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Volume 6

Competencies of Early-Stage Researchers

Development of a Competency Model

Sibel Vurgun (Ed.)

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In collaboration with

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Preface

The German University Association of Advanced Graduate Training (UniWiND/GUAT) was established in 2009 as an organization that brings together German universities for an exchange on opportunities, challenges, and reforms in the advancement of post-graduate training and education. The network currently has 59 member universities. One of UniWiND's main goals is professionalizing institutional promotion of early-stage researchers in Germany. To this end, it has established working groups in which representatives of the member universities discuss essential issues related to early-stage researcher development and existing offers at member universities.

The substantive collaboration among graduate centres at UniWiND's member universities has led both to the development of concepts that span across disciplines and individual universities and to a mutual exchange of best practices. The series of publications of which this volume is part is intended to make this concentrated expert knowledge widely available.

As the Executive Board of UniWiND, we hope that this series will contribute to

- initiating a broad debate on the main challenges in promoting early-stage researchers,
- continued exchange of good practices,
- the development of models and concepts for a sustainable early-stage researcher development at German universities, and
- the formulation of specific recommendations for the responsible stake holders at universities and higher education policymakers.

The authors of each volume are responsible for its contents. Volumes may thus differ in terms of character and emphasis.

This sixth volume presents the results of the 'Competency Profiles for Early-Stage Researchers for Academic and Non-Academic Careers' working group, which began its work in 2011. In its first working phase in the years 2011–2012, the working group set itself the following goals:

- working out a common framework for describing competency profiles of doctoral candidates,
- developing a set of instruments for assessing competencies at the individual level and taking it as a basis for fostering competency development,
- preparing guidelines, instructions, and instruments for increasing awareness among doctoral candidates for competency development,
- compiling a list of general core competencies.

This volume presents an initial outline of a competency model. In the second working phase, which began in 2013, the group is developing this model further into a competency grid.

This is the English translation of UniWiND Publication Volume 6 „Kompetenzen von Nachwuchswissenschaftlerinnen und Nachwuchswissenschaftlern. Entwicklung eines Kompetenzmodells", which was published in March 2016. Concepts and definitions refer to the academic culture in Germany.

The UniWiND Executive Board would like to use this opportunity to thank all of the employees at the member universities for their extraordinarily dedicated involvement in the working groups, without which this series of publications would not have been possible

The UniWiND Executive Board
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Table of Contents

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1 Introduction

Doctoral candidates and early-stage postdoctoral researchers have a wide variety of professions and career paths open to them. Not only do their qualifications make them ideal candidates for careers in university research and teaching or for positions at external research institutions, but they are also cut out for future leadership positions in the private and the public sector including careers at non-profit organisations. Examples include jobs in economic domains such as research and development and applied research and management as well as positions at cultural institutions and foundations, in science management, and at government agencies and social institutions.

However, launching a career and attaining long-term success in these multifaceted professional fields often demands a wide range of competencies. Many of the competencies professionals in these fields are expected to possess are addressed only indirectly or informally in the various phases of academic qualification, often in situations involving 'learning by doing', especially if they are not directly related to research work. Only seldom do early-stage researchers acquire and develop such competencies consciously. Moreover, they are often not aware of the possibilities for transferring these competencies into other domains, meaning that they do not reflect sufficiently on their generic character. It therefore seems useful and necessary on the one hand to continue optimizing the possibilities for helping early-stage researchers to build up a competency profile, both with regard to research and for a career outside of academia. Yet on the other hand it seems just as important to increase awareness for and thus make more transparent the competencies early-stage researchers already possess and have further refined in an academic context, as this enables them to improve their self-image and the way they convey this image to others. The implementation of corresponding strategies in providing qualifications to early-stage researchers constitutes a fundamental task for universities that not only serves to enhance their institutional competitiveness within Germany but also contributes essentially to positioning postdoctoral German academics on the world's interconnected labour markets.

A competency model that affords an overview of possible and relevant competency domains and delineates various attainable competency levels for early-stage researchers can be a helpful tool for developing such strategies and implementing concrete measures. The UniWiND working group 'Competency Profiles for Early-Stage Researchers' spent a first working phase in the years 2011–2012 developing framework parameters for a competency model of this kind, the results of which are presented in this volume.[1]

The working group's basic approach to this goal was marked primarily by extensive experience with existing concepts and measures in daily practice. In addition, the group consulted relevant research literature and existing competency models to develop a common theoretical basis.[2]

The working group took a systematic look at the various stages of the doctoral research process, determined what demands doctoral candidates are confronted with in each of them, and brought together the competencies involved in meeting those demands in an initial outline for a competency model. Moreover, the group compiled a list of conditions and measures for fostering the development of the outlined competency profiles. The results of the group's work up to this point provide a basis for deriving initial general consequences and recommendations on competency profiles. This paper summarizes these findings and also provides a look at the working group's future tasks.

[1] At this point the editor would like to give special thanks to Dr. Christian Dumpitak, who provided constructive feedback and numerous tips during the writing of this publication, even after the working group newly assembled for a second working period in 2013.

[2] Dr. Kristin Knipfer (a research assistant working under the Chair of Research and Science Management at the Technical University of Munich/TUM School of Management) provided an important impulse with her observations on competency development in science.

