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Daniel Pittich (Technische Universität Darmstadt)

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Herausgeber

Bernd Zinn

Ralf Tenberg

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Daniel Pittich (Technische Universität Darmstadt)

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Abstract

Based on a description of the lineages of the competence-construct, in the following essay different empirical approaches are accounted for and analyzed with regard to their specifics. Hereby, the dispositional facet of professional competences is regarded as a basic characteristic. Afterwards, the development and verification of a knowledge-accentuated and dispositionally orientated competence-theory is presented with reference to a validation-study. In the constitutive work-pattern - regarding subject-specific methodical competences - the comprehension of professional objects and processes is viewed as a central determinant of functional profession-competence. This dispositional modeling is diagnostically realized by using a reconstructive procedure. Hereby, different facets of comprehension are reconstructed in complex professional activities, being part of the profession of "carpenter". The findings presage that the hereby developed reconstructive procedure is suitable for a dispositional and therefore didactically orientated competence-diagnosis in the area of science and practise.

Keywords: competence, disposition, didactical theory of competence, reconstructive diagnostic, comprehension-accentuated.

Zusammenfassung

Dispositionale Zugänge im Kontext beruflicher Kompetenzdiagnostiken

In diesem Beitrag werden ausgehend von einer Darstellung der Entwicklungslinien des Kompetenzkonstrukts unterschiedliche empirische Zugänge bilanziert und hinsichtlich deren Spezifika analysiert. Als grundlegendes Merkmal gilt dabei die dispositionale Facette beruflicher Kompetenzen. Anschließend wird anhand einer Validierungsstudie die Entwicklung und Überprüfung einer wissensakzentuierten und dispostional ausgerichteten Kompetenztheorie vorgestellt. Im grundlegenden Arbeitsmodell der fachlich- methodischen Kompetenzen gilt das Verständnis beruflicher Gegenstände und Prozesse als zentrale Determinante fachlicher Berufskompetenzen. Diese dispostionale Modellierung wird anhand eines rekonstruktiven Verfahrens diagnostisch umgesetzt. Dabei werden unterschiedliche Verständnisfacetten in komplexen beruflichen Handlungen des Tischlerberufs rekonstruiert. Die Befunde deuten an, dass das hier entwickelte rekonstruktive Verfahren für eine dispositional und damit didaktisch ausgerichtete Kompetenzdiagnostik in Forschung und Praxis geeignet ist.

Schlüsselwörter: Kompetenz, Dispostionen, didaktische Kompetenztheorie, rekonstruktive Diagnostik, Verständniswissen

1 Initial point

National and international scientific discourse - out of the context of institutionalized educational processes concerning professional qualification and postgraduate training in recent years - has been significantly influenced by the competence-term and its purpose (Winther, 2010, p. 17). This fact can be - among other reasons - traced back to the "learning field-orientated curricula" (Standing Conference of the Ministers of Education and Cultural Affairs of the Länder in the Federal Republic of Germany (Kultusministerkonferenz, 1996)) currently used in Germany and to the so-called "europeanization" of (professional) education. Thereby both aspects appear as a fundamental change of paradigms, which has also manifested itself as a transition from qualifications to competences. This not only means a reorientation - accompanied by manifold challenges for science and practise in professional education - but it also signifies a fundamental shift in perspectives. Before the change of paradigms the focus was mostly concentrated on the input, that is to say on conditions and contents; in contrast to this a consequently realized competence-requirement means that the output - including everything which might be reached due to education and which should also be achieved with it - takes center stage. Viewed from the scientific perspective, this focus is associated with a systematic investigation of the competence-construct, pursuing the target of a modeling and diagnosis of (professional) competences. Until today the large-scaled comparison-studies of different countries - performed by the OECD (1999) - have had and also still have an enormous influence on the investigation of the competence-construct and in particular their theoretical foundation and methodological handling. As far as professional education of the last few years is concerned, the basic approaches – which depend on each other - and the instruments of the sector of general education have been manifoldly adapted and have also been specifically refined. The central focus of these approaches is on their suitability for large-scale-assessements (LSA), which demand both an appropriate standardization and high standards of data-reliability. Hereby - apart from the job-related approaches of Nickolaus and Winther - comprehensive and international endeavors regarding a "vocational-training-PISA" (shortform: VET-LSA), should also be mentioned. As part of a feasibility-study of a "vocational-training-PISA", advertised by the BMBF (among others Baethge et al. (2006), Baethge and Arends (2009b)), it was verified that a common base for a large-scale-assessment already exists in all of the eight [participating] countries regarding both profession-profiles and vocational-education-offer; which means that an investigation was to be underaken to see if in a later performed VET-LSA only those of all the included vocational training can be compared to each other which are really comparable (Baethge & Arends, 2009a, p. 494). The focus was hereby on both specific requirement-profiles and on expert-estimations with regard to basic comparability. In all analyses a general practicability has been observed from a scientific perspective - regarding all of the included specific professional groups - in spite of not insignificant challenges (Nickolaus, 2009, p. 481). These challenges primarily refer to the profession-specific aspect, because within the framework of a VET-LSA it might be barely sufficient to focus on nothing else than the diagnosis of general basic competences, as it was the case, for example, in PISA. Instead, a "vocational-training-PISA" aims at the "measurement of functionally-specialized job-related competences" (Baethge et al., 2006, p. 125). Similar claims and intentions were formulated in a further

