ACADEMIC DISCUSSION PAPERS

Britta Rüschoff

Methods of competence assessment in vocational education and training (VET) in Germany – A systematic review

Conducted on behalf of the Federal Ministry of Education and Research as part of the ASCOT+ Research and Transfer Initiative

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Contents

Summary

The aim of the present review is to provide a systematic overview of the methods of competence assessment currently available in German vocational education and training (VET). This comprises a general inspection of available instruments, obtaining insights into the scientific quality of these instruments, and subjecting them to critical consideration against the background of opportunities for implementation in practice.

After initially inspecting 2,298 publications published between 2001 and 2017, 58 publications were selected for incorporation into the study. These publications include journal articles, monographs, and papers in edited volumes. The results of this review show that the available instruments particularly relate to the assessment of competencies in commercial occupations, industrial and technical occupations, and occupations in healthcare. In the case of commercial occupations, instruments are mainly in place for the training of industrial clerks. Instruments in the industrial and technical sector primarily refer to the assessment of competencies in vehicle mechatronics technicians. In the healthcare sector, instruments are predominantly at hand for trainee medical assistants, although it should be noted that the prevalence of eligible publications in healthcare is comparatively low compared to the other two occupational fields. Most instruments reviewed in this study deal with the identification of professional competencies (66%). These are followed by publications addressing general competencies such as mathematical skills and literacy (24%), and social and communicative competencies (9%). Instruments relating to the assessment of social and communicative skills seem to be particularly under-represented. In respect of the various types of instruments, a trend towards IT-supported approaches can be identified. The results further demonstrate that validation of the instruments is frequently ensured by an inspection of their content validity, which is in some cases complemented by other validation procedures. However, assessments of predictive validity appear to be largely absent. The reliabilities of the instruments are acceptable or good for the most part.

In overall terms, this study demonstrates that there is already a solid basis of diagnostic instruments for the assessment of competencies in vocational education and training. Yet, it would be desirable to expand the development of instruments to encompass a broader spectrum of occupations and occupational fields. Moreover, additional validation and piloting of the instruments need to take place so that they can be rendered usable for potential widespread transfer into practice.

1 Introduction

The acquisition of competencies is the inherent aim of vocational education and training. Reliable proof of the competencies obtained in VET gives young people access to the labour market after successful completion of their training and provides potential employers with reliable evidence of their abilities and skills. In addition, proof of competencies acquired during training can be used to monitor trainees' learning status during VET and can be used to offer targeted support and improve their training process. Finally, evidence of competencies acquired by trainees also serves as an indicator of the success of vocational education and training as a whole and can be used for national and international comparisons.

In the wake of increasing demands for systematic and comparable assessments of training outcomes, the assessment of competencies in both general education and in VET has become increasingly important in recent years. For example, the Standing Conference of the Ministers of Education and Cultural Affairs in the Federal Republic of Germany (KMK) defines the acquisition of vocational action competence as the key objective of school-based vocational education and training (cf. KMK 1996, 2007, 2011, 2017). In vocational schools, the introduction of the learning field approach in the mid-1990s laid a foundation for the orientation towards action competencies that was later extended to other contexts of VET. Competence orientation has thus become a stronger focus of vocational education and training in Germany, and this has certainly been the case since the reformed Vocational Training Act (BBiG) of 2005 has stipulated its primary goal to be the creation of action competence (§ 1 Paragraph 3 BBiG). This development was lent further emphasis by the introduction of the European Qualifications Framework (EQF) in 2012 and the German Qualifications Framework (DQR) in 2013.

Despite this increasing orientation towards competence, there is no uniform definition of the term competence in vocational education and training (cf. Hartig 2008, Klieme/Hartig 2007, Klieme/Maag-Merki/Hartig 2007, Zlatkin-Troitschanskaia/Seidel 2011). In everyday parlance, two main definitions of the concept of competence can be distinguished: Competence in the sense of a power or responsibility to perform a certain action, and competence in the sense of having the knowledge and skills to perform an action (cf. Mulder 2007). Although these two concepts are closely interrelated, the latter is of greater significance within the context of vocational education and training.

However, even within this framework, there are fundamental differences regarding what constitutes professional competence and how it can be reliably measured. Terminologies commonly follow the theories and methods prevailing in their respective disciplines. Different definitions of what constitutes vocational competence are therefore largely based both on different backgrounds of the respective disciplines and on different emphases and objectives in the measurement of competence. This means that any evaluation of the legitimation of different definitions of competence is neither possible nor useful. Such an evaluation can only be undertaken against the background of the context in which competencies are being investigated and in the light of the investigation's purpose. Nevertheless, ambiguities in the definition of the concept of competence and varying methodological approaches in the assessment of competencies make it more difficult to obtain a clear overview of the methods of competence assessment in vocational education and training. To make the best possible use of methodological achievements of past years and to make them usable in practice, it is necessary to obtain an overview of the status of competence research in vocational education and training. The present study aims to provide such an overview.

In a first step, the most common definitions of competence in German VET are examined regarding their main similarities and differences. In a second step, a systematic overview of the current developments and results of competence research in German VET will be compiled to provide a deeper insight into the diagnostic approaches and their suitability for use in practice.

2 Definitions of competence in vocational education and training

An early and still influential definition of competence was developed by Noam Chomsky. Chomsky established a fundamental distinction between (linguistic) competence and performance, i.e. between the knowledge and abilities necessary for the generation of language (competence) and the actual application of this knowledge and ability in the form of language (performance). Within this definitional approach, performance describes the use of competence in specific situations. To examine a person's (linguistic) performance, all the factors that cause this performance must be considered. Linguistic competence is just one among many of these factors (cf. Chomsky 1965, Chomsky 2006). Hence, although this definition infers that competence is a prerequisite for performance, performance also is determined by factors other than competence. Similar distinctions can also be observed in occupational competence research (cf. Nickolaus/Seeber 2013, Zlatkin-Troitschanskaia/Seidel 2011). In the various approaches to the definition of occupational competence, there is no uniform opinion as to where the boundaries of the competence construct should be drawn. There is disagreement regarding the extent to which emotional or motivational factors are an inherent part of competence or should be considered as external factors affecting performance.

In the present review, a distinction is made between cognitive definitions of competence and comprehensive action- or performance-oriented definitions, as was already the case in previous studies (cf. Klieme 2008, Nickolaus/Seeber 2013). In both approaches, assessments of competencies are based on observable behaviour as an indicator of competence. However, they differ in the scope of what factors are included in the construct.

2.1 Cognitive approaches to competence

Cognitive approaches are particularly prevalent in psychology and in educational research. They consider competencies as dispositions, i.e. the presence of the knowledge, abilities and skills necessary for occupational actions. Competencies thus manifest themselves in coping with pre-defined occupational requirements through the use of this knowledge and these skills and abilities (cf. Hartig 2008, Weinert 2001, Zlatkin-Troitschanskaia/Seidel 2011). The application of competencies in an observable action is influenced by (professional) abilities and skills, but also by motivational, volitional, and social factors. However, the latter are generally not considered to be a constituent part of the competence construct.

Cognitive approaches include Weinert's (2001) influential definition of competencies as "the cognitive abilities and skills available to individuals which can be learned by individuals in order to solve certain problems along with the associated motivational, volitional and social readiness and abilities to be able to use these problem-solving solutions successfully and responsibly in variable situations" (Weinert 2001, p. 27). In this case, motivational, volitional and social factors are also included alongside the fundamental ability of a person to carry out an action. Although Weinert's definition does not include any unambiguous statement as to whether these aspects are constituent or determining factors, later interpretations allow the conclusion that such factors are viewed as a prerequisite for the translation of existing abilities into actions and are not seen as a constituent part of the competence construct (cf. Klieme/Hartig 2007). In addition, competencies are regarded as context-specific or domain-specific abilities and skills which are, however, transferable to similar situations. For this reason, approaches which build upon Weinert's definition of competence also define competencies as

"context-specific cognitive performance dispositions, which functionally relate to situations and requirements in specific domains" (Klieme/Leutner 2006, p. 879). As in the definition provided by Weinert (2001), competencies are likewise perceived as being fundamentally learnable. Motivation and volition are similarly considered as (determining) factors that are separate from the concept of competence. They are, however, necessary for the translation of the competence into action.

In summary, we can therefore state that the common features of cognitive competence definitions are that vocational competencies are regarded as learnable and context-dependent performance dispositions whose application is influenced by other factors such as motivation and volition. Motivation and volition are not, however, a constituent part of the competence construct.

2.2 Performance-oriented definitional approaches

Performance-oriented definitions of competence focus on a person's comprehensive vocational capacity to act. Competencies are seen less as individual performance dispositions, but rather as everything that enables a person to effectively apply his or her knowledge, abilities and skills. This means that performance-oriented definitions often extend beyond the occupational context.

A comprehensive model which can be allocated to this school of thought divides action competence into four different levels of competence based on the demands placed on an individual (cf. e.g. Rauner 2008, Rauner/Heinemann/Maurer/Ji/Zhao 2011). In accordance with this subdivision, the first stage of competence is limited to conceptual knowledge (nominal competencies, level 1). This is followed by the development of basic professional knowledge, although the full range of professional knowledge has not yet been achieved at this stage (functional competencies, level 2). The next stage describes the development of an understanding of operational processes and interrelationships (processual competencies, level 3). The final stage involves comprehending the full complexity of occupational tasks, including the conditions that govern them, and gaining an understanding of the structural leeway afforded (holistic structural competence, level 4).

Other approaches extend significantly beyond the occupational context. One early definition describes competence in terms of a person's "maturity", which consists of the ability to act in an autonomous way (self-competence), as well as the ability to be able to judge and act responsibly in selected specialist areas (professional competence) and societal or political areas (social competence) (cf. Roth 1971). This definition not only goes beyond the ability to act professionally, but also explicitly encompasses the components of responsibility and judgement. However, competence is not used as a synonym for responsibility in this case but rather forms the fundamental ability to judge and act, which is a prerequisite for competence. The Standing Conference of the Ministers of Education and Cultural Affairs in the Federal Republic of Germany (KMK) similarly defines action competence as "the readiness and ability of a person to conduct himself or herself in an appropriate, considerate and individually and socially responsible manner in occupational, social and private situations" (KMK 2011, p.14). This definition is further sub-divided into (1) professional competence, i.e. the ability to solve tasks in an appropriate and autonomous manner, (2) self-competence, i.e. the ability to recognise and use individual development opportunities both in working and private life, and (3) social competence, i.e. the ability to shape social relationships and to deal with others in a responsible manner (ibid.). Here too, the definition of action competence extends well beyond the occupational context and explicitly includes private and social contexts. A similar definition is used in the German Qualifications Framework (DQR), which describes competencies as

"the proven ability and readiness to use knowledge, skills. personal, social and methodological competencies in work or learning situations and for occupational and/or personal development" (Federal Government-Federal State DQR Coordination Point 2013, p. 13). It subdivides action competence into (1) professional competence, which comprises knowledge and skills, and (2) personal competence, which comprises social competence and autonomy.

Still other interpretations regard competencies as dispositions in self-organisation in the sense of "inner prerequisites for the regulation of a task developed up until a certain point in time" (Erpenbeck et al. 2017, pp. XII ff.). These dispositions describe a person's fundamental abilities, the realisation of which is determined not only by professional but also by motivational, volitional and personal aspects. This definitional approach also emphasises the multi-dimensionality of the competence construct and divides it into (1) personal competencies, i.e. the disposition for reflectively self-organised behaviour, (2) activity and implementation-oriented competencies, i.e. the disposition for holistically self-organised behaviour, (3) professional and methodological competencies, i.e. the disposition for mentally and physically self-organised behaviour to solve professional problems, and (4) social and communicative competencies, i.e. the disposition for cooperatively self-organised behaviour (cf. Erpenbeck/von Rosenstiel 2003, Erpenbeck et al. 2017).

In summary, performance-oriented definitions of competence are essentially characterised by their use of a comprehensive definition of competence, which integrates social, volitional and motivational aspects along with values and attitudes into the competence construct. In addition, these definitions frequently extend beyond the occupational context.

2.3 Conclusion and methodological implications

The definitional approaches described above clearly illustrate that there is no uniform understanding of what constitutes competence. Even within the definitional approaches, there are differences and the boundaries of the construct are not always clear. Despite the heterogeneous nature of the definitional approaches, general principles can be identified for both schools of thought and corresponding methodological implications for diagnostics can be inferred.