2 Explanation of Terms and Procedure

In grappling with the issue of competency development, it is first necessary to clarify the terms qualification and competency and answer the question of where and how basic ethical attitudes and beneficial qualities are located in this connection. The working group agreed on the following definitions:

- *Qualifications* are formal skills and reproducible abilities people need to possess to perform professional activities. They refer to specific tasks and contexts, so a successful qualification serves as preparation for specific tasks and contexts and lays the necessary groundwork for performing the tasks. Qualifications provide verifiable documentation of a learning unit whose content, scope, duration, format, and setting are institutionally determined. Qualifications are therefore communicable.[3]
- *Competencies* are predispositions composed of knowledge, skills, abilities, and attitudes (toward values)/qualities that enable people to master various situational challenges. The emphasis here is on the capacity to transfer these predispositions to a concrete situation. As such, competencies are not verifiable in the way that qualifications are but can only be made plausible.[4]

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[3] Definitions for qualifications available in the literature include the following: 'Individual working capacity, that is, all of the subjective-individual abilities, knowledge, and behavioural patterns that allow the individual to satisfy the demands in certain work functions in the long term (Baethge). Encompasses the functional, political-economic, and social dimension of work'. Translated from: Gabler Wirtschaftslexikon, URL: http://wirtschaftslexikon.gabler.de/Definition/qualifikation.html [last accessed on 17 July 2017]; 'Capabilities [...], that is, knowledge, abilities, and skills people possess [...] that can be used [...] in performing a professional activity'. Translated from: Teichler, Ulrich: Qualifikationsforschung. In: Arnold, R./Lipsmeier, A. (Eds.): Handbuch der Berufsbildung, Opladen: 1995; 'Items that are, in a manner of speaking, demanded mechanically in a test situation, knowledge and skills items'. Translated from: Erpenbeck, John/von Rosenstiel, Lutz: Einführung. In: Erpenbeck, John/von Rosenstiel, Lutz (Eds.): Handbuch Kompetenzmessung. Erkennen, verstehen and bewerten von Kompetenzen in der betrieblichen, pädagogischen und psychologischen Praxis. Stuttgart: 2003 pp. XVII–XLVI.

[4] They can also be assessed, but always with a focus on a certain aspect of the act of transfer: 'quantitatively (tests), qualitatively (competency passes, competency biographies), by means of simulations (for instance in a flight simulator), and in specific situations (work samples)'. Translated from Erpenbeck, John: Kompetenzen. Eine begriffliche Klärung. In: Heyse, Volker (Ed.): Grundstrukturen menschlicher Kompetenzen. Praxiserprobte Konzepte und Instrumente. Münster: 2010, pp. 13–19, here p. 18. Other definitions of competencies include: 'cognitive abilities and skills for solving particular problems that individuals possess or are capable of learning as well as the associated motivational, volitional, and social willingness and ability to make responsible and successful use of the solutions in changing situations'. Translated from Weinert, Franz: Vergleichende Leistungsmessung in Schulen. Eine umstrittene Selbstverständlichkeit. In: Idem (Ed.): Leistungsmessungen in Schulen. Weinheim & Basel: 2001; 'the ability to produce successful behaviors in non-standardized situations', from Westera, Wim: Competencies in education. A confusion of tongues, in: Journal of curriculum studies, 2001/33, pp. 75–88; 'A competency is the ability to satisfy complex demands in specific situations. Competent action includes the use of knowledge, of cognitive and practical abilities, as well as social and behavioural components (attitudes, feelings, values, and motivations). A competency is thus, for example, not reducible to its cognitive dimension but rather contains more than this'. From Gnahs, Dieter/OECD 2003, p. 2, in a summarizing translation of Gnahs, cited in Gnahs, p. 21f. Gnahs, Dieter: Kompetenzen. Erwerb, Erfassung, Instrumente DIE (Ed.), Bielefeld: 2007, p. 21f.

- *Basic ethical attitudes and beneficial qualities:* The literature speaks in this connection of values. Values (or basic ethical attitudes) are associated with valuations or judgements. Within a group or community, there are accepted values as well as values of higher or lower priority. Values are translated into the personal qualities that are beneficial for realizing a particular moral concept. Erpenbeck defines the following connections within the context of competencies: 'Individual competencies are grounded in knowledge, established by values, made available as abilities, consolidated by experiences, and realized on the basis of will.'[5] This means that the development of competencies in the individual depends among other things on internalized values, personal experiences, and a willingness to act. In order to be brought to bear, however, values need to be translated into the appropriate beneficial qualities.

Existing competency matrices and competency models include the German Qualification Framework for Lifelong Learning ('Deutsche Qualifikationsrahmen für lebenslanges Lernen'), which was passed in 2011,[6] the Researcher Development Framework (RDF) developed by Vitae for nationwide use in Great Britain,[7] and the 2010 APEC-Deloitte study 'Skills and competencies needed in the research field objectives 2020'.[8] While these models cover most of the competencies early-stage researchers need or are expected to possess, they often do not adequately or properly consider the particularities of the targeted group and the characteristics of the academic culture in Germany. It is doubtful, for instance, whether early-stage researchers see themselves adequately reflected in the existing competency grids and models. Moreover, many matrices and models are very extensive and can therefore quickly become confusing.[9] The competency model developed in the following combines a deductive and an inductive approach.