analysis of a VET-LSA (among others Bals and Bohlinger (2009)). In retrospect it can be determined that it was only possible to partially redeem them. The previously performed analyses remained rather unspecific - both viewed from a competence-theoretical or especially from a psychometric perspective; ultimately this fact led to the current stagnation of an international VET-LSA-implementation; nevertheless its predecessors are refined by national research-approaches. For this reason, all internationally relevant research-endeavors of the German-speaking area (among others Nickolaus (2008, 2011, 2013); Nickolaus et al. (2011) and Winther and Achtenhagen (2009, 2010)) should be mentioned in the frame of the following essay. The exposed position of German approaches - out of the context of professional competence-modeling and -finding - can on the one hand be traced back to the DFG-program 1293 (Klieme & Leutner, 2006) and on the other hand to the curricular manifestation of a competence-requirement in all "learning field-orientated curricula" - as an integrative education-perspective of vocational school and enterprise. Thereby it becomes obvious that the currently established competence-requirement disposes of two corresponding target-perspectives: 1) one scientifically and 2) one practise- or school-orientated didactical perspective. First of all - in the context of a scientific investigation of the competence-construct - highly-specific, reliable and valid measurement-instruments can be observed, which are focused on a psychometric diagnosis of mostly professional skills (Nickolaus, 2011). With regard to the didactical or practise- and school-orientated perspective of the competence-requirement, theory and situation of empirical findings appear less multifarious. Approaches, which are in a position to meet the requirements of scientific quality-criterions and which hereby address more comprehensive didactical benchmarks – as completely diagnostical forms of feedback – have remained underrepresented so far. This desideratum takes up the approach being described in the following article. Hereby empirical approaches of professional competence-diagnostics should also be discussed below - based on descriptions of international lineages and on the OECD-wide established competence-term. On the basis of this a balance of both theoretic work-models and empirical approaches aswell as findings of a validation-study (Pittich, 2013) will be later mentioned - including its didactical implications.

2 The scientific competence-construct viewed from a national and international perspective

International lineages of the competence-construct

The scientific investigation of the competence-term was performed as long ago as 1959 (by White) and in 1965 (by Chomsky). Both approaches have been valid up to the present as basic theoretically-orientated initial points in a wide range of different competence-modelings. In Chomsky the construct is modeled - as a part of communication-studies - as the ability to formulate - by using a limited inventory of combination-rules and basic elements - a boundless amount of never-heard phrases in a self-organized way and to understand them (Chomsky, 1965). As a supplement hereunto White interprets competence as the result "of the development of basic skills, which are neither genetically inherent nor the product of

maturing processes, but which were created by an individual person in a self-organized manner" (White, 1959). These two early approaches denote both the reference to an individual person and to self-organization as a basic aspect of the competence-term, which is confirmed in various modelings of the OECD-area till today. Despite this basic theoretical initial point no consistently used competence-term can be determined within the international literature in the field (among others Winther (2010, p. 17)). In lieu of that, three different lineages have emerged as viewed from the international perspective. (Norris, 1991, p. 332 ff.). Thus in the North American education area a traditional behavioral perception is dominant, which contains the surveillance of "performances". The initial point of this approach is both the detailed description of the intended behavior and also the one of the ransoming situation together with its restrictions. In addition to these framework-conditions the explication of nature, extent and manifestation of the skills in particular appear as central features of the behavioral perspective. Regardless of the test- or instrument-specific implementation, these competence-approaches focus on workable outputs or outcomes, which are first and foremost denoted by knowledge and ability. (Winther, 2010, p. 18 f.). In addition, competence - as defined by Scheeres and Hager (1994) - does not distinguish itself by the disposability of knowledge and ability, but in particular by its profound situative application. For this reason, the aspects knowledge, ability and especially their effective application or their appropriability mark the central facets of this perspective. Concerning this matter Winther states that "a widespread knowledge- and ability-basis cannot be the only guarantee of a successful performance in usually complex situations" (Winther, 2010, p. 18).

This behavioral and performance-orientated perspective is confronted with a so-called "generic skill-orientated" one. Within this competence-orientation it is postulated that competence is composed of "a huge number of general abilities, of which it is supposed, that their availableness would facilitate the overcoming of mostly complex and work-world-orientated situatio" (Winther, 2010, p. 18). Hereby a different initial point and (reference-) perspective present themselves versus a behavioristically-orientated approach. The approaches of Mertens (1974) (key-qualifications), but also those of Reich (1991) ("symbol-analyst"), implement it in manifold ways. They should be seen as a reaction or answer to a change of professional activities and aditionally they should be integrated in appropriate learning-processes. The dominant orientation up to the 1970s of professional education to jobrelevant qualifications has become more and more questionable over the course of technologically-productive change. This change implicated advanced job-requirements, which would also demand from skilled workers in the future - in addition to their specialized expert-knowledge - transferable key-knowledge. In 1974 within Mertens' basic approach he differentiated between qualifications (qualifications of a superior category, which might be applied - among other situations - in logical, critical, analytic and restructuring thinking-processes), horizontal-qualifications (qualifications, which facilitate the efficient application of information, especially the acquisition, reprocessing and understanding of information), widespread elements (which means special, but however universally necessary qualifications, such as basic skills (reading, writing and calculating) measurement- or working-techniques) and vintage-factors (suspension of qualification-differences between generations - which were caused by innovations - as for example computer-literacy). At the beginning, the terminology

introduced by Mertens brought in its wake an unsharpness in the perception of the relationship of qualifications and competence; however, in a further discourse - performed in the eighties and nineties - it was proven to be slightly important, because key-qualifications can be interpreted not only qualification-, labour-market- or curriculum-theoretically, but mostly competence-theoretically (Reetz, 1999, p. 34). However, this competence-orientation includes essential limitations, because behind a collection of general abilities there is at the same time the assumption of a universal and profession-transcending applicability. Such a generalizability additionally features in the competence-theoretical context two central unanswered questions: On the one hand, the conveyance-possiblity and learnability seem to be problematic - because of the immense degree of abstraction - and on the other hand such general and at the same time abstract constructs can be only partially operationalized and might be hardly measured in science and practise. (Winther, 2010, p. 20)

These two already described approaches differ from each other in a significant way, as far as the meaning of the term "competence" is concerned. Whereas the North American competence-comprehension manifests itself as rather subject-orientated, the concept of "generic skills" remains more or less object-orientated. For this reason the second approach is (intensively) corresponding with the interpretation of the OECD- (Organisation for Economic Co-operation and Development) education-area. It is here that a traditionally more cognitively orientated competence-perspective (among others Gagné (1977) and Anderson (1992)) can be determined. This is based on the differentiation in performance and competence - regarding Chromsky's essay (1965, p. 3 ff.) - and it has been seen - at least since the important evaluation of Weinert (1999, 2001a) - as something already established. In summary, competences present themselves - within the frame of a cognitive orientation - as the mastery of unknown requirement-situations, based on individual and requirement-situation-specific decisions. (Westera, 2001; Winther, 2010).