Cognitive approaches often aim to employ a definition that makes competencies empirically measurable. Cognitive approaches have their foundations in the tradition of cognitive psychology and usually make use of psychometric procedures (cf. Nickolaus 2018). The aim of this type of approach is to use competence models as a basis for developing context-specific standardised measurement instruments, which map individual facets or sub-dimensions of occupational competence. The focus is to provide a quantifying evaluation regarding the respective level of competence in an individual, i.e. certain knowledge or abilities, rather than to provide a comprehensive depiction of occupational competence. The competence to be assessed is not observed directly but is inferred on the basis of the observed behaviour of an individual on a psychometric test (cf. Nickolaus/Seeber 2013). Cognitive approaches thus represent an attempt to assess the individual components or facets of competence separately from one another. However, a frequent criticism is that assessing individual facets of occupational competence in an isolated manner might not be representative of the application of these competencies in authentic professional situations (cf. e.g. Rauner/Grollmann/Martens 2007). Yet another concern is that aspects such as participants' motivation will inevitably influence the test scores even if they are not explicitly included in the competence construct.

Performance-oriented definitions of competence, on the other hand, are relatively broad and often explicitly incorporate conditional factors such as motivational aspects into the competence construct. They are designed to reflect professional behaviour in comparatively realistic settings. However, the inclusion of private and social contexts implies that a validation of

the construct would need to cover a wide range of possible contexts in which competencies can be expressed. A central challenge here is to describe all these situations across contexts and to define when a situation was successfully mastered or not (cf. Ufer/Leutner 2017). A frequent criticism of comprehensive, performance-oriented competence definitions is therefore that a complete coverage of competence in all its facets and all possible contexts is not feasible due to the high complexity of the construct and its breadth (cf. Liedtke/Seeber 2015). However, it should be noted that such psychometric assessments are usually not the objective of these definitional approaches. The KMK's definition of competencies as "the readiness and ability of an individual person to conduct himself or herself in an appropriate, considered and individually and socially responsible manner in occupational, social and private situations" (KMK 2011, p. 14) was, for example, not developed for application in diagnostics but to provide a guidance framework for the description of educational objectives.

3 Inclusion criteria of the present review

Competence orientation in vocational education and training and the debate centring on the modelling and assessment of occupational competencies have mainly found their way into German educational practice and research following Weinert's systematisation in 2001, but most certainly since the reform of the German Vocational Training Act (BBiG) in 2005. This has not only given competence research a new impetus, but has also changed the conditions under which competence models and measurement methods are developed and applied.

For this reason, publications from the years 2001 to 2017 have been used to prepare this study. Inspection of the publications took place as part of an extensive literature review conducted between April and June 2018 using the databases PubPsych, FIS Bildung (German Education Index), and the German VET Repository (formerly the Vocational Education and Training Literature Database, LDBB). The literature review included empirical studies addressing the assessment of competencies within German VET. There were no restrictions regarding occupations or occupational areas. Entirely descriptive studies were not considered in the review. In addition, only studies that provided a detailed description of the measurement instruments, procedures, and results were considered for inclusion. Publications with fragmentary or inadequate methodological information were omitted. Assessment procedures developed especially for learners with special needs were likewise omitted. A detailed overview over the criteria for inclusion and exclusion can be found in Annex 1.

4 Results

The results of this review are presented below. Chapter 4.1 provides a summary of the publications included in the review and of the range of the occupations and instruments considered. Chapter 4.2 presents an overview of how competencies were operationalised in the incorporated publications and which general types of competencies they address. Next, the instruments used to assess these competencies are discussed in Chapter 4.3 along with their theoretical foundations. Finally, Chapter 4.4 reviews the validity, objectivity and reliability of the instruments.

4.1 Summary of the literature search

An extensive literature search was conducted between April and June 2018 to gain an overview of the relevant publications between 2001 and 2017. Search terms appropriate to the present study were used either as stand-alone terms or in combination with other terms. In this way, a total of 26 searches were performed for each of the three databases. The 26 search terms or combinations of search terms were identical for all three databases. Annex 2 contains a full summary of the terms and combinations of terms used and provides information on the number of hits per database and the respective dates of access.

4.1.1 Selection of publications

The literature search was initially conducted separately for each of the three databases. The search yielded 478 hits in the PubPsych Database, 141 hits in the German VET Repository and 4,146 hits in the German Education Index Database (FIS Bildung). Duplicates were removed prior to merging results from the separate databases. This resulted in 305 unique hits from the PubPsych Database, 105 unique hits from the German VET Repository and 2,084 unique hits from the German Education Index Database (FIS Bildung). These results were then collated into a total of 2,494 publications. After this consolidation, duplicates were once again removed resulting in 2,298 unique publications overall. These publications were then examined with regard to their suitability for inclusion in this study.

In a first step, publications were omitted based on their titles, removing those publications that were clearly not a thematic match. This was the case for 1,652 publications, leaving 647 publications for further inspection. In a second step, the suitability of the remaining 647 publications was assessed based on the pre-determined inclusion criteria. Following an inspection of the abstracts, another 522 publications were removed from the database. At the same time, 22 additional publications were identified though cross references which were deemed suitable for inclusion but were not identified via the incorporated databases. In a final step, the inclusion criteria were deployed to evaluate the full texts of the remaining 147 publications. 58 publications were ultimately included in the study. Figure 1 provides a graphic representation of the selection procedure.

Figure 1: Prism diagram of the literature search

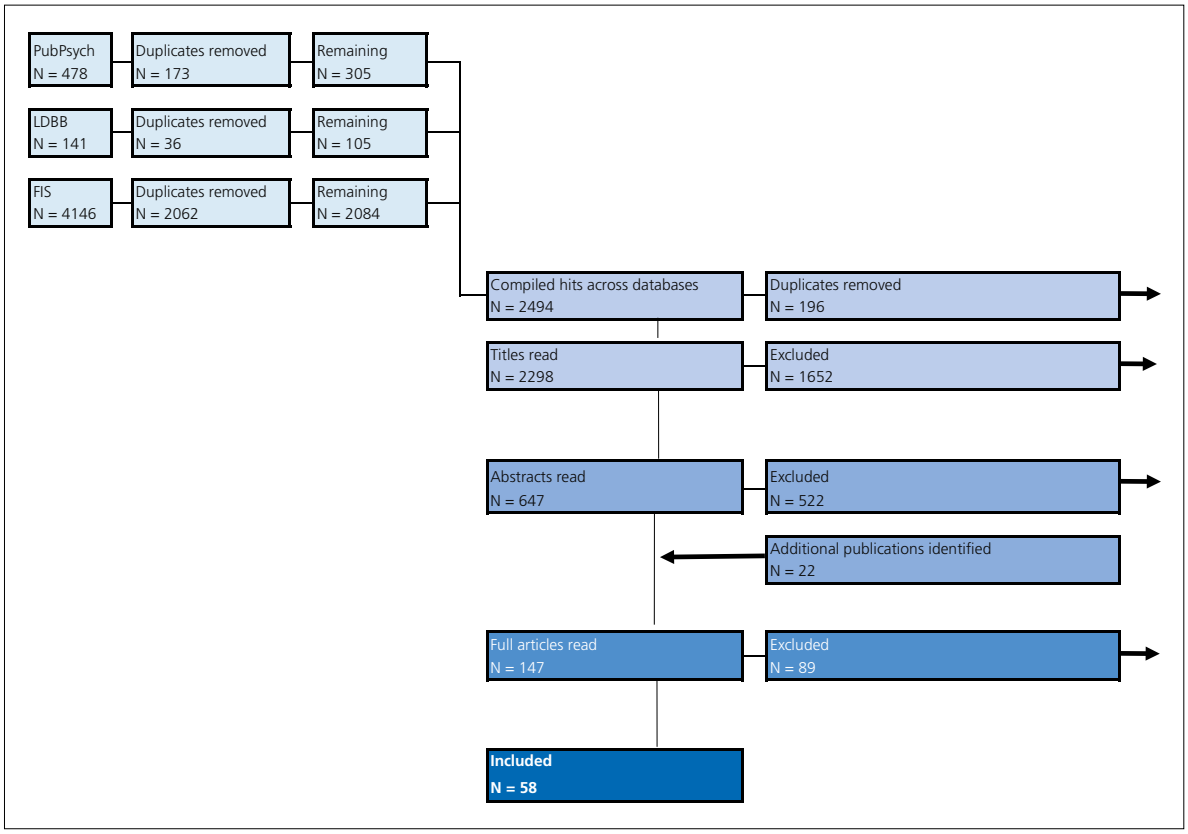
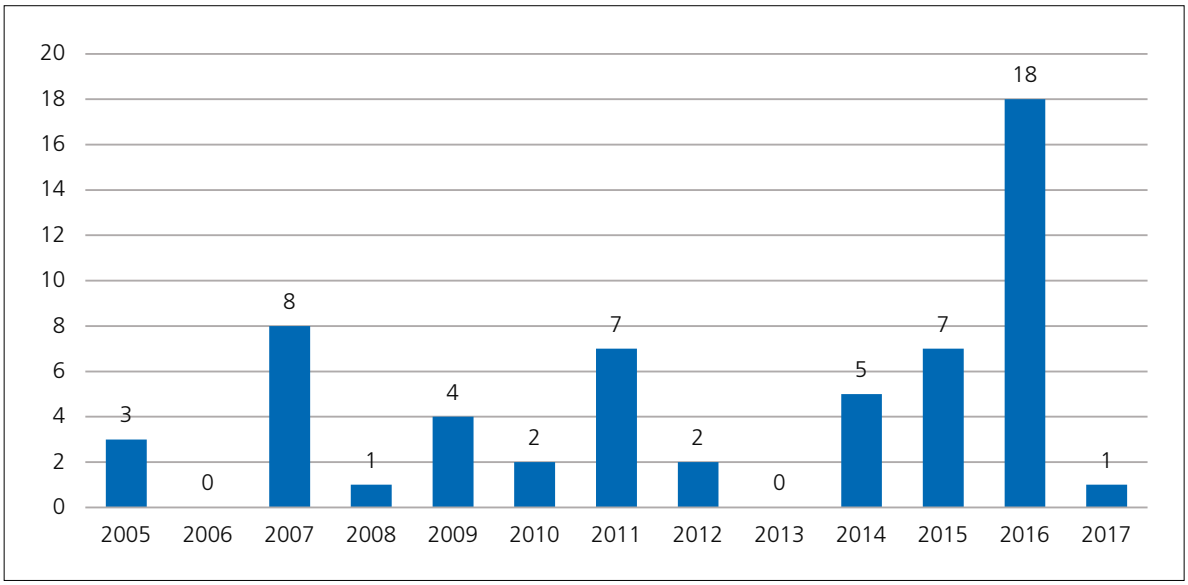