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[5] Translated from: Erpenbeck, John: Kompetenzen. Eine begriffliche Klärng. In: Heyse, Volker (Ed.): Grundstrukturen menschlicher Kompetenzen. Praxiserprobte Konzepte und Instrumente. Münster: 2010, pp. 13–19, here p. 18.

[6] https://www.dqr.de [last accessed on 17 July 2017].

[7] http://www.vitae.ac.uk/CMS/files/upload/Vitae-Researcher-Development-Framework.pdf [last accessed on 17 July 2017].

[8] https://jd.apec.fr/files/live/mounts/media/medias_delia/documents_a_telecharger/etudes_apec/skills_and_competencies_needed_in_the_research_field_objectives_2020/6185e35c6eef813aadaf2ee2bac10c6c.pdf [last accessed on 17 July 2017].

[9] In 2014, the working group drafted a statement on the Vitae Researcher Development Framework (RDF) that is available online: 'A Statement from the Perspective of Graduate Academies at German Universities by the Working Group "Competence Profiles of Early-Stage Researchers for Academic and Non-Academic Careers" of the German University Association of Advance Graduate Training (UniWiND/GUAT) on the Feasibility of Vitae's Researcher Development Framework (RDF) as a Standard European RDF', http://www.uniwind.org/fileadmin/user_upload/Arbeitsgruppen/A-Statement-from-the-Perspective-of-Graduate-Academies-at-German-Universities_finalversion.pdf [last accessed on 17 July 2017].

Deductive Approach

In an approach that infers the particular from the general, the extensive experience interdisciplinary graduate centres have with early-stage researchers in the doctoral stage can provide general principles and hypotheses for explaining individual instances. To this end, we first defined the various stages of the doctoral research process:

1. Orientation stage
2. Introductory stage
3. Research stage
4. Completion stage

We characterized these stages and listed possible demands associated with each of them (see Section 3). Then we compiled the general competencies and those generally attributed to post-doctoral researchers. These typical competencies may be grouped into eight competency clusters.

What competencies does the ideal early-stage researcher possess?

Table 1: Competencies of early-stage researchers

General Competency (Competency Cluster)	What competencies can employers expect early-stage researchers to possess?
Subject and expert knowledge	• Specialist knowledge (broader and more profound than students of the subject) • Method competency • Knowledge of specialist terminology • Good academic practice • Proposal writing skills • Familiarity with funding landscape • Research management competency • Academic marketing
Project management	• Coordination and organization skills • Time and self-management • Project management methods • Effective, efficient, and responsible resource management

General Competency (Competency Cluster)	What competencies can employers expect early-stage researchers to possess?
Capacity for teamwork	• Collaboration capability • Interdisciplinary work • Ability to handle conflicts • Team communication • Feedback methods
Leadership competency (on basis of capacity for teamwork)	• Field competency • Strategic thinking and acting • Conflict management • Assertiveness • Monitoring • Negotiation skills • Ability to control team processes
Creativity	• Open-minded thinking • Flexible thinking • Creativity methods • Courage to develop something new
Teaching and educational competencies	• Basic knowledge of teaching and learning processes • Course planning • Teaching evaluation • Assessment • Advising/Counselling • Supervision

Oral and written communication skills	• Presentation skills
	• Visualization
	• Media competency
	• Communication of knowledge/content for specific audiences and in specific contexts
	  • Interdisciplinary communication
	  • Communication with non-experts and the public
	  • Intercultural communication
	• Rhetoric and argumentation skills
	• Moderation skills
	• Academic writing
	• Context-dependent writing

Systematic and independent work	• Analytical thinking • Critical thinking, the ability to scrutinize and consider various positions • Capacity for abstraction • Problem-solving methods and knowledge • Transfer skills: ability to transfer knowledge to new domains • Organization, structuring, and optimization of processes • Independent thinking • Literature and information management • Information-seeking skills

General Competency (Competency Cluster)	What competencies can employers expect early-stage researchers to possess?
Personality development, views, attitudes, values	• Curiosity • Capacity for motivation (ability to motivate oneself and others) • Discipline, perseverance, and the ability to work under pressure • Reflection skills (self and others) • Ethical thinking and behaviour • Capacity to take on responsibility • Colleagueship • Fairness • Self-confidence
Cross-cutting topics	• Ability to think and act in intercultural contexts • Knowledge extending beyond one's own subject • Diversity • Work–life balance • Authenticity • Networking • (Self-)marketing

The two clusters 'Personality development, views, attitudes, values' and 'Cross-cutting topics' play a special role in that they are connected with the other competency clusters. Attitudes and values, for example, exert an influence on individual behaviour in concrete situations and are therefore an important component of competencies. A competency for 'good academic work' hence involves both corresponding subject and method knowledge (for instance knowledge of formal requirements and specialist topics) as well as social and communicative skills (such as the ability to communicate and integrate) and distinct attitudes concerning ethical values and qualities like respect and authenticity. Stated in highly simplified terms, competencies may be translated into the following formula: competency = knowledge + ability + attitude. The same is true of the cross-cutting topics. They add a further dimension to existing competencies in that they provide the appropriate attitudes for the various competencies, such as an awareness for gender aspects. In a third deductive step, we classified the various competencies as belonging to the stages of the doctoral research process listed above.

