2005

Web-based Aptitude Tests at Universities in German-speaking Countries

Michael Amberg
University of Erlangen-Nuremberg

Sonja Fischer
University of Erlangen-Nuremberg

Manuela Schroder
University of Erlangen-Nuremberg

Follow this and additional works at: http://scholarworks.lib.csusb.edu/ciima

 Part of the Management Information Systems Commons

Recommended Citation

Web-based Aptitude Tests at Universities in German-speaking Countries

Michael Amberg

University of Erlangen-Nuremberg, Lange Gasse 20, 90403 Nuremberg, Germany,
+49-(0)911-5302-801, +49-(0)911-5302-860, amberg@wiso.uni-erlangen.de

Sonja Fischer

University of Erlangen-Nuremberg, Lange Gasse 20, 90403 Nuremberg, Germany,
+49-(0)911-5302-876, +49-(0)911-5302-860, sonja.fischer@wiso.uni-erlangen.de

Manuela Schröder

University of Erlangen-Nuremberg, Lange Gasse 20, 90403 Nuremberg, Germany,
+49-(0)911-5302-863, +49-(0)911-5302-860, manuela.schroeder@wiso.uni-erlangen.de

ABSTRACT

*Universities can select their students more and more independently. In order to support the selection process, web-based aptitude tests are a possibility to balance benefits und efforts of this task. Within this paper, we will point out how current web-based aptitude tests are designed, what competences are covered, and which methods for development are used. For this purpose, we developed a **classification** how web-based aptitude tests are implemented. Furthermore, competences as the basis of web-based aptitude tests are appraised. Four **competence categories** (professional, methodological, personal, and social competences) are selected as the most appropriate pattern. Thereafter, we analyse methods for developing competence specifications. Finally, we state **lessons learned** for the development of web-based aptitude tests at universities. These results are an important preparatory work and a basis for a systematically development of a web-based aptitude test for the University of Erlangen-Nuremberg.*

Key words: web-based aptitude test, competence management, development methods.

INTRODUCTION

In times of decreasing funds, the quality of education is challenged, resulting in an increasing competition among German universities. A high number of students do not finish their studies. 30 % of the students at universities and 22 % of the students at universities of applied science leave without a graduation (Heublein, Schmelzer, Sommer, & Spangenberg, 2002, p. 22). Some of them change their subject and finally get their graduation in another subject; others leave the universities and directly go to work. There is almost no systematic evaluation about results and quality of education at universities. There is a variety of open questions. What causes this problem? Are the freshmen not skilled enough? Is the school education not qualifying for studies? Are motivation and quality of the university lecturers too bad? Or do freshmen often study the wrong subject? Do their skills and aptitude really fit to the subject? Are they fully informed about the requirements of the subject?

Universities in Germany are - to some extent - allowed to select their students according to individual criteria. But mostly they do not use this right. The effort for selecting the applicants this way is very high – as well as the costs. Web-based aptitude tests are a possibility to balance benefits and costs. At present, they are used in some universities to inform and advise the applicants about a field of study. Nevertheless, there is no technical standard, all tests are very individual and have specific strengths and weaknesses. Therefore, there is a strong need at universities to carry out a state-of-the-art analysis for web-based aptitude tests.

Within this paper, we will point out how current web-based aptitude tests are designed, what competences they cover, and which methods for development they use. Therefore, we decided to examine web-based aptitude tests at universities in German-speaking countries. We identified seven applications on different universities. In order to get into more detail, we collected information about these tests with desk research and personal interviews by phone.

Based on the results, we derived a classification how web-based aptitude tests are implemented. We take a close

look at the level of interactivity, the elements of test reporting, the type of questioning, and the number of tested fields of study. Afterwards, competences as the basis of web-based aptitude tests were appraised. Four competence categories (professional, methodological, personal, and social competences) were selected as the most appropriate pattern. Therefore, we analysed methods for developing these competence specifications. Finally, we derived lessons learned for the development of web-based aptitude tests at universities. Our research in this topic is the preliminary work for the development of a specialised web-based aptitude test at the university of Erlangen-Nuremberg.