Figure 2: Number of publications by year of publication



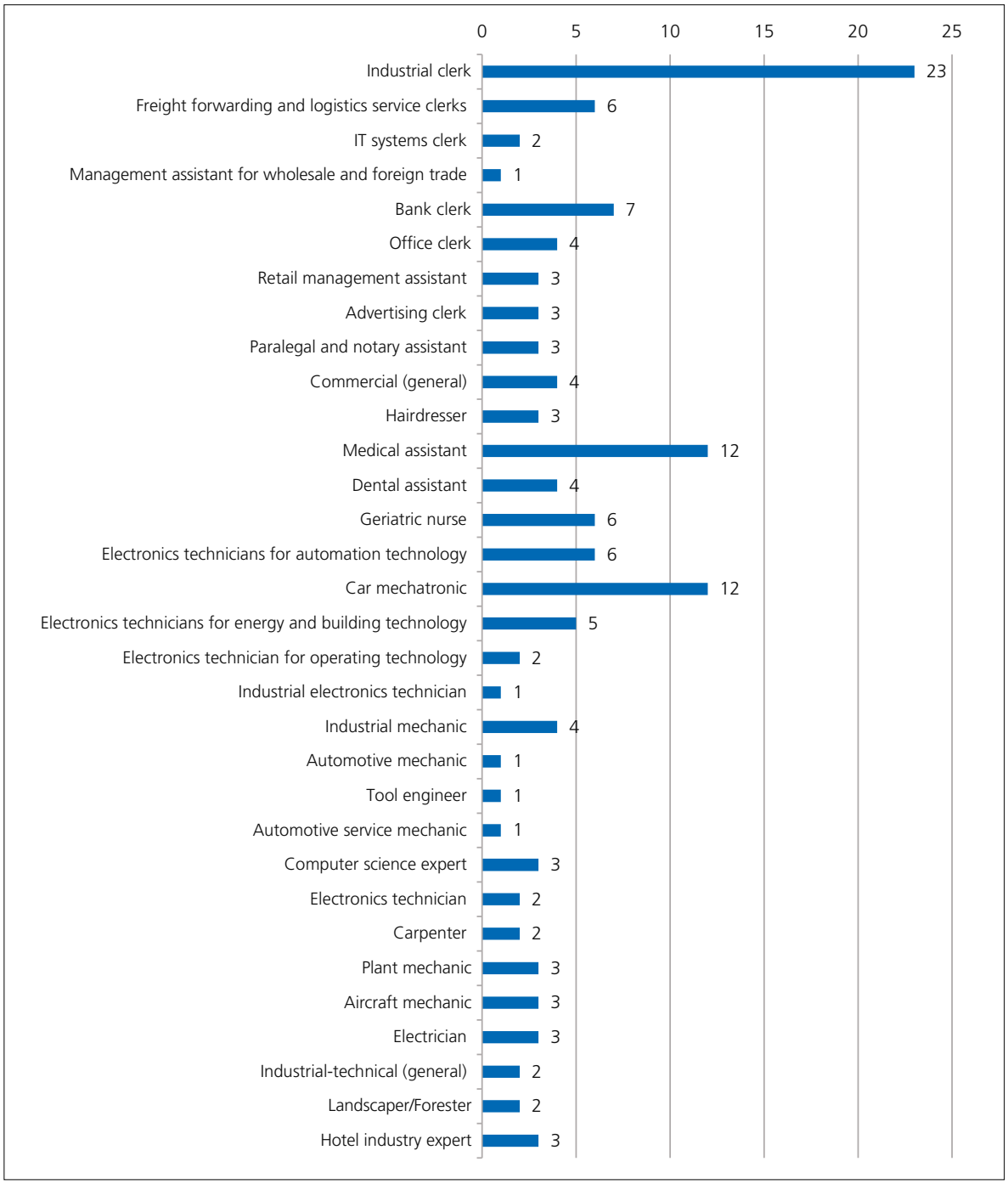
4.1.2 Types of publications and publication dates

The 58 publications included in the study comprise 26 chapters in edited volumes (45%), 22 journal articles (38%), and ten monographs including dissertations. Figure 2 shows the distribution of the publications by year of publication. Although publications from 2001 onwards were eligible for inclusion, no publications appearing before 2005 met the inclusion criteria. The noticeable increase recorded in 2016 was due to publication of results from the first Ascot Research Initiative of the technology-based assessment of skills and competencies in vocational education and training, which ended in 2015 (cf. BMBF 2015).

4.1.3 Occupational areas and occupations

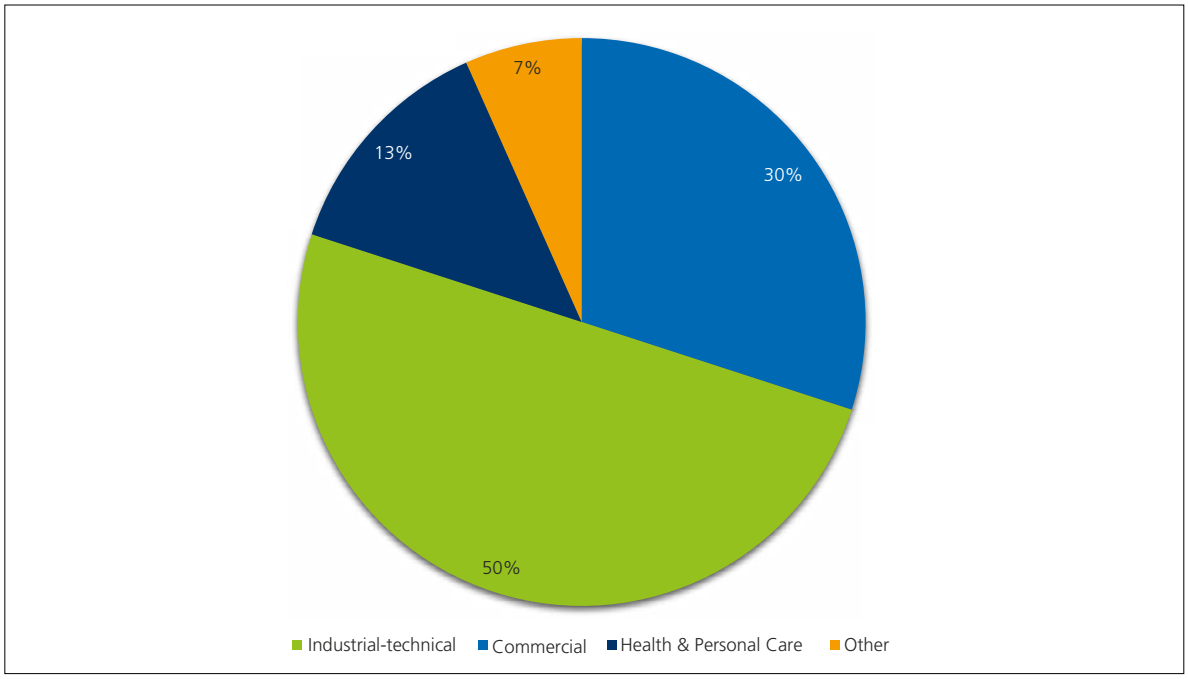
Further examination of the publications shows that a total of 30 different occupations from primarily three occupational areas were considered: industrial and technical occupations, commercial occupations, and occupations in the field of healthcare and personal care. Figure 3 depicts a list of all occupations covered in the publications. It is evident that a total of 15 of the 30 occupations considered (50%) stem from the industrial-technical sector. Another nine occupations (30%) stem from in the commercial sector. Only 4 occupations stem from the health and personal care sector.

Figure 3: Frequency of the occupations considered in the publications



** Some publications cover more than one occupation or occupational area.*

Figure 4: Distribution of occupations across occupational areas



4.1.4 Interim conclusion

The results suggest that the development and piloting of instruments of competence assessment in vocational education and training has thus far been limited to a small number of occupational areas. Almost all publications refer to the industrial-technical or commercial sector or, to a lesser extent, to occupations in the health and personal care sector.

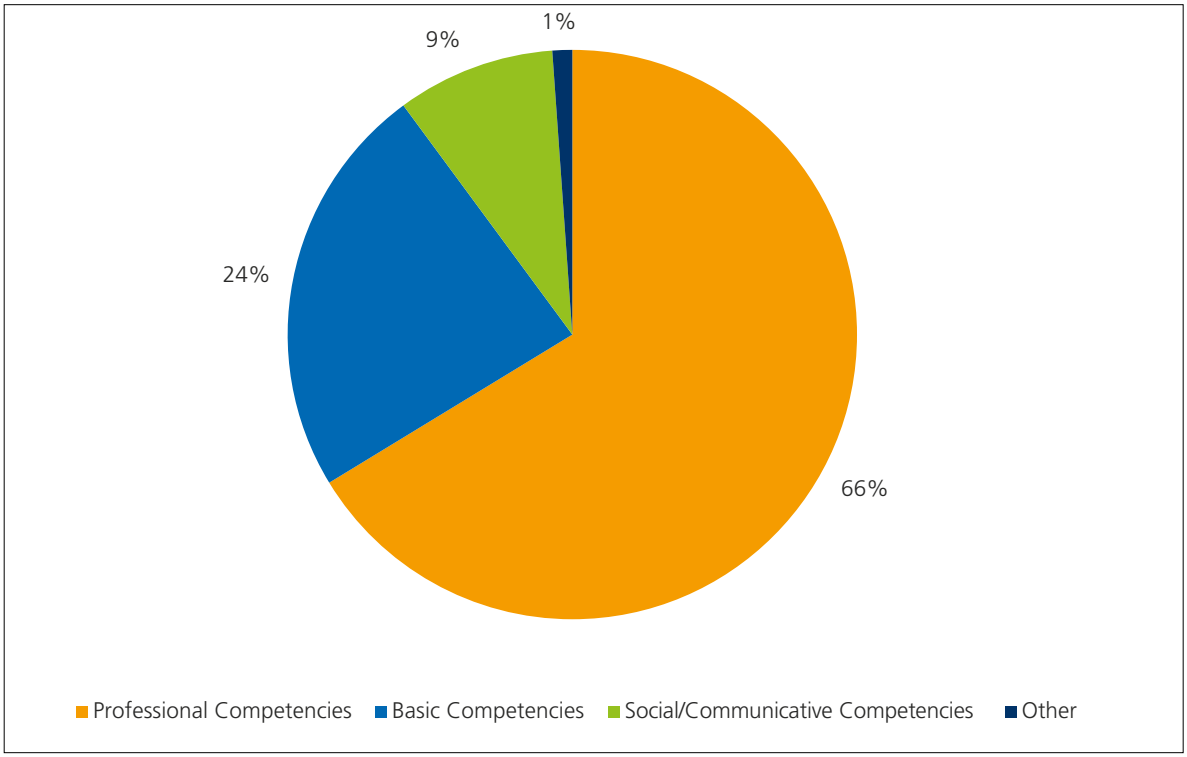
There is also an imbalance in the occupations considered within these three occupational areas. Publications relating to competence assessment of industrial clerks are clearly prevalent in the commercial sector, whilst the industrial-technical and healthcare fields are dominated by publications focusing on vehicle mechatronics technicians and medical assistants, respectively. The extent to which instruments are transferable to other occupations within these occupational areas remains unclear. At the same time, there is a lack of sufficiently robust results relating to traditional craft trades. On the basis of the available information, it is therefore impossible to conclude whether the reviewed instruments are also suitable for these occupational areas.

4.2 Competencies

4.2.1 Competencies considered in the literature

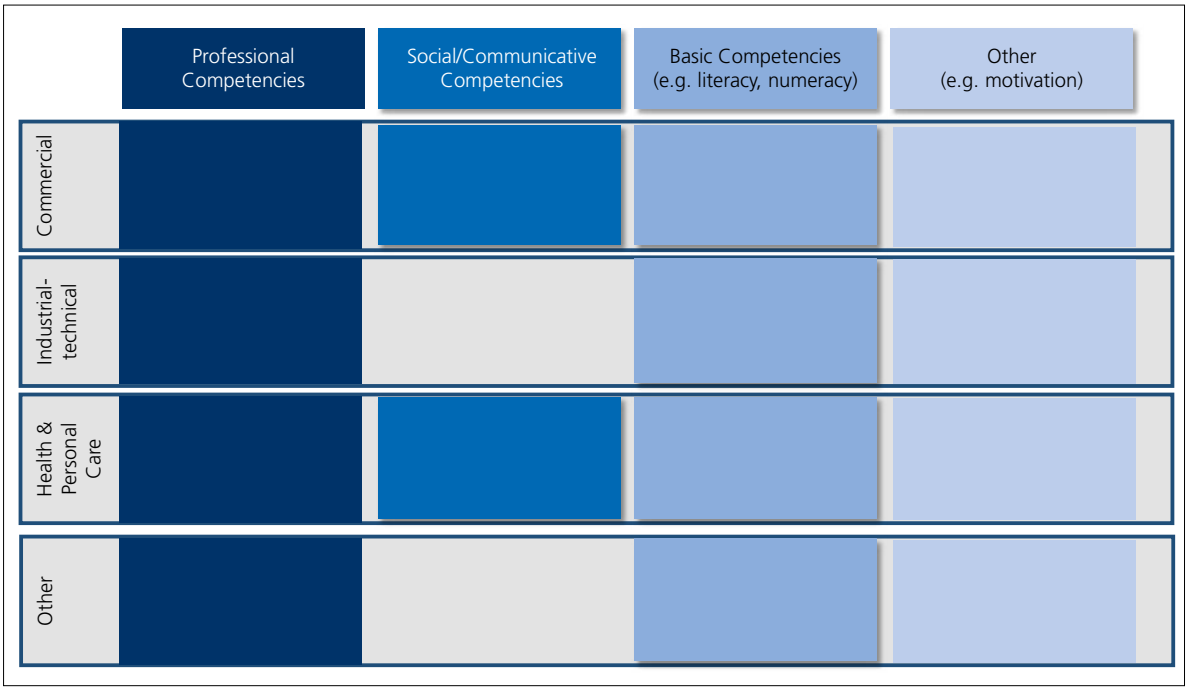
A classification of the competencies considered in the literature shows that the majority of the publications focus on professional competencies (66%) such as commercial competencies industrial clerks or troubleshooting skills in motor vehicle mechatronics. 24% of the competencies investigated are general competencies such as mathematical skills and literacy. Only nine percent of the competencies are social-communicative competencies. A complete overview of the competencies considered is provided in Appendix 3. It should be noted that several competencies can be considered within the same publication and that the percentages relate to the entirety of all competencies addressed in the publications. A summary of the competencies investigated in the individual publications is given in Annex 4. Figure 5 shows a graphic breakdown of the types of competence. Figure 6 shows a graphic representation of the distribution of these competencies across the occupational areas.