Inductive Approach

The opposite approach, an inductive approach, can be used to review and supplement the classifications. Proceeding inductively means starting with known individual instances, i.e., the particular, and using these instances to infer general patterns, i.e., to make generalizations. In this way, particular instances from the wealth of experience with early-stage researchers can be taken as a basis for identifying and describing general principles.

We began by compiling a list of 'critical incidents'[10] or typical challenges doctoral candidates face in each stage of the doctoral research process, including both positive and negative situations. In a second step, we described the desired behaviour for successfully dealing with these situations. This allowed us, in a third step, to infer the competencies and abilities that are necessary for dealing with them.

[10] Flanagan, John C.: The Critical Incident Technique. In: Psychological Bulletin. 51/4 (1954), pp. 327–358.

3 Competency Development, Stages of the Doctorate, and 'Windows of Opportunity'

People generally develop competencies by grappling with specific demands and tasks. The challenges that need to be met during the various stages of the doctoral process are therefore crucial for developing the competencies of doctoral candidates. The doctoral research process may be divided into four stages, which we describe in the following.[11] How long it takes to complete each individual stage depends on a host of factors, such as the field of study, the topic, and the type of funding , as well as other conditions, some of which are individual in nature. The amount of time an individual doctoral candidate needs for each stage may therefore differ considerably. Moreover, there is no clear-cut dividing line between the individual phases. This means, for example, that a person who is still at the introductory stage may already be initiating steps that belong to the research stage. What is important here is that the process of earning a doctoral degree as a whole is marked by the aforementioned stages. The stage model makes no claim to be complete but is intended as a working basis for the following considerations with the examples illustrated here.

Orientation Stage

The orientation stage is where the key parameters for the doctoral research process are defined. Once one has made the decision to pursue a doctoral degree, the next step is to answer questions concerning the topic, supervisor, funding, and type of the doctorate.[12] This stage typically lasts between one and three months, depending on the individual situation.

Introductory Stage

As soon as the general conditions for the particular doctoral project have been set, the task is to begin familiarizing oneself with the topic of research. The introductory stage generally involves reading up on the state of research, narrowing down the topic, laying down the theoretical groundwork, and deciding on which methods to apply. It should be ensured by this point at the latest that doctoral candidates have sufficient knowledge of the rules of academic integrity. The doctoral candidate should arrange a work schedule and timetable with his or her supervisor to structure the further process of the doctoral research. Many disciplines require doctoral candi-

[11] For alternative models for dividing the doctoral studies research process into phasesstages, see, for instance, Gunzenhäuser, Randi/Haas, Erika: Promovieren mit Plan. Ihr individueller Weg. Von der Themensuche zum Doktortitel. Opladen: 2006.

[12] In Germany the doctorate can be achieved on different ways, varying from the traditional "individual doctorate" (i.e. independend doctoral research project supported by a single supervisor) to a doctorate in a structured doctoral degree program (i.e. research project embedded in joint research environment with other early stage researchers supported by a team of supervisors).

dates to write a synopsis of their dissertation project during the introductory stage. For projects involving experimental or empirical research, this stage often includes a period of preparation and familiarization with particular technologies and instruments. The stage typically lasts between three and nine months, depending on the field of study.

Research Stage

The research stage involves implementing the project plan for the doctoral project as well as making any necessary readjustments and changes. The focus lies on the object of research. As with every academic project, the research question, theory, and method are adjusted to reflect knowledge gains and are subject to continuous development. Depending on the discipline, the doctoral candidate may collaborate with other researchers, write parts of the dissertation, publish articles in academic journals, and/or present papers at conferences during this stage. The research stage is generally the longest stage of the doctoral research process and usually lasts between two and a half and three years.

Completion Stage

The completion stage leads to the completion of the dissertation. The research work is concluded in this final stage and the results summarized in the dissertation. After submitting the dissertation, the doctoral candidate takes an oral examination in the form of a defence, a Rigorosum, or a major field examination. The process concludes with the publication of the dissertation.[13] Exploring various career prospects also becomes more important at this final stage of the doctoral process at the latest. The completion stage may often last between three and twelve months, depending on the discipline.

Table 2 summarizes these stages of the doctoral research process, their characteristics, typical challenges associated with them, and relevant topics for institutional support. It provides an overview of the most important issues doctoral candidates are faced at each of the stages. The fact is, however, that there are several issues doctoral candidates regard as important, such as exploring career prospects, but that they do not put any serious thought into it until very late, not to say too late. It is therefore very important to ensure that doctoral candidates are aware of certain topics. The topic of career orientation, for instance, is a great challenge that needs to be addressed by universities and interdisciplinary graduate centres.

[13] The process of revising the dissertation for printing and publication often overlaps with the early postdoctoral stage. The publication is omitted in the case of cumulative dissertations.