STATE OF THE ART FOR WEB-BASED APTITUDE TESTS AT UNIVERSITIES

Aptitude for a task, a field of study or a job is an important part of success and excellence. There are different methods to measure aptitude. First application fields were the evaluation of intelligence and differentiation between learning-disabled and normally talented children in 1905 and the test of applicants for the American corps for an European expedition in 1917, which was based on a personal data sheet (Fisseni, 1997, p. 7). In 1894, American Psychologists firstly used questionnaires to ask for the biographical data. This questionnaire of an American insurance company was used to improve the selection of insurance salesmen (Stehle, 1983, p. 34).

To reduce drop-out rates, admission tests for college are used to select students, who are supposed to pass college (Stumpf & Stanley, 2002). Hereby, the risk that students drop out early can be reduced. In Germany, the first commonly used aptitude test for entering university was in the medical sector. Some of these tests are still making use of paper and pencil, other tests are computer-based but the examination takes place in a test centre. Recently, some aptitude tests use web-based methods. The web-based solution is getting more and more important, because of the recent technological advances. Other reasons are the low cost, high effectiveness, overall availability, and an easy distribution of these web-based aptitude tests.

In the following, selected web-based aptitude tests for studying at a university are analysed and classified. The analysis focuses on web-based aptitude tests in German-speaking countries. Most of these web-based aptitude tests are available on the Internet. Only the web-based aptitude test for a study in veterinary medicine at the "Freie Universität Berlin" is integrated in the application procedure for the future and is not available for the public. Our analysis showed the following four classification criteria:

- level of interactivity,
- elements of test reporting,
- type of questioning,
- number of the tested fields of a study.

The first classification criterion is the level of interactivity between the test candidates and the test application. We differentiate between web-based aptitude tests interacting with the interviewee and tests without any interaction. The test candidates get only an overview about the solutions of the test questions. They can check their answers and assess their aptitude for the study by themselves. An example, which is not interactive, is the web-based aptitude test for computer science at the Chemnitz University of technology. All other web-based aptitude tests analysed are interactive and offer an automatic evaluation of the answers.

Furthermore, we analysed the elements of test reporting of web-based aptitude tests. We could identify the following elements:

- *Solutions* for the test questions, which especially examine the professional competences, e.g. mathematical skills.
- *Information about the aptitude* of the test candidate for the tested field of study.
- *Information about the study*, especially the content and the structure.
- *Information about the fields of activity*, e. g., advantages and disadvantages, required skills or tasks.
- *Information about the skills* of the test candidate.
- *Graphical presentation* of the evaluation, e. g. the skills.

The test reports of the analysed web-based aptitude test include the identified elements in manifold combinations. The web-based aptitude tests in computer science at the University of Munich, at the University of Applied Sciences Augsburg, at the "Freie Universität Berlin", and at the Chemnitz University of technology only offer the solutions for the test questions. In addition to the solutions, the test reporting of the web-based aptitude test in computer science at the RWTH Aachen University includes information about the aptitude of the test candidates, their skills, and the study. The test results are more individual with regards to the answers of the test candidate. Partly, the evaluation is supported by graphical presentations, especially in the field of skills. The web-based aptitude tests for a

study in veterinary medicine at the University of Veterinary Medicine Vienna and at the "Freie Universität Berlin" are more psychologically influenced. The test candidates do not receive the solutions of the test questions, because there is not "the correct answer". The test reporting of these web-based aptitude tests includes information about the aptitude and the skills of the test candidate. The test of the University of Veterinary Medicine Vienna also presents information about the study. The test reporting of the "Freie Universität Berlin" describes the future fields of activity. None of these web-based aptitude tests consider the specifics of the university.

The next classification criterion, which we used for the analysis, is the type of questioning. We differentiate between *indirect* and *direct* questioning. Indirect questioning means that the test includes questions, which examine the skills of the test candidate, especially in the range of mathematical and technical skills. The reason is that these skills are easier to evaluate than social and personal competences. A study in computer science contains al lot of mathematical basics. The web-based aptitude tests for computer science are based on indirect questioning, because of the close connection between computer science and mathematics. The web-based aptitude test for a study in veterinary medicine uses direct questioning. This type of questioning is based on the idea, that the test candidates estimate their own skills. For example, they decide on a scale between 1 (very good) and 5 (insufficient), how good they are in biology or in team working. The only web-based aptitude test having a well-balanced mix of indirect and direct questioning is offered by the RWTH Aachen.