Figure 5: Frequency* of competence considered in the literature



** Frequency of the types of competencies considered in the publications relative to the totality of all competencies considered. Several competencies can be considered within one publication.*

Figure 6: Distribution of competencies across occupational areas



4.2.2 Operationalisations

If we consider the operationalisations of competence in the different publications, it is notable that virtually all publications examine competencies which are clearly restricted to the occupational context. Operationalisation of comprehensive competence definitions outside the oc-

cupational context require competencies to be recorded in all contexts that may arise. This is hardly feasible in terms of practical implementation. This observation supports the previous notion that definitions of competence which go beyond the occupational context and encompass aspects of maturity or societal participation cannot easily be operationalised with the psychometric methods currently available (cf. Liedtke/Seeber 2015).

4.2.3 Interim conclusion on the competencies considered

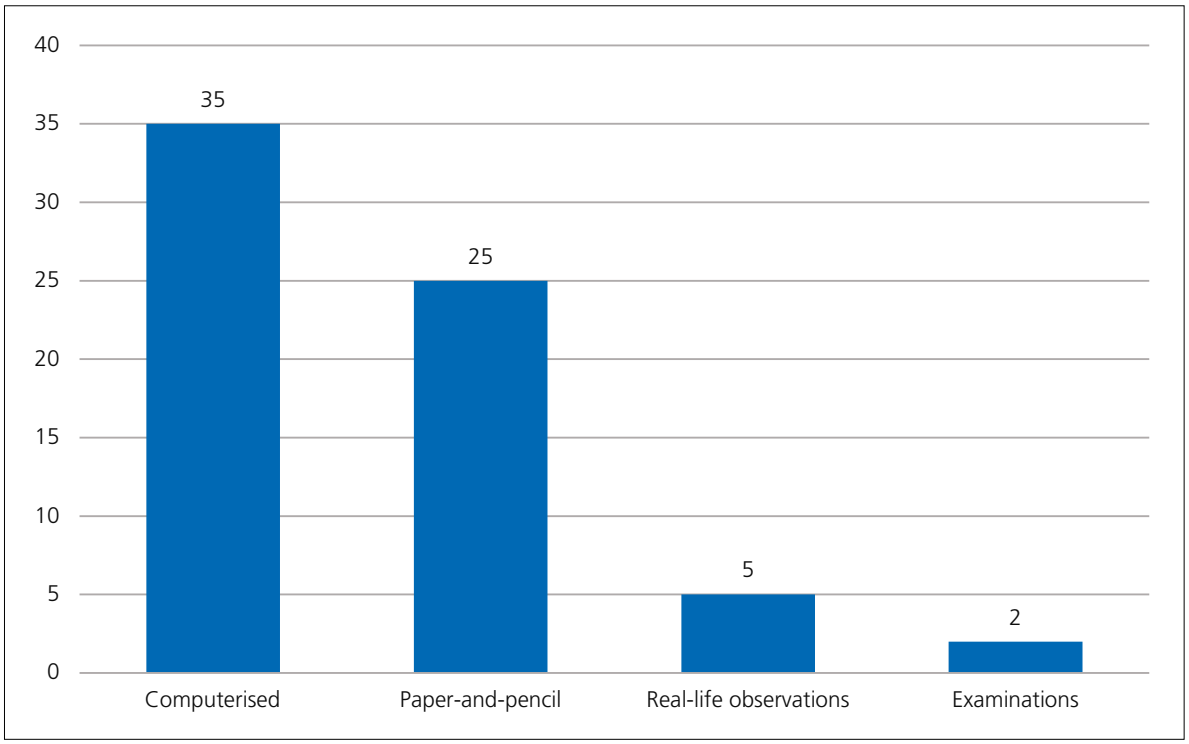
Looking at the operationalisations of competence in the publications, it becomes clear that almost all publications observe sub-competencies that can be clearly defined and confined to the occupational context. Furthermore, despite reference to social and communicative competencies in a multitude of the competence definitions, such competencies noticeably play a subordinate role in the present publications. This highlights a gap in the current instruments and points to the need to move beyond the mapping of professional competence contents to create a broader reference to social and personal competencies in the future.

4.3 Measurement instruments

4.3.1 Classification and frequency of assessment methods

Regarding the classification of the assessment methods, a distinction can be made between four different means of measurement: IT-supported methods, paper-and-pencil tests, real-life observations, and final examinations. Figure 7 provides an overview of the frequency of these methods in the considered publications. Several methods can be considered within one publication.

Figure 7: Frequency of assessment methods



Most of the procedures are based either on IT-supported methods or on traditional paper-and-pencil tests. The range of IT-supported methods goes from computerised versions of classical paper-and-pencil tests, in which questions and tasks are presented and recorded using a computer or a similar electronic device, to computer simulations. Computer simulations can, for instance, be a computer-based recreation of a doctor's practice for the assessment of professional and social-communicative competencies in medical assistants (cf. Seeber et al. 2016, Tschöpe/Monnier 2016, Dietzen et al. 2016), or the simulation of an engine for the assessment of troubleshooting competence in vehicle mechatronics technicians (cf. Gschwendtner/Geissel/Nickolaus 2010). IT-supported methods are applied in 35 of the 58 publications (60%). Paper-and-pencil tests are applied in 25 of the publications (43%). The assessment of competencies through observations of real-life situations is only applied in five of the publications (8.5%). Two further publications deal with the assessment of competencies through regular final examinations (3.5%).

4.3.2 Test theories

Test theories form the basis for the development of psychometric tests and encompass assumptions about how individual characteristics influence a person's test score. Test theories thus permit conclusions about the characteristic to be measured (e.g. competence) and its level based on the results of a test. Tests in vocational education and training usually draw on either the assumptions of classical test theory (CTT) or item-response theory.

CTT assumes that the observed results of a psychological test are comprised of two components: A true score, which is the error-free reflection of the underlying characteristics that was intended to be assessed (e.g. competence), and a random error score. However, neither are directly observable. The only observable score is the test score (e.g. the result of a paper-and-pencil test). In order to obtain as accurate a representation as possible of the true score, CTT uses multiple assessments (e.g. using multiple items to measure a characteristic) and subsequently forms a mean score of these items to balance out random errors. Assessments of competencies by means of a standardised questionnaire, which is identical for all participants, is one example in which Classical Test Theory is applied.

In contrast, Probabilistic Test Theory or Item Response Theory (IRT) looks at a person's response pattern for every single question rather than at the overall result. The assumption is that the (observable) response behaviour is an indicator of the (non-observable) characteristic (e.g. competence) underlying this behaviour. The relation between the test behaviour and underlying characteristic is established by probabilities. For example, test takers with a higher level of competence have a higher probability to solve certain tasks. Item Response Theory is, for instance, applied in the construction of adaptive tests, in which the test items presented to a participant are dependent on this participant's response behaviour on previous items. Participants will thus only be presented with items that can provide additional information regarding the underlying characteristic (e.g. competence). The present publications build on both the Classical and the Probabilistic Test Theory. There is, however, a clear tendency towards the latter, which was used either exclusively or supplementary in 43 of the 58 publications.

4.3.3 Interim conclusion

It can be concluded that primarily IT-supported methods and paper-and-pencil tests are currently being developed or in use, with a slight tendency towards the use of IT-based procedures. There is also a clear tendency to use probabilistic test theory in the development of instruments to assess vocational competencies.

4.4 Quality criteria

4.4.1 Objectivity

Common indicators of reliability, validity and objectivity are used to determine the quality of the instruments. Objectivity intends to ensure that the assessment is not negatively impacted by different assessment conditions, by different evaluators, or by variances in the interpretation system. Ensuring objectivity is hence crucial during the implementation, the evaluation, and the interpretation.

The objectivity of a test procedure regarding its *implementation* is ensured when the procedure is identical for all test takers, i.e. it does not vary between individual examinations or persons. This requires clear test instructions along with a fixed time frame and fixed materials to be used. The degree of standardisation of the test and the environment is a key factor in terms of achieving objectivity in the implementation of a test. The level of standardisation is very high in IT-supported procedures, and even more so in simulation-based procedures, as a large part of the test implementation is technology-based and cannot be influenced or altered between test takes. While paper-and-pencil tests and assessments in real-life situations do not automatically imply low implementation objectivity, it is more difficult to ensure than in a computerised environment.

The objectivity of a test procedure regarding its *evaluation* is ensured when a person's performance results in the same scores (e.g. points in a test) regardless of who is scoring the test. The aim is thus to ensure that an identical test performance always results in the same test score. This requires that there is a clear evaluation system based on which the scores are calculated. Especially in the case of measurement procedures with closed response formats, a high degree of evaluation objectivity can usually be ensured. However, using behavioural observations or expert ratings does not exclude a high degree of evaluation objectivity, if clear evaluation guidelines are in place and adhered to.

The objectivity of a test procedure regarding its *interpretation* deals with the issue of whether test results are interpreted in the same way irrespective of the person who is carrying out the interpretation. The goal is to make sure that identical test results (e.g. the same test score) are always interpreted in the same manner and thus always lead to the same conclusions (e.g. test passed or not passed).

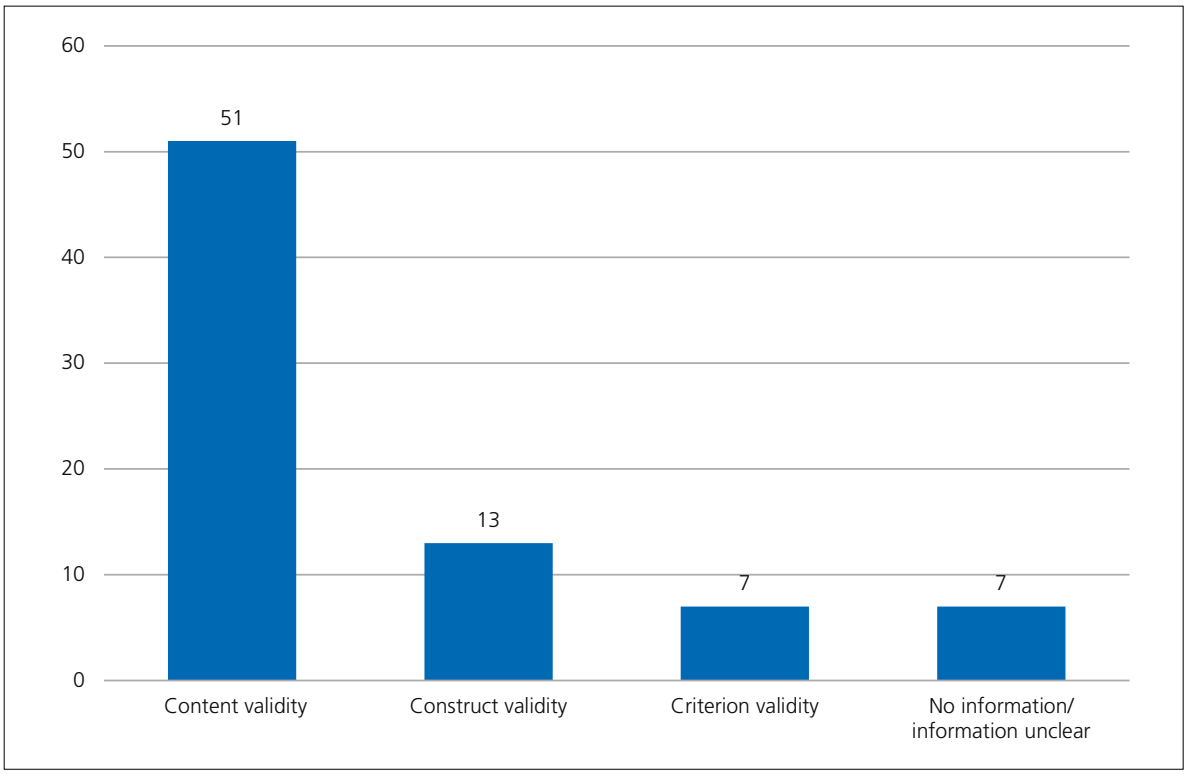
The level of detail contained in the descriptions of objectivity varies in the publications reviewed for this study and in many cases is not sufficient to undertake a useful and pooled analysis. However, it is important to note that detailed descriptions of objectivity are not common in scientific publications. Missing information on objectivity therefore does not necessarily indicate low objectivity. In overall terms, it should be noted that a high degree of standardisation generally contributes to a high degree of objectivity. Standardised procedures should thus be preferred in terms of objectivity.