However, these different concepts and lineages present a huge amount of intersections. As a connecting-link Winther (2010, p. 22) mentions among others the generalizability of competence in similar situations. In addition, especially the cognitive-orientated competence-manifestation of the OECD and the approach of the English-speaking areas – which focuses on "generic skills" – show important connecting factors. In particular, Reich's approach of the "symbol-analyst" (Reich, 1991) presents itself as something which is compatible in this context. The approach marks the conviction that a "symbol-analyst" has to generate "knowledge" increasingly in future activities in order to meet the changing requirements of the technically productive change. Whenever these basic ideas are projected onto the (technical) vocational area, Reich's approach turns out to be something which corresponds intensively with the visions of a science-accentuated (expert-) work, being comprehensible as a "specialized expertise." (Tenberg, 2011, p. 52 f.) Therefore, the line of development and above all Reich's approach present themselves not only as something competence-theoretically relevant, but also as something which marks - based on the focus on advanced expertise including job-relevant cognitions - an important interface to the cognitive basic-idea of competence within the OECD-area.

This common ground of an elaborated knowledge-accentuated skilled labor, furthermore underlines a fundamental distinguishing-characteristic to the more or less behavior-orientated "Learning-by-Doing-approaches" of the North American area. For this reason, - not only because of the OECD-wide established and currently realized Large-Scale-Assessments (PISA and TIMSS) - but additionally with regard to a concept of a basically science-accentuated expertise - a legitimization for the application of a cognitively-orientated (profesional) competence-term or model becomes possible. The meaning of knowledge, as a central facet of professional competences, seems to be unquestioned in science and practise and in addition as something which is empirically supported (Nickolaus, 2011). Such statements are not limited to dual-orientated systems of vocational education, but they are also relevant in a similar form for school-orientated systems - including a certain percentage of traineeships – as for example in Scandinavian countries, in which both theoretical learning and also expert knowledge have a central importance.

The currently used OECD competence-term

Despite the variety of currently realized competence-constructs and the non-uniform use of the term this has caused, model-overlapping aspects might be stated. These correspond intensely with both the cognitive competence-perspective of the OECD-area and also with the evaluation of Weinert - performed for the OECD (2001a). In this cognitive reference-context - among others - the aspects dispositions, situation-specificity, acquirement-possibility, knowledge and handling, but also motivation, should be mentioned as model-overlapping facets of the competence-term. Dispositions stand hereby for the non-explicit observability of competence and they become visible in performance or as part of concrete actions. Therefore performance marks the observed behavior and competence marks the underlying deep structure. The aspect of the situation-specificity considers that competences can be acquired only in specific situations (as for example in the form of duties and challenges.) Therefore, competences always refer back to a context within a specific domain (or school subject) and they are functionally connected with concrete situations. In addition, competences are learnable and it is possible to acquire them. These already outlined facets are estimated as something which is relevant within general approaches and those of vocational education. In addition, in the context of the modeling and diagnosis of professional "ability to perform something", the adding of knowledge and handling to the one of job-capacity is seen to be very important.

In accordance with these facets competences are regarded - in all models as context-specific cognitive dispositions, which enable independent acting and which are determined by knowledge - at a non-insignificant percentage (among others in Klieme and Leutner (2006), Weinert (2001a, 2001b)). Such a competence-term is taken in consideration in German research-programs (DFG SPP 1293, ASCOT), in which competences are explicitly defined as "context-specific cognitive capacity-dispositions, which functionally refer to situations and challenges in certain domains" (Klieme & Leutner, 2006, p. 879). In professional modelings and diagnostics these aspects are supplemented with the job specific applicability - which ultimately means the professional capacity to act. Whereas this article specifically addresses

vocational education and to hereby corresponding competence-approaches and diagnostics, it will be later delineated which empirical approaches currently exist in this context.

Empirical accesses in the context of professional competence-diagnostics

A specific glance at the literature - concerning modeling and psychometric measurement of professional competences - demonstrates, that with regard to approaches of commercial-technical education, in most cases - mostly by using IRT-based approaches - a latent and therefore indirect modeling or measurement of the target-construct competence is currently undertaken. Hereby, a huge amount of (behavioristic) behavior-measurements is performed, in order to finally come back - by using psychometric (probabilistic) measurement-methods - to competence as a latent construct. The strengths of such strategies are established in the precise diagnosability of the work-related target-behavior, the professional performance. But hereby it remains relatively unclarified which are the competence-relevant dispositions in that context that means that professional doers are finally competent enough to yield the performance. This question is only partially relevant for a transnational comparison, because hereby a comparison should be made between which (target-) performance or which outputs are obtained by participants in all test-situations. However these dispositions, which are marked as model-overlapping by an elaborated expertise, determine professional training. Because both the lesson-concept and the herefrom resulting learning- and efficiency-feedbacks necessitate detailed statements - being relevant for teachers and students - about how an individual can be guided to an autonomous problem-solution. However, for such statements all IRT-based competence-models have remained too general; therefore for a didactical orientation only an inversion of the test would be an alternative, that is to say a didactical reconstruction of IRT-confirmed duties, because for teachers of vocational schools these psychometric challenges are only accessible in exemplary sections. In addition, the highly-specific probabilistic statistic, which is behind these challenges, is mostly non-accessible for them and something which at the same time presents itself as hardly understandable. Also teachers determine - partially with good reasons - that within the frame of some test-scenarios competence-spectrums are postulated, that only partially correspond with the scholastic education. When for example a motor-diagnosis is performed - as a main content of a competence-inquiry - both the learning in companies and pratical learning are important, perhaps they are in that case even more significant than scholastic learning. Should the teachers dispose of the test-scenarios, including the appertaining results, widespread statements concerning occupational potential and deficiencies of students might be possible, but only a few corresponding aspects of professional knowledge and understanding. Nevertheless, this and nothing else would be necessary for an appropriate structuring of vocational training. Therefore it seems - both viewed from a national and international perspective - to be necessary to amplify the only diagnostically intended competence-approaches of the German-speaking vocational training-system and the one of vocational education and economic education with didactically intended approaches (Tenberg, 2012).