			Computer science	Computer science	Computer science	Computer science	Computer science/ Electrotechnology/ technical Computer science	Veterinary medicine	Veterinary medicine
			Chemnitz	Berlin (FU)	Munich (TU)	Augsburg	Aachen (RWTH)	Berlin (FU)	Vienna (VU)
classification	level of interactivity		no	yes	yes	yes	yes	yes	yes
	elements of the test reporting	solutions	yes	yes	yes	yes	yes	no	no
		information about aptitude	no	no	no	no	yes	yes	yes
		information about the study	no	no	no	no	yes	no	yes
		information about university	no	no	no	no	no	no	no
		information about fields of activity	no	no	no	no	yes	yes	
		information about skills	no	no	no	no	yes	no	yes
		graphical presentation	no	no	no	no	yes	no	yes
	type of questioning	direct	no	no	no	no	yes	yes	yes
		indirect	yes	yes	yes	yes	yes	no	no
	number of the tested fields of a study	one field	yes	yes	yes	yes	no	yes	yes
		more than one field	no	no	no	no	yes (3)	no	no

Table 1: Classification of web-based aptitude tests.

The last classification criterion is the number of the tested fields of a study. In general, the web-based aptitude tests only include one field of study. The reason could be, that almost every field of study is based on different competences, which are important for the success of the study. Only the web-based aptitude test at the RWTH Aachen University includes more than one field of study, namely computer science, electrotechnology and technical computer science. These fields of study are based on similar, technical basics.

Furthermore, there are different types of web-based aptitude tests. Most web-based aptitude tests are found in the field of computer science. The central elements of the web-based aptitude test are the required competences. They are the basis for the type and the content of the questionnaire and for the evaluation of the aptitude of the test candidates.

COMPETENCE DEFINITION AND CLASSIFICATION FOR WEB-BASED APTITUDE TESTS

In general, competence is a motivational construct, referring to capabilities of people for formulating goals and

producing effortful, continual, goal-directed activity. Humans possess the need to feel competent. Therefore, they seek optimal challenges (Deci, 1975).

Competence is often used to refer to a person's behavioural "inventory". In this usage, a competent person is a person, who possesses certain specified skills or abilities. These skills or abilities represent a person's behavioural potential. However, this potential may not always be utilised. Moreover, even when someone seems to be competent, this may not necessarily lead to successful outcomes. Therefore, skills differ with regard to competences and performance (Ford, 1985, p. 5). According to Erpenbeck and Rosenstiel (2003) motivation for a special task or topic is the basis for competence. This leads to the desire to get qualifications, which are the basis for skilful behaviour. However, competence is the ability to use skills within the right situation to achieve high performance.

Typically, competences are general descriptions of the abilities needed for a special job or task. The term "competences" includes the meaning of "skill" in different fields of competence, like professional competence, methodological expertise, personal, and social competence (Erpenbeck & Rosenstiel, 2003). In the context of organisational theory, competence is used on different levels: The organisational level, the inter-organisational level, and the personal level (Probst, Deussen, Eppler, & Raub, 2000). Concerning the personal level, competence stands for "authority and rights", which are needed to accomplish the job (Wöhe & Döring, 2000, p. 179). Furthermore competence means "being in competition" (Fank, 2004, p. 5). In this sense, the term is used in recruitment and responsibility assignments.

Due to the fact that aptitude tests are often used in the university context, we will now show the impact of competence within an university. Linked to the education at universities, competence can be defined as the ability of graduates to act in a particular situation, to learn, and to be creative as a result of their learning experience. Their competence is the output of the education system and the key knowledge input for employing organisations. The total sum of competent graduates is the contribution of the educational system to the intellectual capital of a society (Sallis, Jones, &, 2002, p. 57). On the basis of the individual competences, authority and rights are stated. This could serve as a starting point for further examinations. During their education at university – and also after their graduation – students are in competition.

This brief description shows that the various meanings of competence should be regarded as complementary rather than competing perspectives. Competences are often arranged according to categories. The number of categories differs. Practical approaches can show a high number of categories (e.g. Volvo, Guide, Sparkasse) filled with specialised competences, whereas the academic literature aggregates competences often in two up to four categories. According to (Bergmann, 2003, p. 229; Kauffeld, Frieling, & Grote, 2002, p. 199; Sonntag, 2002, p. 59), we chose a concept with 4 categories. They distinguish among personal, social, methodological, and professional competence.