4.4.2 Validity

The validity of an instrument broadly refers to how accurately an instrument is able to measure the presumed underlying construct and hence the extent to which the resulting test scores represent this underlying construct. Especially in the assessment of (psychological) constructs that are not directly observable, such as competence, verifying the validity of measurement instruments is essential. One common distinction differentiates between content validity, construct validity and criterion validity, which can be further divided into sub-categories (cf. Rentzsch/Schütz 2009, Schwarz/Stegmann 2013). Figure 8 provides a summary of the val-

idation procedures used in publications incorporated in the present review. Annex 4 contains a brief summary of the validation procedures applied in each publication.

Figure 8: Validation procedures by absolute frequency in the publications included



This figure presents the absolute frequencies of the validation procedures applied in the publications incorporated in this review. Many publications undertook more than one type of validation. Detailed information on each publication is provided in Annex 4.

4.4.2.1 Content Validity

Content validity addresses the issue of how well the information included in a test covers the diversity of all possible tasks, i.e. how representative the content of the test is of the content of the underlying construct to be assessed. Content validity is particularly difficult to ensure in the case of constructs that are hard to delineate, as it is sometimes not possible to draw a conclusion of where the boundaries of the construct lie. Content validity in measurements aimed at assessing vocational competencies is frequently established through an analysis of curricula and teaching materials and by means of expert interviews which evaluate the content coverage of the construct based on the items and tasks in the test instrument.

A less robust variant is the establishment of *face validity*, i.e. validation via an evident relationship between the test items and the construct to be measured. In this instance, assumption of validity is based on whether assessors view the instrument fit for its purpose.

All instruments covered in the publications reviewed for this study were examined with respect to their content validity, i.e. based on curricula and/or via expert assessments. Only one of the publications reported that validation had taken place exclusively through the establishment of face validity without undertaking any further validation steps, which cannot be regarded as sufficient for the intended purpose of the instruments.

4.4.2.2 Construct validity

Construct validity concerns the question of whether a test procedure truly measures the construct, characteristic, or ability (e.g. competence) which it sets out to measure. Construct validity has a strong theoretical foundation and is aligned to the definition of the construct and its theoretical rationale. Construct validity can be established through various approaches. *Convergent validity* seeks to identify a correspondence between the test to be validated and existing measurement instruments used to map the same construct. One example of convergent validation is validation of a newly developed competence assessment procedure via the correlation of this new procedure with an existing and established procedure. Convergent validity can be assumed if the newly developed test shows a strong positive correlation with the existing procedure. In contrast, discriminant validity seeks to establish a correlation between a newly developed instrument and existing tests used to map different constructs. *Discriminant validity* can be assumed when the newly developed test designed to assess a certain underlying construct does not correlate strongly with established tests that have been shown to assess different constructs. A test designed to assess occupation-specific problem-solving competence should therefore show no correlation or only a weak correlation with a test designed to assess the test taker's ability to concentrate.

A further type of construct validity is the *structural validity* of a test. A test is regarded as being structurally valid if it maps the theoretical factor structure of the construct it intends to measure. For example, an instrument that has been developed based on the assumption that competence can be sub-divided into four sub-categories should be able to reproduce this assumed factor structure of the construct in the items or tasks incorporated in the instrument.

Construct validity was addressed in 13 of the 58 publications reviewed for this study (22%). In most cases, this concerned theconvergent validity of the tests, followed by examinations of discriminant validity or of structural validity.

4.4.2.3 Criterion validity

Criterion validity deals with the correspondence of the instrument with external criteria or characteristics with which the instrument should correlate by dint of its assessment objectives. A test intended to assess social competencies should therefore correlate with behaviour in real social situations. Criterion validity can be established in various ways. *Concurrent validity* identifies the correlation of the test results with an external criterion, which was measured at virtually the same time. Troubleshooting competence in vehicle mechatronics technicians can, for example, be assessed via a standardized paper-and-pencil test and in a real-life situation. The correlation between an individual's performances in both assessments can then be used to establish the validity of the paper-and pencil test. If a test is concurrently valid, the results of the paper-and-pencil test and of the real-life situation will be strongly correlated. *Predictive validity* pursues a similar approach, the only difference being that the external criterion is measured later rather than at the same time. Predictive validity can be used to identify the extent to which the test results of a competence assessment in a vocational school context predict subsequent job performance.

Criterion validity was considered in seven of the 58 publications (12%). These validations have solely focused on concurrent validity. None of the publications has identified the predictive validity of the assessment procedures.

4.4.3 Reliability

The reliability of a measurement instrument addresses the issue of its precision, i.e. whether the instrument measures the underlying construct with only minimal error. Reliability can be established in a number of ways, depending on factors such as the basic theoretical principles underlying the test and the nature of the instrument itself.

In Classical Test Theory, the internal consistency of a measure is frequently drawn on as an indicator of its reliability. An instrument's internal consistency refers to the extent to which the items of the test relate to one another, hence the degree to which all items consistently measure the presumed underlying construct. Cronbach's alpha is often used to establish the internal consistency of a measure. It can take on values between 0 and 1. Values of 0.7 or higher are considered acceptable to good. Values of 0.6 (sometimes 0.5) or lower are considered unacceptable. This conception of reliability cannot be directly transferred to Probabilistic Test Theory. In Probabilistic Test Theory, there are various approaches for determining the reliability of a test. EAP/PV reliability and WLE reliability, which is largely comparable to Cronbach's alpha with regard to interpretation, are frequently used (cf. de Ayala 2009, Rost 2004). A comparative interpretation of the reliabilities of the instruments reviewed in the present study is therefore not feasible, as the instruments are built on both Classical and Probabilistic Test Theory.

Although different indicators of reliability are computed in different ways and are not equivalent in terms of their interpretation, they nevertheless provide a rough estimate of the measurement accuracy of the instruments and can be used to gain a general overview. To provide at least an idea of the accuracy of the test instruments, those instruments for which information on Cronbach's alpha, EAP/PV reliability or WLE reliability is available were evaluated with regard to their measurement accuracy.

A total of 44 of the 58 publications contain sufficient information on the reliability of the instruments. The other 14 publications either do not address the reliability of the instruments or do not provide sufficient information to permit a comparison. As the publications frequently cover different instruments, it is difficult to draw overarching conclusion regarding the reliability of the instruments. The reliability of a measurement instrument can also vary with different samples. A detailed analysis of the individual facets of an underlying construct and of different samples may therefore be more appropriate than a comprehensive conclusion. Still, a simplified classification of the instruments addressed in the reviewed publications was undertaken to offer a broad overview of the reliabilities of the instruments. For this evaluation, the above-mentioned cut-off scores were drawn upon. It should be noted that a lack of information on the reliability of an instrument does not necessarily indicate insufficient test accuracy. An evaluation of the reliabilities per publication can be found in Appendix 4.

Overall, that level of detail in the description of the reliabilities of the instruments is very heterogeneous. A comprehensive conclusion is therefore not feasible. In general, it can be concluded that although there are some highly reliable instruments already in place, this is an area which calls for further research. However, this need for further research is not contingent on specific types of competencies or occupational areas but is emergent across all occupations and competencies. There were no indications that instruments developed for the assessment of certain types of competencies or instruments referring to certain occupational areas showed systematically lower reliabilities.

4.4.4 Interim conclusion on the quality criteria of the instruments

Regarding the objectivity of the instruments, it is not feasible to draw an overarching conclusion, as the level of detail in the description of the instruments' objectivities is highly heterogeneous. As far as the validation of the instruments is concerned, it is striking that the majority of the instruments rely on content validations, mostly based on curricula or expert ratings. Although the establishment of content validity is certainly a necessary stage of the validation process, findings regarding construct validity and criterion validity are of equal importance, yet currently under-represented. Especially the lack of research on the predictive validity of the instruments represents a major shortcoming. Regarding the reliabilities of the instruments, the publications in which sufficient information is available draw a positive picture.

5 Overall conclusion and discussion

The acquisition of vocational competence as the primary goal of vocational education and training has been increasingly emphasized in recent years, both in policy and research. However, this competence orientation implies the availability of valid procedures to assess whether trainees have obtained the competencies targeted in their training. Various stakeholders are therefore engaged in the development of vocational competence models and measurement instruments. The present study offers an overview of the methods and instruments currently developed in vocational education and training in Germany.

5.1 Status quo of competence assessment in vocational education and training

The results of the analysis have shown that a multitude of publications have addressed this topic over the past years. However, if we consider the scope of the occupations and occupational areas covered, it is noticeable that virtually all publications focus on either commercial occupations, industrial and technical occupations, or occupations in healthcare. Within these three occupational areas, most publications address competencies among industrial clerks (commercial sector), medical assistants (healthcare sector), and vehicle mechatronics technicians (industrial- technical sector). Therefore, although a lot is already known on the competencies on these occupations, findings are currently still too restricted to too few occupations. Considering that the competence models and measurement instruments developed for one occupation are not easily transferable to other, even related, occupations, it is important to go beyond the occupations considered so far and to include other occupations and occupational areas. If we also take into account the observed trend towards computerised procedures, it is noticeable that the occupations currently in focus already display a high degree of IT-affinity. For example, for trainees in commercial occupations it is part of their everyday work to use computers. The same applies to motor vehicle mechatronics technicians. It remains unclear whether computerised competence assessments can also be successfully applied in occupations with less IT-affinity.

The results further show that most publications deal with the assessment of professional competencies. This emphasis was to be expected given the focus of the present study. However, a direct comparison of the types of competencies covered in the reviewed publications demonstrates that social and communicative competencies are clearly under-represented and competencies are primarily addressed in commercial occupations and in the healthcare sector. Although social and communicative competencies are important in these occupational areas due to the prominence of social interactions (e.g. through interactions with customers or patients), it can be assumed that social and communicative competencies are equally relevant for occupations with a lower contact frequency with colleagues, patients and customers.

5.2 Conclusions for a possible large-scale transfer

One objective of this review was to assess the suitability of the currently available assessment instruments for practical application and potential large-scale transfer. In order to draw a conclusion regarding a possible large-scale transfer, especially the quality and test economy of the instruments should be considered.

5.2.1 Quality of the instruments

It is noticeable that information regarding the objectivity of the instruments is very heterogeneous. Some publications provide only a rudimentary description of how the instruments are to be implemented and evaluated, whilst others provide detailed descriptions.

Due to the usually high degree of standardization in computer-based procedures, it is often easier to meet objectivity requirements in these instruments. The use of computerised instruments and scoring systems ensures that test takers are confronted with largely identical test situations, and their answers are usually subject to identical scoring systems. A potentially greater risk to meeting objectivity requirements occurs when open-ended response formats are used that give leeway for evaluation and interpretation, and when administration, scoring, and interpretation are performed by (sometimes inadequately trained) humans. However, observation, evaluation and interpretation by humans instead of computerised procedures cannot be universally equated with lower objectivity.

Regarding the validation of the instruments, it is important to underline that all instruments were subject to a minimum of one form of validation, usually content validation. It can therefore be concluded that most instruments adequately map the curricular requirements and/or were adequately representing the content of the respective occupations as judged by expert ratings. Validation of the instruments against trainees' performance in real-life situation was scarce. Estimates of the predictive validity of the instrument was not provided in any of the reviewed publications, resulting in a lack of information on whether the instruments are predictive of trainees' future performance in the occupational context. Further validation of the instruments is highly desirable prior to a potential large-scale application of the instruments, especially regarding the capacity of the instruments to predict trainees' behaviour in real-life situations, either through concurrent validity or predictive validity.

Regarding the reliability of the instruments, i.e. their precision of measurement, the available information is again highly heterogeneous. This makes it difficult to draw a uniform conclusion. Reliabilities may also vary within an instrument when measuring different facets of a construct, which makes endeavours to draw a comprehensive conclusion even more difficult. Overall, the reported reliabilities speak in favour of the precision of the instruments. Many of the instruments exhibit either acceptable or good reliabilities. Still, before a large-scale transfer of these instruments into learning contexts or examinations can take place, the instruments need to be able to record the competencies of learners in an entirely reliable way and across different samples. Prior to a potential large-scale transfer, it is therefore necessary to obtain more detailed information on the reliability of the instruments.