For this reason, an alternatively theoretical approach and an empirical access were explored in the frame of the actual validation-study. Therefore, the behavioristic approach might be

contraposed to a cognition-specific or dispositional one as an alternative. The subsequent differentiation of dispositional and behavioristic approaches is performed with regard to two different "kinds of performances": the target-performance (all that might be required by someone regarding professional skills) and the test-performance (all that somebody achieves in the frame of diagnosis). Within actual large-scale-assessments there is mostly an attempt to aggregate several test-performances - of the most likely resemblance - to the target-performance. In the available approach the test-performance does not orientate itself towards the target-performance, but towards the therefore necessary cognitive dispositions. The test-experimentees should be selected to demonstrate a possibly widespread expertise – within the frame of a complex reference to activities. The available access is therefore dispositionally intended; however it should pursue - like every dispositionally intro- and retrospective approach - the indirect method of a test-performance. Within more dispositionally intended approaches - based on an explicit knowledge-fundus (for example concerning reconstructive approaches) - it is therefore attempted to explicate professional behavior. The central strength of this approach is firstly that no latent and therefore indirect modeling of the competence-construct takes place, and secondly an action-related and practise-relevant diagnosis of knowledge is performed. The unanswered question of such a method is contained in the anticipation of professional behavior. Then - in contradistinction to the elaborated behaviouristic accesses - the job-related behavior is not explicitly, but mostly anticipatorily inquired in the dispositional approach, for example by using activity-reconstructions. For these reasons the dispositional and cognition-specific approach might be seen as an alternative or invertion of the behavioral one. At the same time it should be mentioned that its fortitude does not primarily appear in the diagnostical context, but that it should also be seen as a part of the didactical and methodical one, because a more detailed knowledge of job-relevant achievement-dispositions is directly effective for education.

3 Knowledge-accentuated model of specialized and interdisciplinary competences

The basic initial point of the dispositional approach is a knowledge-accentuated competence-theory. The basal theory of (Erpenbeck & Rosenstiel, 2007b) therefore seems to be suitable, because it presents itself – in a first approach – as something which is science-accentuated and which might be basic-theoretically traced back and which is empirically usable. The approach identifies four competence-classifications, (P) personal, (A) activity- and realization-orientated, (F) specialized-methodical and (S) social-communicative competences and in addition the two competence-types evolution- and gradient-strategies (Figure 1).

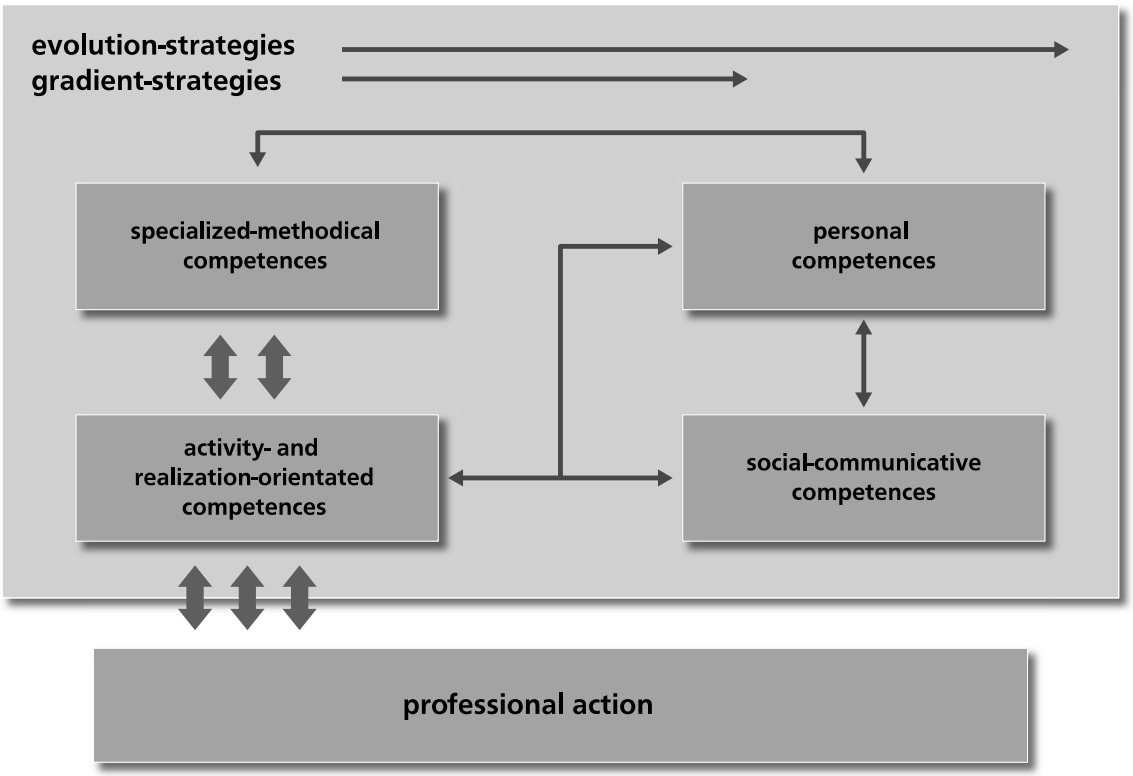

Fig. 1: model of competences referring to Erpenbeck & Rosenstiel (2007) combined with the extension of professional activities (Pittich, 2013, p. 45).