Tabelle 2: Overview of stages of the doctoral research process, their characteristics, topics for support, and typical challenges or crises during these stages (*this last point in accordance with Fiedler and Hebecker, 2005)

Career Phase	Orientation Stage	Introductory Stage	Research Stage	Completion Stage	Postdoc Stage
Duration	**1-3 months**	**3-9 months**	**2,5-3 years**	**3-12 months**	
Stage characterized by	Search for • Topic • Supervisor • Funding • Type of doctoral research (individual or within structured programme)	• Synopsis/project plan • Familiarization with research topic	• Implementation of project • Review • Changes/readjustments • Documentation of results	• Conclusion of project • Completion of dissertation • How can I finish? • What comes afterwards? • Funding • Final exam • Publication	• Project planning • Funding proposal • Teaching • Leadership functions
Topics for support	• Advising, counselling and coaching • Clarification of goals: Why earn a doctorate?	• Good academic practice for doctoral candidates • Project management • Self- and time management • Development of goals and strategies for research (milestones) • Supervision agreement • Mentoring (introduction to doctoral studies)	• Academic communication: publications, presentations, conflict management, diversity, etc. • International experience: trips abroad • Networking: integration into the academic community, private sector • Progress reports/records of meetings • Situation analysis and career development • External funding proposal • Professional teaching in higher education • Team development measures • Leadership principles • Mentoring in the advanced research stage (career orientation) • Creativity methods • Feedback methods	• Training for disputation • Career options • Public relations and press work (How can I bring my topic to public attention?) • Self-marketing • Job applications • Development of Leadership competencies • Entrepreneurship • Entrepreneurial thinking and behaviour	• External funding proposal • Professional teaching in higher education • Leadership topics • Moderation skills • Creativity methods
Typical challenges and crises*	**Preparation**	**Euphoria** **Sense of being overwhelmed**	**Crisis of meaning**	**Completion crisis**	**Career orientation**

The table lists crises doctoral candidates are typically faced with in the individual stages.[14] The authors Fiedler and Hebecker describe the following typical crises within the context of advising and supervising doctoral candidates:

1. Preparation phase: Difficulty choosing a topic and supervisor and settling issues concerning organizational conditions and funding.[15]
2. Sense of being overwhelmed: 'Overabundance of material on theories, methods, data, and sources [...] that one supposedly needs to use: "One does not see the forest for the trees."[16]
3. Crisis of meaning: 'Significance of one's own research findings, their importance in comparison to other studies, is unclear and difficult to determine [...] The crisis is triggered by an uncertainty as to the relevance and significance of one's own research and findings.'[17]
4. Completion crisis: 'not being able or wanting to finish, particularly [...] when one has clearly exceeded one's original work schedule and timetable'[18], mounting pressure and increasingly unrealistic demands (from within and from outside). Moreover, 'uncertainty with regard to the time after completion'[19] and a delay of submission reinforce each other.[20]

If one assumes that adults are more willing to learn when it seems difficult or hopeless to overcome challenges or crises by simply 'muddling through'[21] them, it is precisely these phases that gain a special significance in the context of initial and further training. Such phases of increased willingness to learn can become 'windows of opportunity'[22] for long-term competency development when the graduate centres offer their doctoral candidates specially designed advising and training programmes. It is therefore very important to obtain an overview of stages of the doctoral research process in which doctoral candidates will likely exhibit an increased willingness to learn, not least with an eye to providing training in the domain of transferable skills.

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[14] Cf. Fiedler, Werner/Hebecker, Eike: Promotionskrisen und ihre Bewältigung. Empfehlungen zur zielführenden Planung und ergebnisorientierten Gestaltung des Promotionsverlaufs. In: Behrendt, B./Voss, H.-P./Wildt, J. (Eds.): Neues Handbuch Hochschullehre. Berlin: 2005, pp. 1–16.

[15] Ibid. p. 2ff.

[16] Translated from ibid. p. 4.

[17] Translated from ibid. p. 5.

[18] Translated from ibid. p. 6.

[19] Translated from ibid. p. 6.

[20] Cf. ibid. p. 6f.

[21] The strategy of muddling through challenges on the basis of existing knowledge, skills, and attitudes is described by Charles E. Lindblom in his 1959 study. Cf. Lindblom, C. E.: The Science of 'Muddling Through'. Public Administration Review 19(2) (1959), pp. 79–88.

[22] In developmental psychology, windows of opportunity refer to phases in which children and adolescents are receptive to learning. Since neural connections are established in the brain during these phases, they are often also called neural windows. For the background of the term as well as recent scientific findings, cf. Bardin, Jan (2012).

Stage-Dependent Competency Development: Results

The main result is an initial overview of the inductive analyses of the doctoral research process that is already quite comprehensive. It is illustrated in the following tables, which are also organized according to the stages of the doctoral research process. The representation also includes the early postdoctoral stage, because this phase often involves a process of getting one's bearings, and the transition to an academic career also calls for the development of competencies. The vast majority of doctoral candidates in Germany seek employment outside of universities, meaning that they primarily find jobs at private enterprises or in the public sector, where they are generally out of reach for the universities and the interdisciplinary graduate centres. The competencies of this group are thus no longer available for systematic development by these institutions. In light of this situation, it is all the more important to make doctoral candidates aware of their career options early on and to offer them relevant orientation measures, such as opportunities for further competency development.

The steps of the inductive approach are visible on the left-hand side of Table 3: the challenging situations or critical incidents, the desired behaviour for successfully dealing with the situations, and the competencies that are necessary for dealing with them. It should be noted that a critical incident may correspond to several desired behaviours and also to several competencies.