5.2.2 Test economy

In addition to the quality of the instruments, their suitability for a potential large-scale transfer into vocational training practice and examinations is also contingent on economic considerations. This refers to the expected resource expenditure in their development and implementation and their scalability, that is, extent to which they can be applied in both small and large samples without a linear increase in the required resources. Regarding the resource expenditure, a distinction can be made between the initial resources invested in the development of an instrument and the resources required in its ongoing application.

5.2.2.1 Development costs

Regardless of the test format, i.e. irrespective of whether a paper-and-pencil format or a computer simulation is used, the first stage of creating an instrument for competence assessment is the development of a theoretically sound competence model. While this initial step is re-

source-intensive, it is necessary to lay a theoretical foundation on which the instruments are to be built. The costs associated with the development of a competence model are not contingent on the test format to be used.

Beyond this initial development of an underlying competence model, there are notable differences in the development costs depending on the test format. IT-supported procedures are often very time-consuming and resource-intensive, especially when compared to paper-and-pencil formats, due to their high expenditures for technical development. Unlike paper-and-pencil formats, computerised formats must first be transferred to appropriate software, or this software must first be developed and tested. The technical requirements of computerised procedures is thus associated with considerable additional expenditures in the development phase. Likewise, structured behavioural observations, regardless of whether computerised elements are used or not, also tend to be time-consuming due to the development of a detailed evaluation scheme to rate the observed behaviour and due to the extensive training required on the part of the observers. Thus, during development, more resources are usually expended on instruments which aim to assess competencies either in real-life contexts or though computerised formats than on instruments using questionnaire-based paper-and-pencil formats.

5.2.2.2 Implementation costs

Next to the development costs, expenditures incurred for the implementation of the instruments is a relevant factor. Scalability is thus a second issue to be considered. Scalability refers to the extent to which an instrument can be applied in a cost-efficient way and without loss of quality to both small and large groups, such as within the scope of a large-scale transfer. As far as response formats are concerned, instruments which use closed answers and are thus subject to a clear evaluation system are particularly scalable. The implementation costs of test procedures with closed response formats is largely independent of the number of participants, especially if these tests can be conducted and evaluated in an IT-supported manner. A different situation arises in instruments that use open response formats and whose evaluation is based either on observations or other expert judgements, whether through direct behavioural observations or through the evaluation of written responses. The implementation cost of these instruments will always be proportional to the number of test takers. High implementation costs will also arise in assessment formats that involve the use of role players such as in simulated customer meetings or conflict situations. Such role-plays require the use of both trained observers and of the role players themselves. Especially in the case of these resource-intensive tasks, using technology-based elements such as films or computer simulations to depict the respective situations in which the competencies of learners are to be assessed can be useful. However, it must always be carefully considered whether the respective professional situations can be authentically depicted via a film or a computer simulation.

5.2.2.3 Further conclusions

In the above comparison of the resources required, it should be borne in mind that the decision as to which test format should be used cannot be made solely on the basis of the required resources but depends to a large extent on the competence under consideration. Not all test formats are equally suited to assess all types of competence. Particularly in the case of tasks which are subject to a uniform and automated evaluation system, i.e. which do not require an additional evaluation by an expert in every case, automated procedures can offer a major economic advantage. Computerised procedures can therefore be a valid and cost-effective test variant for tasks that have a pre-defined solution. The trend towards computerised procedures identified in the present study shows that increasing use is being made of the benefits of these formats. However, computerised solutions cannot entirely replace expert ratings.

A further criterion in deciding which format to employ is the availability of a sufficient number of items in an instrument. To allow for a large-scale application, it is first necessary that a sufficiently large number of validated items is available. Many of the instruments considered in this study currently still have a pilot character and do not yet have a large item pool.

5.3 Limitations and implications for further research

The present study was compiled in accordance with the inclusion and exclusion criteria described above. As a result, the included references and analyses are limited to those publications that meet these inclusion criteria. It hence cannot be completely ruled out that individual publications potentially worthy of inclusion were omitted from the study due to these restrictions. However, this limitation is inherent to virtually all systematic reviews, which are forced to stipulate certain criteria to ensure the manageability of reviewed data. There are, for example, initial studies on the development of instruments for the assessment of social and communicative competencies in the industrial and technical sector, which represent a first step towards placing a stronger emphasis on social and communicative competencies outside the commercial and healthcare occupations (cf. Güzel et al. 2016). However, publications on these studies did not meet the inclusion criteria of the present study. Given the extensive nature of the literature search, which started out with an inspection of 2,298 publications, the number of potentially relevant but unidentified publications can be assumed low.

Regardless of these limitations, the present review offers detailed insights into the status quo of competence assessment in vocational education and training in Germany. Based on this review, gaps and areas for further research can be identified, which are particularly relevant against the background of a possible use of the instruments in practice.

5.4 Recommendations

Based on the results of this study, it can be concluded that a broader spectrum of occupations and occupational areas should be considered in the development and testing of instruments for competence assessment in vocational training, extending beyond commercial, industrial-technical and healthcare occupations. Within these three occupational areas, a greater diversity of occupations is desirable. Regarding the increasing use of IT-supported procedures, pilot studies of these formats should likewise extend their focus to incorporate occupations with a lower IT-affinity than the occupations currently under study. This will provide valuable information on the extent to which the instruments are transferable to a broader spectrum of occupations and are applicable to, for example, traditional craft trades. Finally, in order to allow for a potential large-scale application of the instruments, there is a strong need for further validations of the instruments, especially regarding their predictive validity, and for more extensive piloting in practice. Many of the instruments considered in the present study are in a development or piloting stage. This implies that further steps are necessary in order to ensure a smooth transfer of these instruments to training or examination contexts. Notwithstanding this, the results of the present study provide evidence of the enormous progress being made in occupational competence assessment and of potential practical applications of the instruments.

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Annexes

Annex 1: Selection and evaluation criteria

Inclusion criteria
Assessment of competencies
Cognitive and performance-oriented approaches
Learning status checks and final examinations
Published between 2001 and 2017
German context
Vocational education and training context
All training occupations, no restriction
Occupation-specific/professional competence contents
Social, emotional and volitional competencies (insofar as investigated in a VET context)
Literature from stated literature databases
Empirical studies
Sufficient description of measurement instruments (methods, evaluation, results etc.)
Exclusion criteria
Descriptive approaches
Normative approaches
Inadequate information on assessments carried out
Inadequate information on results (data, quality criteria etc.)
Higher education context
Teacher competencies
Foreign publications
Conference papers
Competencies in continuing training
Competencies acquired by informal means
Samples with particular funding requirements
Organisational or other contexts
Consideration criteria of the methods/assessment procedures
Competence approaches
Scope of the occupational areas considered
Extent of competencies recorded
Typisation of measurement instruments
Tests based on theoretical principles
Objectivity
Validity
Reliability
Broad usability

Annex 2: Search terms used and results per database including date of access

Search terms	PubPsych	Date	LDBB	Date	FIS	Date
Kompetenzmodellierung	23	10.04.2018	9	08.05.2018	105	09.05.2018
Kompetenzmessung	60	10.04.2018	31	08.05.2018	522	09.05.2018
Berufliche Kompetenzmodellierung	11	10.04.2018	0	08.05.2018	0	09.05.2018
Berufliche Kompetenzmessung	34	10.04.2018	1	08.05.2018	1	09.05.2018
Berufliche Handlungskompetenz	102	10.04.2018	14	08.05.2018	60	09.05.2018
Berufliche Handlungsfähigkeit	21	10.04.2018	3	08.05.2018	23	09.05.2018
Berufliche Bildung*Kompetenz	16	10.04.2018	3	08.05.2018	1347	14.05.2018
Berufliche Bildung*Handlungskompetenz	6	10.04.2018	2	08.05.2018	118	14.05.2018
Berufliche Bildung*Handlungsfähigkeit	2	10.04.2018	8	08.05.2018	30	14.05.2018
Berufliche Bildung*Messung*Kompetenz	10	10.04.2018	1	08.05.2018	65	14.05.2018
Berufliche Bildung*Messung* Handlungskompetenz	1	10.04.2018	0	08.05.2018	12	14.05.2018
Berufsbildung*Kompetenz	16	10.04.2018	11	08.05.2018	1347	15.05.2018
Berufsbildung*Handlungskompetenz	3	10.04.2018	2	08.05.2018	118	15.05.2018
Berufsbildung*Handlungsfähigkeit	1	10.04.2018	19	09.05.2018	30	15.05.2018
Berufsbildung*Messung*Kompetenz	1	10.04.2018	0	09.05.2018	65	15.05.2018
Berufsbildung*Messung* Handlungskompetenz	0	10.04.2018	0	09.05.2018	12	15.05.2018
Messung*Berufliche Handlungskompetenz	16	10.04.2018	1	09.05.2018	0	15.05.2018
Messung*Handlungskompetenz	25	10.04.2018	2	09.05.2018	36	15.05.2018
Messung*Kompetenz*Berufsausbildung	3	10.04.2018	0	09.05.2018	30	15.05.2018
Messung*Kompetenz*Beruf	17	10.04.2018	0	09.05.2018	22	15.05.2018
Modellierung*Kompetenz	72	09.05.2018	5	09.05.2018	180	15.05.2018
Modellierung*berufliche Kompetenz	34	10.04.2018	1	09.05.2018	13	15.05.2018
Modellierung*Handlungskompetenz	1	09.05.2018	7	09.05.2018	10	15.05.2018
Modellierung*berufliche Handlungskompetenz	1	10.04.2018	7	09.05.2018	0	15.05.2018
Modellierung*Handlungsfähigkeit	2	09.05.2018	7	09.05.2018	0	15.05.2018
Modellierung*berufliche Handlungsfähigkeit	0	10.04.2018	7	09.05.2018	0	15.05.2018
TOTAL per database	**478**		**141**		**4,146**	
Without duplicates	305		105		2,084	
Duplicates removed per database	173		36		2,062	
TOTAL after collation	2,494					
Duplicates removed after collation	196					
TOTAL	**2,298**					

Annex 3: Overall summary of the competencies considered

Type	Competence*	References
Professional	Commercial competence	KLOTZ 2015; KLOTZ/WINTHER 2012; KLOTZ/WINTHER 2015; KLOTZ/WINTHER 2016; LIEDTKE/SEEBER 2015; WINTHER 2011; WINTHER/ACHTENHAGEN 2009a; WINTHER/ACHTENHAGEN 2009b; WINTHER et al. 2016
	Economic competencies	SEEBER 2008; SEEBER et al. 2015
	Intrapreneurship competence	WEBER et al. 2016a; WEBER et al. 2016b
	Business competence	EBERLE et al. 2016
	Patient care	SEEBER 2014; SEEBER 2016; SEEBER et al. 2016
	Laboratory activities	SEEBER 2014; SEEBER 2016; SEEBER et al. 2016
	Administrative healthcare tasks	SEEBER 2014; SEEBER 2016; SEEBER et al. 2016
	Diagnostic and reflective nursing competence	DÖRING et al. 2016a; DÖRING et al. 2016b
	Practical and technical competence	DÖRING et al. 2016a; DÖRING et al. 2016b
	Professional competence (vehicles)	ABELE 2014; MUSEKAMP et al. 2010
	Occupational competence (specialist, functional, contextual, orientation and summary knowledge)	RAUNER/HEINEMANN 2009; RAUNER et al. 2011; RAUNER et al. 2007
	Occupation-specific professional performances	FEHRING 2007; HOFFMANN/LEHMANN 2007; SEEBER 2007c; SEEBER 2007b; STRAKA/LENZ 2005
	Action competence horticulture/landscaping	HASS 2016
	Problem-solving competence (e.g. troubleshooting competence ability)	ABELE et al. 2016; EGLOFFSTEIN et al. 2016; GSCHWENDTNER et al. 2009; GSCHWENDTNER et al. 2010; LINK/GEISSEL 2015; MUSEKAMP 2011; NICKOLAUS et al. 2011; NIETZSCHKE et al. 2011; SEIFRIED et al. 2016; WALKER et al. 2016; WUTTKE et al. 2015
	Specialist competence (repair, maintenance)	SCHMIDT et al. 2007
	Banking competence	BÖHNER/STRAKA 2005; ROSENDAHL/STRAKA 2007; ROSENDAHL/STRAKA 2011a; ROSENDAHL/STRAKA 2011b
	General economic competence	ROSENDAHL/STRAKA 2011a; ROSENDAHL/STRAKA 2011b
General	Reading	BALKENHOL 2016; BERNHARDT 2017; ROSENDAHL/STRAKA 2011a; ROSENDAHL/STRAKA 2011b; SPODEN et al. 2005; ZIEGLER et al. 2016
	Mathematics	BALKENHOL 2016; BERNHARDT 2017; ROSENDAHL/STRAKA 2011a; ROSENDAHL/STRAKA 2011b; SIEBERT/HEINZE 2014; SPODEN et al. 2005; ZIEGLER et al. 2016
	Natural sciences	BALKENHOL 2016; BERNHARDT 2017; SIEBERT/HEINZE 2014; SPODEN et al. 2005; ZIEGLER et al. 2016
	Literacy	SEEBER 2007a
	Technical English	LEHMANN/NEUMANN 2007
	Methodological competence	FREY/BALZER 2005
Social and communicative	Social and communicative competence	DIETZEN et al. 2016; DÖRING et al. 2016a; DÖRING et al. 2016b; FREY/BALZER 2005; TSCHÖPE/MONNIER 2016
	Intercultural competence	WEBER/ACHTENHAGEN 2014
Other	Motivational and emotional factors	STRAKA/LENZ 2005