The four competence-classifications result from both the subject-object and the subject-subject-relationships and describe several mental or physical (self-organized) activities (Erpenbeck & Rosenstiel, 2007a, p. XXIII). In addition to the competence-classifications the model defines so-called competence-types. These are designated as gradient- and evolution-strategies. The first mentioned are so-called self-control-strategies (Erpenbeck & Rosenstiel, 2007a, p. XXI ff.), and especially algorithmically orientated and are used by skilled workers - above all within the frame of not too time-intensive processes. On the other hand, the evolution-strategies (self-organisation-strategies) are heuristically orientated and are used in particular in amplified problem-solving-situations of skilled workers. The distinction of competences - with regard to the requirement of corresponding demand-situations - conforms to the empirically well-founded findings of the commercially-technical competence-research of the German speaking area. For this reason, among others Nickolaus and Geißel indicate that especially at the beginning of the expertise-development, specialized competences and subject-specific knowledge would be of significant importance (among others in Knöll (2007, p. 22), Nickolaus et al. (2008), Nickolaus (2010)). Viewed from a theoretical perspective, Erpenbeck and Rosenstiel emphasize that personal and social-communicative competences would be more relevant for the realization of evolution-strategies and for this reason also necessary for a further development of expertise. As far as the transition from vocational education to a profession is concerned, the focus is placed on specialized-methodical

competences – as performed in the frame of the available validation-study. A central content of specialized-methodical competences is - with regard to Erpenbeck and Rosenstiel (2007a, p. XXIV), but also referring to formerly demonstrated models and findings - to integrate knowledge sense-orientated into activities. Despite this basic assumption the relationship between "knowledge and activity" in some of the currently used competence-modelings remains more or less unspecific and therefore also represents a current desideratum.

4 The comprehension-accentuated work-model of specialized-methodical competences

The preoccupation with a (competence-relevant) knowledge has - in the international area - a long tradition concerning different science-disciplines. In particular, cognition- or pedagogical psychology created a large amount of different descriptions and classifications of knowledge, in which definitions in this context mostly present themselves as approach-specific and are in most cases not transferable to other approaches.

Within a formerly performed analysis concerning cognition-theoretic knowledge-models the aspect of (professional) understanding was identified as a central factor of premium (professional) knowledge. As a result of this assumption further analyses have already been carried out in order to clarify the aspect of understanding. Especially important in this context is the explicit and implicit knowledge of Polanyi (1967), the expert-knowledge - defined by Bereiter (2002), the conceptual knowledge of Rittle-Johnson and Alibali (1999); Rittle-Johnson et al. (2001), the declarative and procedural knowledge of Anderson (1983), the activity-knowledge of Schelten (2004), the job-related-knowledge of Ebner (2001) and the transfer-model of Renkl (1994, 1996). The knowledge- and transfermodel of Renkl seems to be important for an understanding-accentuated modeling of knowledge, referring to two different aspects: 1) It takes the facet of understanding-knowledge into consideration in the form of conceptual knowlege and 2) it should be interpreted in the sense of a transfer-theory, which not only contains different aspects of knowledge, but which also tries to observe them with regard to (professional) activities.

Referring to an analysis and synopsis of the above-mentioned approaches, in a first step a cognition-theoretical working-model - including the explicit types of knowledge such as factual knowledge, process-knowledge and conceptual know-how - [1]was formulated. The conceptual knowledge hereby represents a professional comprehension-know-how and receives - in the context of the comprehension-accentuated model of knowledge - an exponated position, because it represents the reference-background of the different types of

[1] A detailed theoretical derivation and definition of types of knowledge is mentioned by Pittich (2013).

knowledge. Only by having a previously elaborated grounding in conceptual knowledge can an individual engage with argumentation-contexts and use them in (professional) situations in order to find a solution for (professional) problems. Referring to the partially outlined competence-, activity-, and cognition-theoretical pre-reflectations, the already recognized theories of the validation-study (Pittich, 2013) are combined in an integrative work-model. In this regard, the models of Erpenbeck and Rosenstiel (2007b) and Renkl (1994, 1996) and also the formerly mentioned basic theories of the cognition-theoretical model of work are especially relevant. Figure 2 visualizes the cooperation of the different types of knowledge as far as job-related activities and their liberty-graduations or their variabilty are concerned.

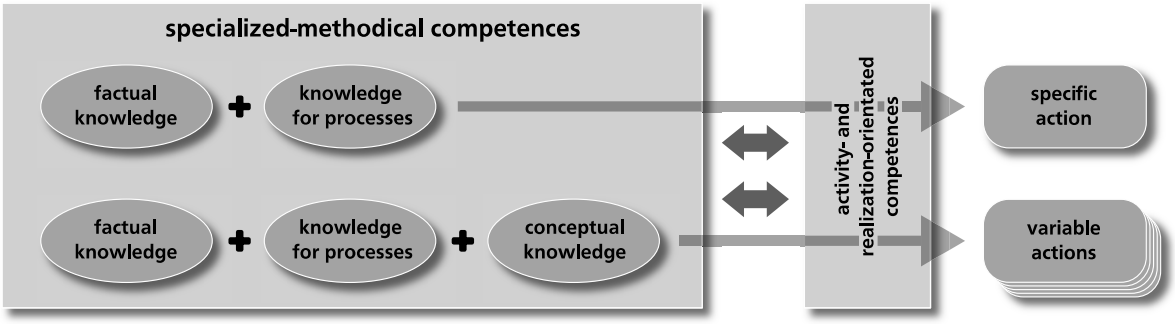

Fig. 2: Work-Model concerning specialized and methodical competences by using the theories of Erpenbeck and Rosenstiel (2007) and Renkl (1994).

Behind this postulation one could find the assumption that craftsmen or skilled workers are in a position to perform specific actions because of their factual knowledge and their knowledge of processes. A specific action mostly arises in action-routines of skilled workers and might be executed in the sense of the regulation of activities (among others Hacker (1973) and Volpert (1983)) – on the level of activity-planning or subgoal-planning. The range and the flexible applicability, that is to say the variability of activities, is hereby limited – with respect to this assumption. In order to reach a variable, which means a flexible and autonomously expandable and modifiable capacity to perform (professional) actions, conceptual knowledge is necessary. According to these assumptions, specialized and methodical competences concerning the professional know-how – are on the one hand influenced by a professional know-how - as an integrative knowledge, including factual knowledge and knowledge of processes and by a conceptual knowledge on the other hand. Its quality appears in the situation-flexibility of skilled workers or craftsmen. The more professional expertise - by the use of conceptual knowledge – made available by skilled workers or craftsmen within the respective occupational area the more they are capable of acting in real professional scenarios.