Table 3: Stages of the doctoral research process and necessary competencies (inductive)

Career Phase	Orientation Stage	Introductory Stage	Research Stage	Completion Stage	Postdoc Stage
Critical incidents (examples)	• I can't find a topic. • I can't find a supervisor. • I don't have funding. • I want to explain/save the world/ deal with my own problems.	• I can't narrow down my topic. • I don't know where to get my working material, how and when I can use the equipment. • I've discovered a source that already fully covers my topic.	• The circumstances leave me no time to work toward a doctorate (teaching, conferences, administration, funding, family, etc.). • I don't have any results. • I have writer's block/blank page syndrome. • There's no point in pursuing my doctoral research project.	• My funding is running out. • Writing a dissertation is not for me; I want to quit. • Writing a dissertation is taking over my life; no private life/ work–life balance.	• I don't know how and where I can submit an application. • I'm afraid of taking on leadership functions. • Should I stay in academia or get out? • Should I go abroad? • Family and/or career?
Desired behaviour, e.g.:	• Reading and gaining an overview • Reflecting on your own interests and expectations (professional and personal). • Making a realistic appraisal of the opportunities and risks of pursuing a doctorate • Making an effort to secure funding	• I have the courage to make decisions. • I accept the terms of conducting research (ambiguities, uncertainties). • I communicate my dissertation project. • I demand supervision and seek support.	• I learn to say no. • I set priorities. • I create a sense of achievement for myself. • I don't let myself be discouraged. • I identify conflicts and deal with them constructively. • I start writing.	• I communicate my dissertation project. • I enquire about completion grants and career options. • I activate my network. • I tackle problems and seek professional help if necessary.	
Derived competencies, e.g.:	• Transfer skills: Ability to transfer knowledge to new domains (e.g., master's thesis) • Independent thinking • Literature and information management • Self-reflection, decision-making competency	• Organization, structuring, and optimization of processes • Time and self-management • Self-reflection • Decision-making competency • Analytical, critical thinking	• Project management • Time and self-management • Self-reflection • Decision-making competency • Writing competency • Capacity for teamwork • Capacity for cooperation	• Ability to present research findings • Self-reflection • Decision-making competency • Writing competency • Capacity for teamwork • Appropriate attention to detail	• Information management • Leadership competency • Teaching competency
Personality development: Values, views, attitudes, e.g.:	• Courage to develop something new • Taking on responsibility for oneself	• Courage • Passion • Perseverance • Assertiveness	• Passion • Perseverance • Assertiveness • Frustration tolerance • Self-motivation	• Perseverance • Frustration tolerance • Self-motivation • Self-efficacy belief	

Table 4 illustrates which competencies are or can be called for at which stages and thus shows the overall results with regard to the stages of the doctoral research process and the necessary competencies for each of them.

Table 4: Stages of the doctoral research process and necessary competencies (inductive and deductive)

Career Phase	Orientation Stage	Introductory Stage	Research Stage	Completion Stage	Postdoc Stage
Subject and expert knowledge	• Literature and information management • Information-seeking skills • Method competency	• Good academic practice • Method competency • Knowledge of specialist terminology • Specialist knowledge (broader and more profound than students of the subject)	• Research management competency • Academic marketing • Motor skills • Method competency	• Familiarity with funding landscape • Project proposal writing skills • Information management • Motor skills • Method competency (research)	• Information management
Creativity		• Open-minded thinking (without blinkers)	• Courage to develop something new • Flexible thinking		
Project management		• Coordination and organization skills • Time and self-management • Project management	• Effective, efficient, and responsible resource management • Organization, structuring, and optimization of processes, project management • Event management	• Organization, structuring, and optimization of processes, project management • Time and self-management • Event management	
Systematic and independent work	• Independent thinking • Analytical thinking • Critical thinking • Capacity for abstraction • Ability to think and act in intercultural contexts • Transfer skills: ability to transfer knowledge to new domains (e.g., master's thesis)	• Literature and information management • Information-seeking skills • Organization, structuring, and optimization of processes • Analytical, critical thinking	• Analytical thinking • Critical thinking • Capacity for abstraction • Problem solving methods and skills • Transfer skills • Independent thinking • Information management • Appropriate attention to detail • Ability to defend one's own interests (e.g., university self-administration and policy)	• Ability to contextualize research findings • Analytical thinking • Critical thinking • Appropriate attention to detail • Ability to defend one's own interests (e.g., university self-administration and policy)	

Career Phase	Orientation Stage	Introductory Stage	Research Stage	Completion Stage	Postdoc Stage
Oral and written communication skills		• Writing competency • Communication and presentation competency • Intercultural competency	• Presentation skills • Visualization • Technical media competency • Communication of knowledge/content for specific audiences and in specific contexts • Interdisciplinary communication (given context) • Intercultural communication (given context) • Rhetoric and argumentation skills • Academic writing • Context-dependent writing	• Communication with non-experts and the public/media (given context) • Ability to present research findings to specific audiences • Writing competency • Communication and presentation competency • Intercultural competency	
Capacity for teamwork		• Capacity for teamwork • Capacity for collaboration • Intercultural competency	• Capacity for collaboration • Interdisciplinary work • Ability to handle conflicts • Ability to deal with criticism • Team communication • Capacity for teamwork • Intercultural competency • Ability to give and receive constructive feedback • Ability to learn from mistakes	• Capacity for teamwork • Capacity for collaboration • Ability to give and receive constructive feedback • Ability to learn from mistakes	
Leadership competency			• Strategic thinking and behaviour • Conflict management • Assertiveness • Negotiation skills • Ability to control team processes • Leadership competency • Decision-making competency • Ability to defend one's own interests (e.g., university self-administration and policy)	• Field competency • Decision-making competency • Leadership competency	• Strategic thinking and behaviour • Conflict management • Assertiveness • Monitoring • Negotiation skills • Ability to control team processes • Leadership competency