Personal competence includes personality traits, which cannot be classified within the other categories. It consists of personal participation and the motivation to create one's working place and environment constructively. Self-activity when learning during work and the acceptance of responsibility are also important factors of personal competence. There is no assured index of these criteria. The list depends on the special situation for which the competences will be analysed, e. g., flexibility is a pre-requisite for social competences but has also further connotation and can be used in the context of personal competence (Bergmann, 2003; Hösch, 1995; Kauffeld et al., 2002).

Generally speaking, social competence can be viewed as more than good communication. Social skills allow a person to interact and communicate in nature with others. Social competences are the cognitive, behavioural, and communication skills necessary to have successful interpersonal interactions. Many researchers view social competence as a combination of different factors, including positive relations with others, absence of non-adaptive behaviour, exhibition of specific behaviours that maximize the probability of reinforcement, as well as employment of behaviours that focus on group-related acceptance, and effective social skills. Subsequently, social competences have been defined as the cognitive functions and specific verbal and nonverbal behaviours that an individual engages in interacting with others including both verbal and nonverbal skills (Coleman & Lindsay, 1992; Gresham & Elliott, 1987; Vaughn & Haager, 1994).

Methodological competence is the ability to act in different situations, describe problems in a flexible and structured manner. Furthermore, this category stands for the ability to identify autonomously faults and transfer these insights to other situations. The willingness to use personal mental abilities and knowledge and the willingness to learn are important factors too. Methodological competence is almost independent of professional competence. It is needed to build up professional competences (Bergmann, 2003; Faix, Buchwald, & Wetzler, 1991; Kauffeld et al., 2002;

Muellerbuchhof & Zehrt, 2004).

The concept of professional competence has evolved over the last 20 years from a one-dimensional construct representing "specialised occupational knowledge" to a more general one, which includes the application of this knowledge. Competence represents the entirety of combining knowledge, skills, and abilities required for professional practice with the special focus on the application context. Professional competence implies a minimum level of proficiency and performance. Certification is the mechanism that represents to the public that someone has completed his or her professional education and possesses a minimum level of knowledge. Professional competence is not only used to indicate the professional standing of an individual with respect to work performed, but also for the qualitative content or "value" of the job done. In this second meaning, "professional competence" is also used as the term of comparison among different jobs, grades and job categories (Education Council of the American Academy of Physician Assistants, 1996).

The web-based aptitude tests, discussed here, can be arranged according to these competence categories. Some of them inquire predominantly professional skills and methodological skills. Others have more complex questions in regard to the different aspects of the field of study; e.g. required skills, interests, content of a study, abilities, or potentials. Personal and social competences like interests and motivation were asked for. For example, the web-based aptitude test for computer science at the University of Munich includes the following topics: logic, algorithmic thinking, ability to abstract, mathematics, English language, and German language. These contents all refer to professional and methodological competences. In contrast, the web-based aptitude test for a study in veterinary medicine at the University of Vienna does not only cover professional and methodological competences, but also reviews to social and personal competences like interest, initiative, and motivation.

		Computer science	Computer science	Computer science	Computer science	Computer science/ Electrotechno-logy/ technical Computer science	Veterinary medicine	Veterinary medicine
		Chemnitz	Berlin (FU)	Munich (TU)	Augsburg	Aachen (RWTH)	Berlin (FU)	Vienna (VU)
competence categories	professional competence	yes	yes	yes	yes	yes	yes	yes
	methodological competence	no	yes	yes	yes	yes	yes	yes
	social competence	no	no	no	no	yes	yes	yes
	personal competence	no	no	no	no	yes	yes	yes

Table 2: General categories for competences.

All competence categories are covered by the tests about veterinary medicine and the test from RWTH Aachen. This is an advantage in comparison to basic tests like the one from Chemnitz University of Technology. Applicants have to face different requirements within this field of study. They are confronted with the need to have a high motivation, interest for the topic as much as the need to have a general ability for logical and analytical thoughts.
The combination of skills within the competence categories leads to a detailed competence specification. This is the basis for all development methods of web-based aptitude tests. In the following, we will give an overview of possible methods to generate a competence specification.