5 Research-methodical reflections of the study

In the study, which is taken as a basis for this essay, relationships between knowledge (of independent variables) and qualities concerning activities should be analyzed with reference to theoretical basic-assumptions of a dispositional competence-diagnosis. The focus of the

actual essay is concentrated hereby on the definitions of the empirical access to comprehension-accentuated knowledge of independent variables.

Random test and time of the inquiry

The explorative study is realized by an overall random sampling of N=32 probands. All participants pass the apprenticeship of a carpenter within the dual system and were in their third and last year of their education when the inquiry took place. The inquiry was performed eight weeks before the final examinations. The point of time proved to be adequate in two different ways: On the one hand it could be thereby guaranteed that a majority of all curricular contents of the dual education had been already passed, and on the other hand the professional discussion could be offered as a trustworthy repetition of and as a preperation for the later examinations. In particular, the last-mentioned aspects leads to an appropriate interest and motivation and proved itself in that context as something which is important for the empirical access.

Methods and instruments of the dispositional access

The choice of the inquiry-process orientates itself towards the characteristic of the activity-orientated dispositional knowledge-diagnosis and towards a psychological test. Those tests might be either realized in writing or verbally. Oral tests are also defined in literature by expressions like interrogation or interview (Atteslander, 2006). In order to perform these oral tests, a so-called reconstructing-approach was chosen. Reconstructional accesses are confronted with process-diagnostical ones. Thus the latter have tempted to expose "a modification of conditions or behaviors during a certain period of time" (Wild & Möller, 2009, p. 309). The diagnostics hereby directly take place in the frame of the process. In the meantime, in the course of a retrospection the diagnosis is performed, which means after the process. In the frame of a pre-study (Pittich, 2008) it becomes apparent that the process-diagnostical access shows among other things two unanswered questions, as far as diagnostics of competences is concerned. 1) An observation of the relationship between knowledge and acting seems to be only possible in a limited way, and 2) the process-diagnostical access presents itself as an extensive procedure, during which all relevantly complex activities can be only directly or appropriately observed within certain limits, which is caused by their duration and multifacetedness. Therefore an observation would only include certain segments and would aditionally restrict the range of empirical statements – as far as (vocational) competence-diagnostics is concerned. In order to make complex professional activities with a superior content-requirement accessible to a competence-theoretical diagnosis, a reconstruction seems to be adequate - also viewed from a perspective including research-economical facts. In addition both retrospective and reconstructive inquiries have been proven to be applicable for dispositional reference-contexts (Rausch, 2012, p. 252). According to this assumption professional activities can be reconstructed and at the same time also causative coherences - that is to say activity-determinated knowledge-contexts (dispositions of acting) - might be aditionally presented. Hereby the relationship between the comprehension-orientated working model and the reconstruction-approach seems to be applicable because of the knowledge-focused reflection of professional activities and it also seems to be interesting for an activity-orientated knowledge-diagnosis. The access of the reconstructive-dispositional

approach was performed in the context of a concrete professional problem-situation - a door with jamb - in the occupational field of wood engineering (or carpenters). The door with jamb has six manufacturing errors or patterns of defect – which are recognizable to a skilled wood-worker ("fraying on the front side", "burn marks in the rebate", "fraying in the wooden surface of the rebates", "dark spots on the panel", "dents" and "imperfections in the area of surface coating"). All patterns of defect are realistic and authentic and open a complex explanation-background, as far as their reasons, their correction or removal and also their prospective means of avoidance are concerned. These are based on a detailed object-analysis of several experts of wood technology and additionally lean towards the curricular guidelines of the recognized trade of "carpenter". As a result of this connection it was possible to guarantee that all central subject-specific contents of the occupational profile are shown in the diagnosis.

By using a specialist-knowledge-test it is firstly proven whether and how the apprentices are in a position to estimate all six patterns of defect. The estimation is performed by using a defined mode: 1) intensive inspection of the workpiece, 2) drawing up of a production plan, 3) recognizing, counting and describing the defects 4) clarification, of why each of the defects could appear, and 5) correction or removal and future avoidance of the defect. This procedure was created in pilot studies and it has been already optimized. All technical discussions are recorded during the interview and are additionally documentated audiovisually. Because of the simultaneous protocol, queries concerning the comprehension-background and also concerning activity-related dispositions are even possible during the interrogation.

6 Findings of a reconstructive-dispositional diagnosis

The description of findings of the reconstructive-dispositonal diagnosis is on the one hand orientated towards methodical basis-reflections - referring to the reconstruction-approach - and on the other hand towards the comprehension-accentuated modeling of knowledge. Hereby the description is especially performed qualititatevely - referring to all three postulated types of knowledge - factual knowledge, knowledge of processes and conceptual knowledge - and also referring to the steps of the reconstruction-approach and all six patterns of defect and the related correspondences. Subsequently the argumentation is sometimes performed with respect to correlation-coefficients and signification-levels; for more detailed, interference-statistical analyses of the scores – which were fixed for the whole approach - we suggest a closer look at Pittich (2013, 2014).

With regard to the correspondences of the types of knowledge and patterns of defect it should be established that the scores concerning the patterns of defect "fraying on the front side" and "burn marks" are significantly correlating with each other - transfering all types of knowledge. (p=.01). The pattern of defect "dark spots" is on the one hand correlating with "fraying on the front side" and with "burn marks". The correlations on the level of the knowledge of processes and the conceptual one reach the niveau p=.01, the factual knowledge is on the significance-level p=.05. The correlation of "fraying on the front side" and "fraying in the rebate-area" significantly refer to the knowledge of processes (r=.584; p=.004) and the

conceptual knowledge (r=.553; p=.011). The factual knowledge of these patterns of defect correlates with r=.354 and it just failed the marginal significance-level of p =.106.

