of degree of difficulty and Rasch homogeneity of the problem. In order to determine the identified quality criteria, a one-dimensional Rasch scale is completed for the problems for each dimension of problem. With those results it can now be decided which problems can be taken for the testing for each dimension and how the presentation of the problems can be optimized. On the basis of the item analysis a final revision of the problem-pool has to follow.

Phase III – Standardisation study: Verification of the competence model

Phase II results in a final pool of problems which can be used in the main study. In the main study 1.200 students are working on the problems in a 60 minutes test. The target group for the study has to consist of students from schools in urban and rural areas as well as of students with different family backgrounds. The problems are presented in a multi-matrix design. Thus, not all of the students have to work through all of the items. The usage of a Youden-Square-design for the test booklet guarantees a linking of all problems as well as a control of the positions of the items (Frey, Hartig & Rupp, 2009).

By means of a confirmatory factor analysis and more dimensional item-response theory models (Hartig & Höhler, 2009; Reckase, 2009) it is being checked afterwards if the theoretically created and within practical school testing reduced competence dimensions can be empirically verified or if the model has to be changed fundamentally.

For a further validation of the construct ‘geographical system competence’, the individual results from the students are connected with the outer criterion ‘school grade in geography’. Within a convergent validation geographical system competence should (at least to a moderate extent) correlate with the proband’s school grades in geography, biology and maths. Within discriminant validation, however, little correlations should be observed with grades from other subjects (such as German, foreign languages etc.).

4. CONCLUSION AND OUTLOOK

The development of a competence model on geographic system competence, as shown above, is still a long way off. At the end of our research process, however, we should not only have a model for it but also a pool of suitable test assignments. Both will help geography teachers to diagnose the geographic system competence of their students. Nonetheless, it must be stated that a mere diagnosis does not yet mean a promotion of the student’s performance. That is why we also ascertain potential factors of influence which might be related to the stages of geographic system competence. This includes individual preconditions like age, gender, place of residence, mother tongue, social background as well as intelligence and interest. The preconditions are expected to provide first clues for possibilities of promoting individual students. After that these possibilities have to be validated in an experimentally empirical pre-post-comparison.

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