METHODS FOR DEVELOPING COMPETENCE SPECIFICATION

For developing competence specifications, several research methods are possible. All these methods are generally subdivided into primary data collection and analysis and secondary data research and evaluation. Psychologists often use primary data because of the individuality of the competence specifications. In addition, competence specifications are very dynamic and should be up-to-date. Due to the individuality, the dynamic, and the necessary up-to-dateness, secondary data is appropriate for developing competence specifications but rather for preparing the primary data collection. The analysis shows that the more complex web-based aptitude tests are based on primary data, e. g. the test of the RWTH Aachen University.

Secondly, the survey depends on the target group. Especially, the working environment and the concerned persons are crucial for the specification of the necessary competences (Fisseni 1997 S. 479f.; Jeserich 1990 S. 582;

Jüttemann 1990 S. 479f.). Due to this fact, it is useful to select respondents, which are concerned with the field of study. In the range of academic web-based aptitude tests, the competence specifications can be based on surveys with the following respondents:

- Expert having knowledge with regard to the study or the method.
- Students having experiences in this field of study.
- Alumni working in a related job.
- Lectures having knowledge about the content of the study.

Two of the analysed web-based aptitude tests are based on a survey with experts and lectures, e. g., the test of RWTH Aachen University and of the University of Applied Sciences Augsburg. Sometimes, alumni and students were the target group, e. g., alumni for the test of "Freie Universität Berlin" and regular students for the test of the University of Applied Sciences Augsburg.

A third aspect is the type of the survey, which can be in oral or in written form. Both forms of the survey can be combined: starting with an interview to collect data with regard to the types of required competences and following with a survey in a written form to check the value of the collected competences. The University of Applied Sciences Augsburg and the "Freie Universität Berlin" combine both types of the survey.

A further aspect is the standardization of the questionnaire, which can be differentiated with regard to the following types:

- Standardised: The questionnaire includes questions with proposed answers.
- Semi-standardised: The questionnaire only includes the questions.
- Open-ended: The questionnaire includes only the topic of the survey.

At the "Freie Universität Berlin", the interviewer used a semi-standardised questionnaire to develop the competence specification for veterinary medicine. There was not enough information about the required competences of this study. After the first data collection, the interviewer used a standardised questionnaire to validate the identified competences.

Furthermore, there are different rates of iteration, which refers to how often the interviewer executes the survey. In addition to a singular survey, it is possible to interview an expert panel more than one time and integrate feedback about the results of the last cycle in the questionnaire. This method resembles on the "Delphi Technique" (Mertens, 2005). Only the University of Applied Sciences Augsburg and the "Freie Universität Berlin" executed the survey more than one time.

Finally, one can differentiate between direct and indirect questioning. Methods with regard to *direct questioning* are checklists of competences and a scale to evaluate the registered competences. The experts directly name and evaluate the required competences. The University of Applied Sciences Augsburg and the "Freie Universität Berlin" used the direct questioning. For the *indirect questioning*, it is possible to choose situational or biographical questions. The goal is to identify and analyse the most important competences because of real and possible behaviour. Biographical questions include the analysis of critical events or curriculum's vitae of concerned persons. With the aid of information due to biographical questions, it is possible to evaluate former behaviour of concerned persons. The assumption is that previous behaviour is the best indicator for future behaviour (Stehle, 1980, 1983, 1986). The critical incident technique by Flanagan (1954) is based also on this assumption and is providing the formulation of the critical requirements of an activity. In this context, incident is defined as: *"extreme behaviour, either outstandingly effective or ineffective with respect to attaining the general aims of the activity."* (Flanagan, 1954, p. 338). The procedure of the critical incident technique includes the following steps (Flanagan, 1954, p. 354):

1. *Determination of the general aim of the activity.*
2. *Development of plans and specifications for collecting factual incidents regarding the activity.*
3. *Collection of the data [...] in an interview or written up [...].*
4. *Analysis of the data.*
5. *Interpretation and reporting of the statement of the requirements of the activity.*

One important application of the critical incident technique is job design and purification (Fisseni, 1997, p. 479; Jeserich, 1990, p. 582), which can also be transferred to the competence specification for a field of study. In contrast to the biographical questions, the situational questions include the possibility that persons can estimate their behaviour even though they do not experience this situation. In this context, the persons get a description of a fictitious, but realistic situation and should estimate their behaviour. Indirect questions were used by every

university, here primarily focusing on primary data. The University of Applied Sciences Augsburg and the RWTH Aachen University, both use the critical incident technique. An overview of the analysis gives table 3:

			Computer science	Computer science	Computer science	Computer science	Computer science/ Electrotechnolog y/ technical Computer science	Veterinary medicine	Veterinary medicine
			Chemnitz	Berlin (FU)	Munich (TU)	Augsburg	Aachen (RWTH)	Berlin (FU)	Vienna (VU)
methods of the development	research methods	primary research	no	not available	no	yes	yes	yes	not available
		desk research	yes	not available	yes	yes	yes	no	not available
	target group	experts	no	not available	no	no	yes	yes	not available
		students	no	not available	no	yes	no	no	not available
		lectures	no	not available	no	yes	yes	no	not available
		alumni	no	not available	no	no	no	yes	not available
		others	no	not available	no	no	no	no	not available
	type of the survey	in oral form (interview)	no	not available	no	yes	yes	yes	not available
		in written form	no	not available	no	yes	no	yes	not available
	rate of iteration	once	no	not available	no	no	yes	no	not available
		twice	no	not available	no	yes	no	yes	not available
		more often	no	not available	no	no	no	no	not available
	standardization of the questionnaire	standardised	no	not available	no	yes	no	yes	not available
		semi-standardised	no	not available	no	no	yes	yes	not available
		open ended	no	not available	no	no	no	no	not available
	type of questioning	direct	no	not available	no	yes	no	yes	not available
		indirect biografical	no	not available	no	yes	no	yes	not available
		indirect situational	no	not available	no	no	yes	no	not available
		technique	no	not available	no	yes	yes	no	not available

Table 3: Methods for developing competence specifications.

CONCLUSION

Our analysis of web-based aptitude tests at universities is based on the following three criteria:
- Implementation of web-based aptitude tests
- Competence categories applied
- Methods applied for developing competence specifications

These criteria are helpful to show the differences among web-based aptitude tests and to identify best practices. Due to an Internet research, we could identify seven web-based aptitude tests for a field of study, which were the basis of our analysis.

The first criterion is the classification how the web-based aptitude tests are implemented. The interaction between applicants and web-based aptitude test is important. Only one test does not offer an interaction. Three web-based aptitude tests include reports with detailed, personal information with regard to the test results, the requirements of this field of study, and information about the fields of activity. Only two web-based aptitude tests offer reports with a graphical presentation of the skills, which helps to better understand the results. Most of the web-based aptitude tests are based on indirect questioning. In contrast, only two of the identified tests are based on direct questioning. The problem with direct questioning is that the test candidates can easier manipulate the test results. For self-evaluation of the test candidate, direct questioning is adequate. When the test result is obligatory or has an impact on the admission, indirect questioning should predominate.

The second criterion of the analysis is the type of competence category, which the web-based aptitude test includes. Three web-based aptitude tests consider personal, social, methodological, and professional competencies. A web-

based aptitude test should cover each of the four competence categories to give the applicant a full overview of the required skills.

Finally, the third criterion refers to methods, applied for specifying competence profiles. There are different approaches to develop the competence specification. Most of the web-based aptitude tests are based on primary research. Nevertheless, the desk research approach is important and helpful in getting an overview of required competences. Combinations of oral and written survey and together with a mix of standardised, semi-standardised, and open ended questions lead to a more comprehensive result. This assures that additional competences can be evaluated. To support this goal, the type of questions can also be mixed; the critical incident technique is superior in finding out the most critical situations for a study. When designing the survey, the individual characteristics of the university have to be considered accordingly.

The use of web-based technology is relatively new for aptitude tests. At this stage, information about the success of these tests and the acceptance do not exist at a sufficient rate. The results of this analysis can be seen as a first step towards a systematical development of a web-based aptitude test at the University of Erlangen-Nuremberg.

REFERENCES

Bergmann, B. (2003). Selbstkonzept beruflicher kompetenz. In J. Erpenbeck & L. v. Rosenstiel (Eds.), *Handbuch kompetenzmessung* (pp. 229-261). Stuttgart: Schäffer-Poeschl.

Coleman, W. L., & Lindsay, R. L. (1992). Interpersonal disabilities. Social skill deficits in older children and adolescents: Their description, assessment, and management. *The Pediatric Clinics of North America, 39*(3), 551-567.