The confrontation of all patterns of defect shows that in particular the patterns of defect ”fraying on the front side” and “burn marks”, which are the most important referring to all scores, are intensively connected. In addition, above all these two also correspond to other patterns of defect. These findings lead to a conclusion that “fraying on the front side” and ”burn marks” would not only quantitavely (parameter and score) but also qualitatively represent all central patterns of defect of the available approach. Statements - referring to the capacity of different patterns of defect - are only partially realizable because of their structure and extent, and also because of the related data. For estimations of the real capacity, comparable patterns of defect, that is to say those with a similar technical background, are necessary. Additional statements concerning predictive dependences only seem to be limitedly adequate because of the available complete approach.

Within the actual study a causal or predictive dependence might be only determined, if at all possible, regarding the patterns of defect “fraying on the front side”, “burn marks” and “fraying at the rebate-area”, because mostly it refers to the objective area and to the “contentual bracket” of the area of manufacturing-technique.

The inspections of all patterns of defect showed, that all of them - excluding only one - were in a position to meet with the requirements of an empirical diagnosis. The pattern of defect “dents” was not taken into consideration for further evaluation-steps, because it was not in a position to fulfil the empirical quality-criterions of an item-analysis after Bortz and Döring (2006) (especially the consistence of Cronbachs-α and homogeneity). In addition, it should be mentioned, that the patterns of defect “fraying on the front side” and “burn marks” make an important contribution in all types of knowledge because of their central specialized contents when their score is regarded. The patterns of defect “fraying at the area of rebate”, “dark spots” and “surface” have a less important quantitative influence, however they allow on different levels interesting possibilities of differentiation. The findings of all reconstruction-steps seem to be plausible, because the reconstruction-steps are based on an established procedure of defect-regulation (among others explained by Rapp et al. (2011)). The findings concerning the steps “reasons” and “avoidance” are particularly important in order to find out whether probands recognized central contexts and whether they are therefore disposing of profound comprehension-accentuated aspects of knowledge. Finally, it should be mentioned that in consideration of an exploration or of a qualitive access the instruments were mostly able to fulfill all expectations and intentions. The pattern of defect “dents”, which appeared to be inconsistent during the item-analysis, shows, that this diagnostically reconstructive procedure opens an enormous spectrum of cognitive accesses in the context of job-related situations. In addition, these findings emphasize the absolutely not self-evident consistency of other patterns of defect. Finally, it should be mentioned, that the diagnostical access should be proven by increasing the number of probands and also in a more standardized form - which should if necessary be modified or specified.

The findings of the comprehension-accentuated modeling of knowledge present themselves as similar to the findings of the empirical access. Within the below-mentioned descriptions, it

should be outlined to what extent 1) the types of knowledge factual knowledge, knowledge of processes, and the conceptual knowledge enable an empirically sustainable diagnosis of explicit knowlege-bases 2) and to what extent the already used diagnosis allows profound statements concerning both knowledge-profundity and knowledge-spectrum. The central findings of knowledge-modeling are also based on descriptions and interference statistical calculations. The descriptions, that is to say the quantities of the scores of the different types of knowledge, are a first indication for differentiation-possibilities - referring to the interpretation of different qualities of knowledge, even though a proof of standardized studies has not been performed up to now. In addition to the descriptive findings, the types of knowledge factual knowledge and knowledge of processes (α=.799 und α=.777), but especially the conceptual knowledge (α=.836), have been proven to be consistent during a rentability-study. In addition, the findings of interference-statistical analyses presage that conceptual knowledge plays the most important role in the frame of all competence-relevant knowhow. However, these findings should be relativized because of the insufficient random test and because of the explorative access. In particular, this is relevant for findings concerning factual knowledge or knowledge of processes, because during interference-statistical analyses reciprocal dependences of factual knowledge and knowledge of processes could be proven (r=.921). These dependences should be interpreted referring to the amalgamation-processes, which were observed by Nickolaus (2011). Certainly, they are plausible and might be traced back to an interdependent modeling of both factual knowledge and knowledge of processes and also to the structure of specialized contents.

As a summary it might be mentioned in the context of knowledge-modeling, that 1) the findings signify differentiation-possibilities between factual knowledge, knowledge of processes and the more profound conceptual knowledge and that 2) furthermore there is a phenomenon, which was mentioned as an amalgamation-process by Nickolaus (2011) - also belonging to factual knowledge and knowledge of processes.

7 Discussion and perspective

Discussion

As part of the later performed discussion - regarding the focusing of this essay - it should first be described, where the modeling of a competence-relevant knowledge, and secondly where the diagnostical access of a reconstruction of productional defects, can be localized. As an addition, at the end there will be a description, which might be an intermediate result of this study, concerning the question of a connection between knowledge and activities of skilled workers in the context of an application-orientated diagnosis of specialized competences.

The findings of this competence-model – which is including different knowledge-qualities – indicate that the differentiation of factual knowledge and knowledge of processes appears as an explicit and individual comprehension-facet, which is theoretically, diagnostically and didactically applicable. The seperated dimensioning of factual knowledge and knowledge of processes, seems – viewed from a theoretical perspective – to be suitable – despite the already

observed amalgamation-processes, because professional activities are always influenced by task-orientated and process-orientated elements of knowledge. In addition this division into two different parts is also important for a diagnostical realization, because a seperated consideration of both of the two knowledge-facets facilitates the operationalization of different items during a test-construction. Furthermore – irrespective of its scientifical usage - the differentiation of factual knowledge and knowledge of processes seems to be relevant for the didactical practise. Only by an appropriate differentiation of specialized knowledge-aspects can 1) didactical or learning processes be conceptualized and diagnosed and 2) possible problems in individual learning processes be recognized. In respect of the conceptual knowledge a currently not forseeable dimension indicates itself in the analysis of the deficits. Therefore, it should be verified, whether - in the context of the conceptual knowledge - a dimensioning in causative and correction-specific aspects of comprehension could be sustainable for prospective operationalizations. As a supplement to the - until now undeveloped - facet of conceptual knowledge, also the deficient concepts already described by probands, which have been operationalized as dysfunctional conceptual knowledge, appear as an interesting connecting factor. These deficient comprehensions should be seperately analyzed, because it is in particular relevant for school-related and didactical accesses. All basic starting points of further scientifical studies should be stated regarding the test-theoretical influences 1) of an interdependent modeling of factual knowledge and knowledge of processes and 2) of a standardization or operationalization of the individual comprehension-knowledge.