Career Phase	Orientation Stage	Introductory Stage	Research Stage	Completion Stage	Postdoc Stage
Teaching and educational competencies			• Supervision • Basic knowledge of teaching and learning processes • Course planning • Teaching evaluation • Assessment • Advising	• Teaching competency	• Basic knowledge of teaching and learning processes • Course planning • Teaching evaluation • Assessment • Advising • Teaching competency
Personality development, views, attitudes, values	• Curiosity • Reflection skills (self and others) • Ability to take on responsibility (for self) • Self-reflection • Decision-making competency • Courage to develop something new	• Self-confidence • Ethical thinking and acting / good academic practice • Self-reflection • Decision-making competency • Courage • Passion • Perseverance • Assertiveness		• Self-reflection • Perseverance • Frustration tolerance • Self-motivation • Taking on responsibility for oneself • Self-efficacy belief	• Professional identity • Self-confidence • Ethical thinking and behaviour
Cross-cutting topics	• Ability to think and act in interdisciplinary and intercultural contexts • Knowledge extending beyond one's own subject • Diversity • Work–life balance • Authenticity • Networking • (Self-)marketing				

4 Conclusion and Usefulness of the Competency Model

What conclusion can be drawn from the results? It should first be emphasized that the model described here makes no claims to be complete with regard to the listed competencies, nor does it consider various proficiency levels it might be possible to achieve in the individual competencies. Moreover, it should be noted that the model is not a profile of requirements for doctoral candidates or postdocs. It is nonetheless possible to draw an initial interim conclusion for three groups: universities and university administrators, interdisciplinary graduate centres and their employees, and doctoral candidates and postdocs.

Universities

The competency model should not be understood as a list of competencies all universities should be asked to foster in their doctoral candidates. This would neither be economically possible, nor would it make sense from the perspective of doctoral training. What universities can do, however, is use the competency model to fine-tune their respective approaches to promote early-stage researchers and to derive specific emphases. In particular, the list can serve as a basis for defining the general conditions for the doctoral research process, taking into account each university's particular situation. Besides the university's profile, meaning features like the region in which it is located, its reputation, the infrastructure available to it, etc., this also includes the goals of the individual universities. Examples of specific emphases include internationalization, possibly with a focus on preferred regions, research priorities, etc.

Interdisciplinary Graduate Centres

For the staff of interdisciplinary graduate centres or other departments offering advanced qualification programmes for doctoral candidates, the competency model provides an overall picture and a means of orientation. On the one hand it provides them a basis for systematically analyzing their own programmes and for better comparing them with those of other universities. On the other hand it allows them to structure their own programmes more clearly and integrate them into an overall strategy. If a university has several departments that offer continuing education courses for doctoral candidates, the list provides an opportunity to unite the existing offerings and present them together in an intuitively accessible system.
The model presented here provides a clearly understandable picture of the process of pursuing a doctoral degree, the challenges it involves, and measures for supporting doctoral candidates at specific stages. It can therefore furnish arguments or strengthen argumentations for communication at and outside of the university: with university administrators, research funders, doctoral

supervisors, the university's administrative staff, colleagues, trainers, coaches, and not least the doctoral candidates themselves. The model can also serve as an initial basis for competency-oriented advising services, for general advising of doctoral candidates regarding issues such dealing with crises, at departments or organizations with individual career advising on career development, etc.

Doctoral Candidates

For doctoral candidates, the competency model provides an overview and detailed insight into the stages involved in the process of earning a doctoral degree and the competencies called for in each of them. It can be applied in the following ways depending on the stage in question.

Before starting work on a doctoral degree, prospective doctoral candidates can consider which aspects of the doctoral research process they might find easy and which difficult. In the course of the doctoral process, they can use the grid to decide which areas they would like to explore in more depth and what kind of support they need to do so. Once they have completed their doctorate, early-stage researchers can use the model to reflect on their competencies and decide which competencies can be useful for the labour market. Experience with this last aspect in particular reveals a special need: In the qualification phase, many doctoral candidates gain a lot of experience in the areas of project management, communication, self-management, information seeking, etc., yet they often do not perceive these activities as involving the acquisition of competencies and can therefore not or only insufficiently use them to cultivate a positive self-image and promote individual career development. In a worst case scenario, this leads to 'inert knowledge', i.e., knowledge that is not available for use in various concrete situations because one is unable to transfer it to a new context.

The results are useful for these three actors. In addition, they provide a basis for developing measures in the form of training courses or coaching and mentoring programmes. It is also possible to develop guidelines, portfolio concepts, and further instruments, for instance to encourage self-reflection. Table 5 illustrates the potential of the results achieved so far in the form of a summary of recommendations for possible measures.