**The designations of competencies listed here are guided by the designations applied in the respective publications or summarise these into root categories.*

Annex 4: Overall summary of all studies included

Programme/ project		Competence	Sample	Instrument	Reliability*	Validation**	Reference
ASCOT	Cobalit	Commercial competence	Industrial clerks (N = 179), freight forwarding and logistics services clerks (N = 423)	Computerised video-based assessment (ALUSIM company simulation), 18 items from the logistics and transport sector	./.	Content validity (+)	Liedtke/Seeber 2015
		Commercial competence (commercial literacy, business process competence)	Industrial clerks (N = 494)	Computerised video-based assessment (ALUSIM company simulation), 72 items (36 items commercial literacy, 36 items business process competence)	(++)	Content validity (+)	Winther et al. 2016
		Cross-cutting economic and occupational competencies	Industrial clerks (N = 186), freight forwarding and logistics services clerks (N = 637)	Computerised video-based assessment (ALUSIM company simulation), 26 items cross-cutting competencies (closed)/18 items occupation-specific competencies	(++)	Content validity (+)	Seeber et al. 2015
		Intrapreneurship competence (generation of ideas, planning/implementation)	Industrial clerks (N = 357)	Computerised video-based assessment (ALUSIM company simulation), open items, 14 items generation of ideas, 32 items planning/implementation	(+ - to +)	Content validity (+)	Weber et al. 2016b
		Intrapreneurship competence (generation of ideas, planning/implementation)	Industrial clerks (N = 906)	Computerised video-based assessment (ALUSIM company simulation), open items, 14 items generation of ideas, 32 items planning/implementation	(++)	Content validity (+)	Weber et al. 2016a
		Business competence (domain-linked and domain-specific)	Industrial clerks (N = 512), freight forwarding and logistics services clerks (N = 327)	Computerised video-based assessment (ALUSIM company simulation), 6 problem situations with 56 items (multiple choice, dichotomous, forced choice, open items), of which 26 items from WBT/OEKOMA	(+ to ++)	Content validity (+)	Eberle et al. 2016

Programme/ project		Competence	Sample	Instrument	Reliability*	Validation**	Reference
ASCOT	CosMed	Social and communicative competencies (regulation of emotion, perspectives coordination, communication strategies)	N = 405 medical assistants	Computer-based simulated situational judgement test with 12 video sequences (text-based questions with open response format, multiple choice, and picture-based answers)	./.	Content validity (+)	Tschöpe/ Monnier 2016
		Social competencies (regulation of emotion, perspectives coordination, communication strategies, listening, speaking intelligibly)	N = 405 medical assistants	Computer-based simulated situational judgement test with 12 video sequences (text-based questions with open response format, multiple choice, and picture-based answers)	./.	Content validity (+) Convergent validity (-)	Dietzen et al. 2016
		Occupational professional competence, dimension (1) patient care, support and guidance (2) laboratory activities and (3) administrative activities	Medical assistants (N = 997)	Computer simulation with video vignettes (1) Adaptive test to record declarative specialist knowledge relating to medicine and healthcare, 87 items, multiple choice (2) Video and simulation-based test to assess occupational competence, 24 video and audio scenes and 22 simulation-based scenarios, total of 79 test items (open/decision-making questions, sequence questions, situational judgement)	(+)	Content validity (+) Convergent validity (-)	Seeber 2016; Seeber et al. 2016
ASCOT	TEMA	Professional competence in nursing (diagnostic and reflective competence, practical and technical competence, interactive and communicative competence)	Geriatric nurses (N = 402)	Computer simulations with video vignettes from 12 occupational action situations, 76 closed written test tasks	(+)	Content validity (+)	Döring et al. 2016a
		Professional competence in nursing (diagnostic and reflective competence, practical and technical competence, interactive and communicative competence)	Geriatric nurses (N = 402)	Computer simulations with video vignettes from 12 occupational action situations, 62 test tasks	./.	Content validity (+)	Döring et al. 2016b

Programme/ project		Competence	Sample	Instrument	Reliability*	Validation**	Reference
ASCOT	DomPL	Domain-specific problem-solving competence in the area of controlling (application of knowledge, action regulation, self-concept, interest)	Industrial clerks (no N stated)	Computer-based office simulation, task assignments in the form of emails (open response format)	./.	Content validity (+)	Egloffstein et al. 2016
		Domain-specific problem-solving competence in the area of controlling (application of knowledge, self-concept, interest)	Industrial clerks (N = 562), wholesale and foreign trade clerks (N = 116), information and telecommunications system support specialists (N = 108)	Computer-based office simulation, task assignments in the form of emails (open response format)	Application of knowledge (+ to ++), self-concept (+), interest (+-)	Content validity (+)	Seifried et al. 2016
		Domain-specific problem-solving competence in the area of controlling – application of knowledge (identify action requirements, process information, make decisions, communicate decisions)	N = 123 (N = 86 industrial clerks, N = 37 information and telecommunications system support specialists)	Computer-based office simulation, task assignments in the form of emails (open response format)	Identify action requirements (+), process information (+-), make/communicate decisions (-)	Content validity (+)	Wuttke et al. 2015
ASCOT	KoKoEA	Professional competence (specialist knowledge, analytical problem-solving competence/error diagnosis competence, constructive problem-solving competence)	Electronics technicians for automation technology (N = 278-878)	Specialist knowledge – paper-and-pencil tests (119 closed items). Analytical problem-solving competence – computer simulations (20 items) and actions on a real model. Constructive problem-solving competence – computer simulations (20 items) and paper-and-pencil test.	(+ to ++)	Content validity (+) Convergent validity (+) Concurrent validity (+)	Walker et al. 2016
		Constructive problem-solving ability	Electronics technicians for automation technology (N = 145)	Real requirements situation (real computer-based development environment) and paper-and-pencil test for the recording of constructive problem-solving abilities, 8 problem tasks with a total of 20 items	(++)	Content validity (+)	Link/Geissel 2015

Programme/ project		Competence	Sample	Instrument	Reliability*	Validation**	Reference
ASCOT	KoKo Kfz	Professional competence (specialist knowledge, practical knowledge, error diagnosis competence)	Vehicle mechatronics technicians (N = 121-918)	Specialist knowledge – paper-and-pencil tests (85 items, multiple choice), computerised video-based test with 6 repair situations (each consisting of 3 situations with a total of 45 items, predominantly multiple choice)	(+ to ++)	Content validity (+) Convergent validity (+-) Concurrent validity (+)	ABELE et al. 2016
ASCOT	KoKo Kfz/ DFG NI 606 7.1 and 7.2	Professional competence (action-related (standard service, repairs) and non-action related knowledge)	Vehicle mechatronics technicians, electronics technicians specialising in energy and building technology (N = 235-240)	Paper-and-pencil test/video vignette to measure action-related (71 items) and non-action related knowledge (12-16 items), items primarily closed	Standard service (++), repair (+-)	Content validity (+) Convergent validity (+)	SCHMIDT et al. 2007
ASCOT	Makadapt	Reading, mathematics, natural sciences	Industrial and technical/commercial occupations (N = 1224)	Computerised, adaptive test instrument largely comprising existing instruments (71 items reading, 125 mathematics, 133 natural sciences, 33 items per test subject)	./.	Content validity (+)	SPODEN et al. 2005
		Reading, mathematics, natural sciences	Vehicle mechatronics technicians, electronics technicians for automation technology, industrial clerks, geriatric nurses, medical assistants (N = 1632)	Computerised, adaptive test instrument largely comprising existing instruments (71 items reading, 125 mathematics, 133 natural sciences, 33 items per test subject)	(++)	Content validity (+)	BERNHARDT 2017
		Reading, mathematics, natural sciences	Vehicle mechatronics technicians, electronics technicians for automation technology, industrial clerks, geriatric nurses, medical assistants (N = 1093)	Computerised, adaptive test instrument largely comprising existing instruments (71 items reading, 125 mathematics, 133 natural sciences, 33 items per test subject)	(++)	Content validity (+)	ZIEGLER et al. 2016
ASCOT	Makadapt	Literacy, supplementary – mathematics, natural sciences	Medical care occupations, industrial and technical occupations, commercial administrative occupations, gardeners, forest managers (N = 1632)	Simulations in a computer-based adaptive test procedure (9 items – identify and extract, integrate and interpret, reflect and evaluate), mathematics and natural sciences (12 items), closed response formats	./.	Content validity (+)	BALKENHOL 2016
(DFG) main focus programme on competence modelling		Specialist occupational knowledge, professionally specific problem-solving ability	Vehicle mechatronics technicians (N = 286), electronics technicians specialising in energy and building technology (N = 203)	Specialist knowledge – paper-and-pencil test (vehicle mechatronics technicians 27 items, electronics technicians 21 items). Problem-solving competence – paper-and-pencil test (mechatronics technicians 6 tasks/ error functions), MILAS computer simulation (electronics technicians 4 tasks/error functions)	Specialist knowledge (+ to ++) Problem-solving competence (- to - -)	Content validity (+)	GSCHWENDTNER et al. 2010

Programme/ project	Competence	Sample	Instrument	Reliability*	Validation**	Reference
Competence models for the recording of individual learning outcomes and for the evaluation of educational processes	Commercial competence, area of business processes	Industrial clerks (N = 1768)	Chamber of commerce and industry final and intermediate examinations (AkA) from 2008 (6 tasks, free response format)	Average competence profile (+), low competence profile (- -)	Content validity (-) Construct validity (-)	Klotz/Winther 2012
	Commercial competence, area of business processes (marketing, procurement, HR/ service provision)	Industrial clerks (N = 1768)	Chamber of commerce and industry final and intermediate examinations (AkA) from 2008 (6 tasks, 38 items, free response format)	Total (++), marketing (+-), procurement (- -), HR (+ -), service provision (-)	Content validity (-) Construct validity (-)	Winther 2011
	Professionally specific problem-solving ability/error analysis – supplementary motivational factors	Vehicle mechatronics technicians (N = 77), electronics technicians specialising in energy and building technology (N = 96)	Computer-simulated work samples (vehicle mechatronics technicians 15 tasks, electronics technicians 11 tasks, solution in written form), supplemented by paper-and-pencil tests (19 tasks)	(+ - to -)	Content validity (+-)	Nickolaus et al. 2011
	Professional competence (knowledge/skills)	Vehicle mechatronics technicians (N = 798), mechatronics fitters (N = 163)	Knowledge – vehicle mechatronics technicians theoretical journeyman examinations (paper-and-pencil test 78 items), mechatronics fitters theoretical final examination Skills – vehicle mechatronics technicians computer simulations, mechatronics fitters practical final examination	Knowledge (++), skills (+ -)	Content validity (+) Convergent validity (+) Discriminant validity (+) Structuralvalidity (+)	Abele 2014
	Commercial competence (domain-linked and domain-specific – marketing, procurement, HR/service provision)	Industrial clerks (N = 877)	Digital test booklets with tasks, modelled company background with typical work orders (40 items, open response format)	(++)	Content validity (+)	Klotz 2015
	Commercial competence (domain-linked and domain-specific)	Industrial clerks (N = 877)	Digital test booklets with tasks, modelled company background with typical work orders (46 items, supplementary tasks, brief responses, essays)	(+ - to +)	Content validity (+)	Klotz/Winther 2015
	Commercial competence (domain-linked and domain-specific)	Industrial clerks (N = 877)	Digital test booklets with tasks, modelled company background with typical work orders (46 items, supplementary tasks, brief responses, essays)	(+ to ++)	Content validity (+)	Klotz/Winther 2016
	Banking competence	Bank clerks (N = 53-64)	Banking competence test (BKT, 6 sub-tests with 22-24 items, multiple choice)	(+)	Content validity (+) Convergent validity (+)	Böhner/ Straka 2005
	Banking competence, motivation	Bank clerks (N = 61)	Banking competence test (BKT, 46 sub-tasks), motivation recorded via standardised self-assessment	(++)	N/A	Rosendahl/ Straka 2007