At the center of the reconstruction-approach was the subject-specific substantial clarification of all defect-patterns of the framed-door, which was oriented towards the reconstruction-steps “reasons”, “removal” and “avoidance”. Hereby, in all respective reconstruction-steps - taking account of all contents, which had been described by probands so far - profound spezialized comprehension-contexts were also tested. In the case of five-out-of-six defect-patterns, the aspects of comprehension reside in causative contexts and therefore in the reconstruction-step “reasons”. This contentual justification of the importance of the reconstruction-step “reasons” is supported by (descriptive) findings. For this reason, the reconstruction-step “reasons” presents itself – caused by its comprehension-accentuation – on the one hand qualitively and on the other hand quantitatively as a core element of the reconstruction-procedure. In addition, it directly corresponds with the reconstruction-step “avoidance”, because this one should be seen as a conclusion of former defect-causing activities. The explicitly described connection of “reasons” and a future “avoidance” presents itself especially as something that is important for the evaluation of conceptual knowledge, because hereby a transfer-relevance of knowledge is indicated. The correspondence of “reasons” and “avoidance” can be partially seen as something already proven regarding some aspects. In addition, it is reasonable, because the “avoidance” should be seen as a conclusion and finally as an inverted application of “reasons” of a defect-pattern. In the case of cognition of these contents an increasing comprehension might appear. The reconstruction-step “removal” presents itself as something being “uncoupled” from the two other reconstruction-steps and it has reference to a subject-specific appropriate removal of an occuring defect-pattern.

It became apparent that the modeling of a competence-relevant knowledge - within the frame of a qualitative access - is 1) metrologically-appropriate applicable and 2) empirically valid and reality-conformably verifiable. The analysis of the types of knowledge further shows, that in particular the knowledge of processes and also its subdimensions allow - regarding its approach - an appropriate selective diagnosis and analyse. In addition, it could be proven that in the frame of a first qualitative access it was possible to operationalize comprehension in a sufficient way. The operationalization of defect-specific misunderstandings presents itself currently as the unanswered question of the complete approach. In summary, it can be observed that it is possible to recognize - by using both a retrospective and reconstructive procedure - a wide range of possible requirement-situations as a part of the daily business of skilled workers and that this form of activity-orientated investigation of knowledge is of great importance - also in the context of a professional competence-diagnosis. Hereby each of all steps should be correlated with a specifical investigation-potential; combine together the already taken steps affirm, supplement and extend the accessed knowledge.

Regarding a superordinate classification of these findings, below the already described statements - with regard to the complete design - that is to say the correspondence of knowledge - and activity-qualities - will be presented. All of the most important previously referred to findings might be traced back to the analysis of (manifest) rang-correlations. The rang-correlative findings show, that the conceptual knowledge disposes of the most important coherence to professional ability to act. ($r=.553$, $p=.005$). Factual knowledge correlates to $r=.418$ ($p=.014$) and knowledge of processes to $r=.496$ ($p=.014$) with the professional ability to act. If types of knowledge - arranged in the sequence of factual knowledge, knowledge of processes and conceptual knowledge - are seen as increasing know-how-qualities, all of these findings have to be interpreted as an intended correspondence of knowledge- and activity-qualities.

Prospects

The study, which is the basis of this article, could demonstrate by the collectivity of its theories, its empirical methods and findings – including the restriction of an explorative approach – that 1) a knowledge-accentuated modeling of job-relevant competences, 2) an explication of comprehension-accentuated knowledge and also 3) a direct or dispositional investigation-access, including a recourse to 4) a reconstructive diagnose-procedure for an investigation of professional competence, are all of great importance. Regarding this importance and also with respect to the general applicability of this complete approach, two possible development-perspectives appear in the context of an application-orientated research of professional competences : 1) One scientifically- and 2) one practise-relevant perspective. For a sustainable scientifical competence-diagnosis, which might be seen as an alternative and a supplement of the currently elaborated LSA-approaches of professional education (national among others Winther (2010) and Nickolaus (2011)), the basic ideas of a competence-theory (which means the allocation of knowledge- and activity-qualities in a special respect of an explication of comprehension) and of the reconstructive diagnosis (which means the retrospective activity-access) should be both operationalized and standardized. For this purpose, further development-steps will be necessary, especially regarding the test-

construction. The extraordinary challenge will be whether the particularly individual facets of a comprehension-knowledge can be operationalized “ex post” to the extent that reliable and valid test-procedures, with respect to aspects of research-economy, will also be possible in the frame of large-scaled random samplings.

Viewed from the perspective of didactic practise, it will become on the one hand necessary to perfect all didactical implications of the complete approach - with regard to the professional development of competences, both didactically and methodically – and on the other hand to realize them. This is also relevant for the planning, conception and the execution of professional learning-scenarios. Based on this, the reconstruction-approach should be simplified to an amount that it might be used in an education-close diagnosis of specialized competences. A possible realization of the reconstructive approach might be performed - with respect to different qualities of knowledge – for example by using so-called “checklists” (Pittich & Tenberg, 2013). Finally, all of these reflections should be concretized in consideration of the respective schoolastic practise; they also should be evaluated and adapted to the current national requirements.

Regarding these two development-perspectives it should be mentioned finally that - with respect to a current didactical “design based research” - they might be above all performed integratively, because within that field the most important, quantitative-empirical findings are also only then in a position to convince, when they remain in a closed and non-contradictory relationship to the area of practise. In addition, in an actual placement-practise of technical positions, it might not be enough to make didactical and methodical decisions on the basis of vaguely confirmed statements from purely explorative research. It might only be possible to answer this - up to now only normatively clarified - basic theoretical question by further studies: which the competence-concept for technical professions - being offered in a modernized form as part of dual education in Germany - will in addition be active internationally and at the same time pioneering.

8 Literature

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Author

Daniel Pittich

TU Darmstadt, Arbeitsbereich Technikdidaktik

Alexanderstraße 6, 64283 Darmstadt (Germany)

pittich@td.tu-darmstadt.de

www.td.tu-darmstadt.de

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