Table 5 demonstrates the wide variety of approaches for targeted support and gives an impression of how complex the array of offerings looks as a whole. For example, the measures should not be conceived solely with the early-stage researchers in mind but should also take into account other persons involved in the process of earning a doctoral degree, such as the supervisors. The possible formats are very diverse and may be adapted to various objectives and university profiles.

Table 5: Overview of initial conclusions concerning measures on the basis of the results achieved so far

Career Phase	Orientation Stage	Introductory Stage	Research Stage	Completion Stage	Postdoc Stage
Support topics, e.g.:	• Advising, counselling and coaching • Clarification of goals	• Good academic practice • Project management • Self-/time management • Development of goals/strategies • Doctoral supervision agreement • Mentoring	• Academic communication • International experience • Networking • Progress reports/records of meetings • Situation analysis/career development • External funding proposals • Theory and practice of higher education teaching and learning • Team development measures • Leadership principles • Creativity methods • Feedback methods	• Training for defence • Career options • Public relations/press work • Self-marketing • Job applications • Development of Leadership competency • Entrepreneurial thinking	• External funding proposals • Theory and practice of higher education teaching and learning • Moderation skills • Creativity methods • Leadership topics
Advising/ Counselling	• Clarification of goals: Why earn a doctorate? • On funding for doctoral research projects	• On the formal process: acceptance, matriculation, registration • On insurance, on status	• On problems with supervision • On general questions and challenges that appear in the process of earning a doctoral degree	• On career options • On the course of events during the examination	• On appointment procedures
Training		• Workshops on the aforementioned topics	• Workshops on the aforementioned topics	• Workshops on the aforementioned topics • Defence simulations	• Workshops on the aforementioned topics
Coaching	• To clarify goals: How do I want my research process organized (structured, individual, etc.), what do I expect from my supervisor • On decision making, e.g., employment or scholarship	• On developing strategies • On reflection	• Career coaching (group)	• Career coaching (individual)	• Decision-making coaching • Leadership coaching

Career Phase	Orientation Stage	Introductory Stage	Research Stage	Completion Stage	Postdoc Stage
Mentoring	• E.g., by doctoral candidates, for the decision-making phase	• E.g., by second- or third-year doctoral candidates	• E.g., by alumni with doctoral degrees from the private or research sector as role models	• E.g., by alumni with doctoral degrees from the private or research sector as role models	• E.g., by experienced principal investigators, emeritus professors, alumni from the private or research sector
Other courses	• Informational event on the doctoral research process			• Informational event on career options (career talks) • Networking events, e.g., with companies • Assessment centre training courses	
Other instruments	• Self-reflection with guiding questions	• Doctoral supervision agreement	• Progress reports		
For supervisors	• Guidelines	• Recommendations for organizing the entry phase • Support on the doctoral supervision agreement	• Ombudsperson for problems	• Ombudsperson for problems	

5 Outlook

This paper has laid the groundwork for a competency model for developing the competencies of early-stage researchers. It may now serve as the basis for developing competency models for various proficiency levels.

The competency model described in this paper is already pre-structured according to the stages of the doctoral research process. One key question concerns how to arrange these competencies into levels. This might involve differentiating the existing model into a competency grid. One possibility would be to use the model proposed by Dreyfus and Dreyfus, who differentiate between the levels of novice, advanced beginner, competence, proficiency, and expertise.[23] In the competency grid, it would then be necessary to also indicate which competency level might be particularly important at a certain stage of the doctoral process and/or at which stage it seems particularly useful to foster a particular competency. A special challenge for this type of classification is that the gradation of individual competency levels does not necessarily run parallel to progress in the process of earning a doctoral degree. For example, in some cases certain competencies may already be much more strongly developed at the beginning of the doctoral research process.

Considering the perspectives of employers, the early-stage researchers themselves, and universities would involve treating competency standards, awareness-raising measures, and formats of support as separate issues. Table 6 shows the usefulness of the competency grid for these groups.

[23] Dreyfus, Stuart E./Dreyfus, Hubert L.: A Five-Stage Model of the Mental Activities Involved in Directed Skill Acquisition. Washington, DC: 1980.

Table 6: Usefulness of the competency model for various groups

User Perspective	Aspects
Employers What competencies can employers of early-stage researchers expect?	**Attractiveness for the labour market** Why should employers be interested in hiring doctorate holders?
Early-stage researchers How or in which situations may early-stage researchers develop these competencies in the qualification process?	**Awareness** How can universities raise their early-stage researchers' awareness of their own competencies, reflect on them, and develop them more deliberately and to transfer the competencies they developed during the doctoral research process to the non-academic labour market.
Universities What measures can/should universities take and what impulses can they give to foster the development of the competencies named in this paper?	**Support formats and measures** How can universities qualify their early-stage researchers, give them impulses, provide them tools or tests, or offer them advising or coaching?

The purpose of this volume was to give new impulses for discussions and to further the development of programmes and measures for developing the competencies of early-stage researchers. The results lay the foundations for a competency model that considers the course of the qualification phases along with their special challenges. This facilitates the process of differentiating the model into a matrix by defining individual competency levels and developing recommendations for their concrete implementation. If a fully fledged competency grid is to be integrated permanently into the advising and qualification services of graduate centres, it will need to address programme developers as well as trainers, coaches, and advisors. Competency development is a complex process involving many different stakeholders – a competency model is now the next step.

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