Programme/ project	Competence	Sample	Instrument	Reliability*	Validation**	Reference
	General economic competence, banking competence, mathematical competence, literacy	Bank clerks (N = 456)	General economic competence (business education test, WBT, 46 items, multiple choice), banking competence (banking competence test, 43–48 items, multiple choice), mathematical competence (LAU, 20 items, multiple choice), literacy (Gates-McGintie Test, 4–6 items, multiple choice)	WBT T1 (+ – to +), BKT T2 (+ – to ++)	Content validity (+) Convergent validity (+)	Rosendahl/ Straka 2011a
	General economic competence, banking competence, mathematical competence, literacy	Bank clerks (N = 452)	idem	Mathematical competence (+ –), literacy (–), WBT (+– to +), BKT (+– to ++)	Content validity (+)	Rosendahl/ Straka 2011b
Construct validity of simulation tasks – computer-aided assessment of professional competencies	Commercial competence – action-based (procedural/interpretative), understanding-based (conceptual)	Industrial clerks (N = 264)	Computerised video-based assessment (ALUSIM web-based company simulation). Action-based competence – video sequences in ALUSIM (test areas procurement, sales, work preparation, 33 items). Understanding-based competence – application tasks (24 items), written responses	(+)	Content validity (+)	Winther/ Achtenhagen 2009b
	Commercial competence (procurement/sales and work preparation)	Industrial clerks (N = 264)	Computerised video-based assessment (ALUSIM web-based company simulation), 9 video sequences – 3 x sales (24 items), 4 x procurement (29 items), 2 x work preparation (7 items), written documentation of results	./.	Content validity (+)	Winther/ Achtenhagen 2009a
ManKobE	Mathematical and natural sciences competencies	Industrial and technical trainees (N = 360), commercial trainees (N = 653)	Prior school learning (standard educational tasks from the Institute for Quality Development, IQB, federal state comparison of 2012), professionally specific supplementary tasks for the assessment of occupational field-related mathematical competencies (aligned to chamber of commerce and industry examination tasks)	(+)	N/A	Siebert/Heinze 2014
	Intercultural competence	Trainees from trade and industry and administration (N = 61)	Case study involving intercultural conflict situations (Intercultural Critical Incident Method), 10 items, solutions in an open task format (essay)	(++)	Face validity (+)	Weber/ Achtenhagen 2014

Programme/ project	Competence	Sample	Instrument	Reliability*	Validation**	Reference
KOMET	Experience-based, systematic advanced knowledge, detailed and functional knowledge, context knowledge, orientation knowledge and summary knowledge	Electronics technicians specialising in industrial engineering, electronics technicians specialising in energy and building technology (N = 700)	1 evaluation task/work order per domain (4 in total), 2 tasks per test subject (40 items, paper-and-pencil test, open response format)	./.	Content validity (+)	Rauner/ Heinemann 2009
	idem	Electronics technicians specialising in industrial engineering, electronics technicians specialising in energy and building technology (N = 777)	Open, complex test tasks in real situations	./.	Content validity (+)	Rauner et al. 2011
	Occupational competence	Industrial electronic technicians, industrial mechanics, automobile mechanics, tool makers, industrial clerks (N = not stated)	Open, complex test tasks in real situations	./.	Content validity (+ -) Ecological validity	Rauner et al. 2007
	idem	Electronics technicians (N = not stated)	Open-structured, complex test tasks (4 test tasks, 40 items on observer evaluation sheet)	./.	N/A	Haasler 2011
ULME III.	Medical assistants (patient care, administrative & non-personal medical tasks), qualified dental employees (dental, diagnostic, treatment-related and administrative tasks)	Medical assistants (MFA, N = 285), qualified dental employees (ZFA, N = 204)	Occupation-specific test tasks (81 items MFA, 87 items ZFA), closed response format (multiple choice)	(++)	Content validity (+)	Seeber 2014
	Economic competence	Office managers (N = 284)	Occupation-specific test tasks (51 tasks with 112 items), multiple choice and open response formats	(++)	Content validity (+)	Seeber 2008
	Technical English	idem	Test tasks (paper-and-pencil test, 18 tasks, 78 multiple choice items)	(++)	N/A	Lehmann/ Neumann 2007
	Occupation-specific professional performances	Plant mechanics (N = 131), industrial mechanics (N = 143), aircraft mechanics (N = 93), electrical fitters (N = 74), joiners (N = 65)	Text tasks (paper-and-pencil) – plant mechanics (93 tasks), industrial mechanics (40 tasks), aircraft mechanics (79 tasks), electrical fitters (31 tasks), joiners (94 tasks). Response formats multiple choice, true/ false, allocation tasks	(+ to ++)	Content validity (+)	Hoffmann/ Lehmann 2007

Programme/ project	Competence	Sample	Instrument	Reliability*	Validation**	Reference
ULME III.	Literacy (understanding texts and tables, reading comprehension, arithmetical skills)	Office managers, management assistants for retail services, industrial clerks, freight forwarding and logistics services clerks, advertising clerks, legal and notary assistants, plant mechanics, electrical fitters, aircraft mechanics, industrial mechanics, joiners, medical assistants, qualified dental employees, hairdressers, information technology specialists, hotel specialists (N = 1128–2018)	Test tasks (paper-and-pencil test, 45 items), closed response format	./.	N/A	Seeber 2007a
	Occupation-specific professional performances	Office managers (N = 156), bank clerks (N = 189), management assistants for retail services (N = 308), industrial clerks (N = 58), freight forwarding and logistics services clerks (N = N/A), advertising clerks (N = 121), legal and notary assistants (N = 76)	Text tasks (paper-and-pencil) – office managers (51 tasks, 95 items), bank clerks (72 tasks, 106 items), management assistants for retail services (60 tasks, 76 items), industrial clerks (67 tasks, 100 items), freight forwarding and logistics services clerks (55 tasks, 65 items), advertising clerks (64 tasks, 73 items), legal and notary assistants (73 items). Multiple choice, true/false, allocation tasks/open response formats	(++)	Content validity (+)	Seeber 2007c
	Occupation-specific professional performances	Hairdressers (N = 85), medical assistants (N = 204), qualified dental employees (N = 204)	Text tasks (paper-and-pencil test) – hairdressers (78 tasks, 93 items), medical assistants (82 tasks, 81 items), qualified dental employees (104 items). Response format multiple choice, true/false, allocation tasks	(++)	Content validity (+)	Seeber 2007b
	Occupation-specific professional performances	Hotel specialists (N = 118), information technology specialists (N = 86)	Text tasks (paper-and-pencil test) – hotel specialists, hairdressers (58 tasks, 56 items), information technology specialists (46 tasks, 55 items). Response format multiple choice, true/false, allocation tasks	(+)	Content validity (+)	Fehring 2007

Programme/ project	Competence	Sample	Instrument	Reliability*	Validation**	Reference
Competence modelling and competence development in industrial and technical vocational education and training	Professional competence (specialist knowledge, error analysis ability), motivation	Electronics technicians (N = 96)	Specialist knowledge – paper-and-pencil test (39 items), closed and open response formats. Error analysis ability – Computer simulation of repair orders (supplemented by closed questions, 11 items)	Specialist knowledge (+-), error analysis ability (- -)	Content validity (+)	Nietzschke et al. 2011
	Vehicle error diagnosis competence	Vehicle mechatronics technicians (N = 257)	Computer simulation and real work samples of faults in vehicles, 8 faults per setting as twinned items (2 faults processed per setting and per test subject), evaluation via documentation sheet	(+-)	Facevalidity (+) Content validity (+) Concurrent validity (+)	Gschwendtner et al. 2009
	Vehicle competence	Vehicle service mechanics (N = 41-82), vehicle mechatronics technicians (N = 48-64) plus skilled workers (N = 21) and trainees in basic training (N = 20)	Written work orders, aligned to occupational practice, open response formats only (essay form)	./.	N/A	Musekamp et al. 2010
	Vehicle service and diagnosis competence	Vehicle mechatronics technicians (N = 492, of which N = 51 experienced skilled workers)	Service competence (25 items), diagnosis competence (27 items), response format multiple choice	(+)	Content validity (+) Concurrent validity (+)	Musekamp 2011
	Action competence horticulture/ landscaping	Gardeners specialising in horticulture and landscaping (N = 754)	Evaluation sheet (paper-and-pencil test, self-assessment and external assessment, 70 items), external assessment via observation of actions	(+ to ++)	Content validity (+) Concurrent validity (+)	Hass 2016
	Social competence, methodological competence	Commercial (N = 600) and industrial and technical trainees (N = 124)	Paper-and-pencil self-assessment test (evaluation sheet on social and methodological competencies (smk), 128 items)	(++)	Content validity (+) Structural validity (+) Differential validity (+) Criterion validity (-)	Frey/Balzer 2005

Programme/ project	Competence	Sample	Instrument	Reliability*	Validation**	Reference
EDUKAT pilot project	Prior learning and learning outcomes/professional competence – cognitive, motivational, and emotional factors	Commercial trainees (N = 149)	Paper-and-pencil test – individual learning predispositions (business education test, WBT, 46 items, multiple choice), learning outcomes/professional competence (class tests in the area of business management). Cognitive, motivational, and emotional conditions (MOSLISB partial scales, self-assessment)	(+ to ++)	N/A	Straka/Lenz 2005

**In some cases, descriptions of reliabilities differ strongly between the publications in terms of scope and level of detail. In addition, publications often consider several competencies, all of which show reliability estimates. The publications use different measurements of reliability, make overarching comparisons difficult. In order to offer an insight into the reliabilities of the instruments discussed in the publications, the following highly simplified classification was used to permit conclusions at publication level. These classifications each refer to the respective estimate provided in the publications (Cronbach's alpha, EAP/PV or WLE reliability). In cases where there was a strong discrepancy between the reliability values of the different instruments discussed in the same publication, only the range of the estimates were included in the table.*

./. No information or information unclear

++ .80 or higher

+ .70 or higher

+- between .61 and .69

- .60 or lower

-- .50 or lower

*** + = good or acceptable validity, - = low or unacceptable validity*

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Abstract

The present study provides a systematic overview of the methods of competence assessment in German vocational education and training (VET). To this end, 58 publications from the years 2001 to 2017 have been reviewed regarding the occupational areas for which assessment instruments were developed, types of competencies that were assessed, the types of instruments used to assess the competencies and the psychometric properties of these instruments. The results indicate that the instruments described in the reviewed publications particularly address commercial, industrial-technical and health occupations. The majority of the instruments deal with the identification of professional competencies (66%), followed by basic (24%) and social/communicative competencies (9%). Most instruments employed paper-and-pencil or computerised assessment methods with a clear trend towards computerised procedures. In most cases, the instruments were subjected to at least one type of validation. The reliabilities of the instruments varied greatly in some cases. In conclusion, this study shows that there is already a sound base of instruments available for the assessment of competence in German vocational education and training. However, the instruments should be extended to cover a broader range of occupational areas and subjected to additional validation and piloting prior to a potential large-scale transfer.

The present study provides a systematic overview of the methods of competence assessment in German vocational education and training (VET). To this end, 58 publications from the years 2001 to 2017 have been reviewed regarding the occupational areas for which assessment instruments were developed, types of competences that were assessed, the types of instruments used to assess the competences and the psychometric properties of these instruments. The results indicate that the instruments described in the reviewed publications particularly address commercial, industrial-technical and health occupations. The majority of the instruments deal with the identifi cation of professional competences (66%), followed by basic (24%) and social/communicative competences (9%). Most instruments employed paper-and-pencil or computerized assessment methods with a clear trend towards computerized procedures. In most cases, the instruments were subjected to at least one type of validation. The reliabilities of the instruments varied greatly in some cases. In conclusion, this study shows that there is already a sound base of instruments available for the assessment of competence in German vocational education and training. However, the instruments should be extended to cover a broader range of occupational areas and subjected to additional validation and piloting prior to a potential large-scale transfer.

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