Deci, E. L. (1975). *Intrinsic motivation*.New York: Plenum Press.

Education Council of the American Academy of Physician Assistants. (1996). Professional competence - a position paper. from http://www.aapa.org/policy/professional-compet.html

Erpenbeck, J., & Rosenstiel, L. v. (2003). *Handbuch kompetenzmessung*. Stuttgart: Schäffer-Poeschl.

Faix, W., Buchwald, C., & Wetzler, R. (1991). *Skill-management*. Wiesbaden: Gabler.

Fank, M. (2004). *Kompetenzmanagement*. Köln: ifem.org.

Fisseni, H.-J. (1997). *Lehrbuch der psychologischen diagnostik* (2. Auflage ed.). Göttingen et al.: Hogrefe.

Flanagan, J. F. (1954). The critical incident technique. *Psychological Bulletin, 51*(4), 327-358.

Ford, M. E. (1985). The concept of competence, themes and variation. In H. A. j. Marlowe & R. B. Weinberg (Eds.), *Competence development* (pp. 4-15). Springfield, USA: Charles C. Thomas.

Gresham, F. M., & Elliott, S. N. (1987). Social skills deficits of learning disabled students: Issues of definition, classification, and assessment. *Reading, Writing, and Learning Disabilities, 3*, 131-148.

Heublein, U., Schmelzer, D., Sommer, D., & Spangenberg, H. (2002). *Studienabbruchstudie 2002*.Hannover: Hochschulinformationssysteme GmbH.

Hösch, G. (1995). *Evaluation eines computergestützten planspiels*. Unpublished Thesis, Johannes Gutenberg-Universität, Mainz.

Jeserich, W. (1990). Assessment-center. In W. Sarges (Ed.), *Management-diagnostik* (pp. 580-587). Göttingen, Toronto, Zürich: Hogrefe.

Kauffeld, S., Frieling, E., & Grote, S. (2002). Soziale, personale, methodische oder fachliche: Welche kompetenzen zählen bei der bewältigung von optimierungsaufgaben in betrieblichen gruppen? *Zeitschrift für Psychologie, 210* (4), 197-208.

Mertens, D. M. (2005). *Research an evaluation in education and psychology* (Vol. 2). Thousand Oaks, London, New Delhi: Sage.

Muellerbuchhof, R., & Zehrt, P. (2004). Vergleich subjektiver und objektiver messverfahren für die bestimmung von methodenkompetenz - am beispiel der kompetenzmessung bei technischem fachpersonal. *Zeitschrift für Arbeits- und Organisationspsychologie, 48*(3), 132-138.

Probst, G. J. B., Deussen, A., Eppler, M. J., & Raub, S. P. (2000). *Kompetenz-management: Wie individuen und organisationen kompetenz entwickeln.* Wiesbaden: Gabler.

Sallis, E., Jones, G., &. (2002). *Knowledge management in education: Enhancing learning & education.* London: Kogan Page Limited.

Sonntag, K. (2002). Personalentwicklung und training - stand der psychologischen forschung und gestaltung. *Zeitschrift für Personalpsychologie, 1*(2), 59-79.

Stehle, W. (1980). Verfahren zur auswahl von führungskräften. *Schmalenbachs Zeitschrift für betriebswirtschaftliche Forschung (ZfbF), 32,* 89-97.

Stehle, W. (1983). *Zur konzeption eines personalauswahlverfahrens auf der basis biografischer daten.* Universität Hohenheim, Hohenheim.

Stehle, W. (1986). Personalauswahl mittels biografischer fragebogen. In H. Schuler & W. Stehle (Eds.), *Biografische fragebogen als methode der personalauswahl.* Stuttgart: Verlag für Angewandte Psychologie.

Stumpf, H., & Stanley, J. C. (2002). Group data on high school grade point averages and scores on academic aptitude tests as predictors of institutional graduation rates. *Educational and Psychological Measurement, 62*(6), 1042-1052.

Vaughn, S., & Haager, D. (1994). The measurement and assessment of social skills. In G. R. Lyon (Ed.), *Frames of reference for the assessment of learning disabilities: New views on measurement issues* (pp. 555-570). Baltimore: Paul H. Brookes Publishing.

Wöhe, G., & Döring, U. (2000). *Einführung in die allgemeine betriebswirtschaftslehre.* München: Vahlen.