

## Web-based Aptitude Tests for Student Guidance

**Michael Amberg, Sonja Fischer**

University of Erlangen-Nuremberg, Lange Gasse 20, Chair for Business Administration, esp. Business Information Systems III (WI-III), 90403 Nuremberg, Germany

Web-based aptitude tests which are a particular category of aptitude tests can be used for a large number of users to test their competence, knowledge and aptitude with standardised testing methods. The web-based solution is getting more and more important, because of the recent technological advances and low cost, high effectiveness, overall availability, and an easy distribution. We analysed and classified web-based aptitude tests for a field of study at universities in detail. Based on this we are developing an information system for student guidance with web-based aptitude tests. Our research questions were: Can web-based aptitude tests be used to advise a large number of users? Is this virtual advice useful for the future freshmen? The system contains information sites, tests and analysis modules. More than 1000 interested people already registered at this voluntarily offer of guidance to young people, interested in studying at our department.

**Keywords** competence management; skill management; web-based aptitude tests

### 1. Motivation

To choose a study program is a very important decision for further success in working life, but many young people do not know their strengths and weaknesses. Often the view for the requirements of studies is missing. Due to the change in Germany's the educational system the large number of new Bachelor and Master Courses does not make the decision easier. There is a significant number of students who 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 [1]. Some of them change their subject and finally get their graduation in a different one; some leave the universities and go to work. Do freshmen often study the wrong subject? Does their competence and aptitude really fit the subject? Are they informed about the requirements of the subject?

Linked to the education at universities, competence can be defined as the ability of graduates to act in a particular situation and 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 [2].

The submission process does not give much help nowadays and is still scarcely individualized and IT-supported. We will point out how it is possible to support students to choose the right subject for their competence and aptitude in a virtual environment. On the one hand, aptitude and competence is not easy to recognise in virtual environments. On the other hand, a virtual environment has many advantages for students and universities. Web-based aptitude tests, as part of a virtual information system, can be used for a large number of users to test their competence, knowledge and aptitude with standardised testing methods. Based on this scenario, our research questions were:

- Can web-based aptitude tests be used to advise a large number of users?
- Is this virtual advice useful for the future freshmen?

### 2. State of the Art

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. Among the 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 a European expedition in 1917, which based on a personal data sheet [3]. 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 choice of insurance salesmen [4].

Web-based aptitude tests are especially relevant within the university context. Using standardised methods, universities can assess the competence of a large amount of high-school graduates at relatively low cost. To reduce drop-out rates, admission tests for college are used to find students, who likely pass college [5]. The "Scholastic Aptitude Test" (SAT) for example is one of the most used college entrance tests today. The "Graduate Management Admission Test" (GMAT) and the "Test of English as a Foreign Language" (TOEFL) are often prerequisite for a study at an international university. The risk that students drop out early should 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.

We analysed and classified web-based aptitude tests for a field of study at universities in detail. The analysis focuses on web-based aptitude tests in German-speaking countries. Due to an Internet research, we could identify seven web-based aptitude tests for a field of study, which were the basis for the analysis. Most of these web-based aptitude tests are available on the Internet. The following criteria are the basis for the analysis:

- Implementation of web-based aptitude tests
- Used competence categories
- Used methods for developing competence specifications

These criteria are helpful to show the differences between the web-based aptitude tests and to identify best practice. The first criterion is the classification on how the web-based aptitude tests are implemented. The interaction between applicants and web-based aptitude tests is important. Only one test does not offer an interaction. Three web-based aptitude tests include reports with detailed, personal information in regard of 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 better understanding the results. The most web-based aptitude tests base on indirect questioning. Two tests base only on direct questioning. The problem of 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 competences. A web-based aptitude test should cover every of the four competence categories to give the applicant a full overview of the required skills.

Finally, the third criterion analyses the used methods, with which the competence specifications of web-based aptitude tests are developed. There are different approaches to develop the competence specification. The most web-based aptitude tests are based on primary research. Nevertheless, the desk research is important and helpful in getting an overview of required competences. A combination within the character of the survey (oral and written form) and within the amount of standardization (standardised, semi-standardised, open ended questions) seems to be useful to get the full range of results. This assures that additional competences can be evaluated. To support this aim, the type of questions can also be mixed; the critical incident technique gives the most opportunities to find out the most critical situations for a study. Additionally, the special characteristics of every university should be considered when designing the survey.

### 3. Developing web-based aptitude tests

The use of web-based aptitude tests is a relatively new application field. Information about the success of these tests and the acceptance do not exist at a sufficient rate. The results of this analysis are an important preparatory work for the development of a web-based aptitude test at our faculty. Based on this, we are developing an information system for student guidance with standardised web-based aptitude tests. It will be a voluntary offer of guidance to young people interested in studying at our faculty.

The system fulfils thereby several goals:

- Course guidance: With the help of a multi-perspective competences analysis the prospective student gets detailed feedback about his/her abilities and courses of studies which can be recommended for him or her.
- Provide information: The study applicant gets information about the university, the faculty, the study place Nuernberg and the different kinds of studies.
- University marketing: The information system transports a positive picture and the advantages of the WiSo faculty to the prospective students. Multimedia content, like 360 degree images, movie sequences and photos support this.

In this way, a high number of study applicants get personal university advisory service. Later on, they can speak about special questions with their student advisor personally. With this two phase system of student guidance possibly even the ratio of the university drop-outs can be reduced.

Based on a state-of-the-art analysis of web-based aptitude tests the prototype of a competence based information system for the future freshmen of our faculty has the following structure (Table 1).

Part	Information sites and tests	Content
A) Fit for university	<ul style="list-style-type: none"> <li>- Fit for our university?</li> <li>- Fit for our faculty?</li> <li>- Fit for the city?</li> <li>- Fit for the students' life?</li> </ul>	Knowledge about the university and the city shows the interest and motivation of the future freshmen for their university.
B) Fit for studies?	<ul style="list-style-type: none"> <li>- Qualifications</li> <li>- Methodical competence</li> <li>- Personal competence</li> <li>- Social competence</li> </ul>	The tests in this part check the competences, which are relevant for studies at our faculty, e.g. ability for teamwork, ability to communicate.
C) Which course program?	<ul style="list-style-type: none"> <li>- Your interests</li> <li>- Your knowledge</li> <li>- Your career perspectives</li> </ul>	Interests, knowledge and career perspectives are useful to choose the right course program.

**Table 1** Structure and content of the virtual information system

Each part consists of four (A and B) or three (C) sub-parts containing an information site with internal and external links and a web-based aptitude test. Furthermore, we used in part A multimedia-content (short film sequences and panorama pictures) to support the information needs of the future freshmen. Part A ("Fit for university?") consists of information about the university, the faculty, the city and the students' life. The purpose of part A lies mostly in university marketing, since in the associated test modules information is obtained in a motivating way. Block B ("Fit for studies?") serves the competence analysis. The test modules examine four competence classes with questions developed according to current literature in self assessment. In this way the general studying ability of the user (regarding the business administration area) is evaluated. After conducting the test, which is assigned to part C ("Which course program?") the offered course programs are brought into a sequence according to the user's personal preference.

### 3.1 The information sites

Information modules appear as HTML-sites and fulfil above all the aspect of information. Interesting information and suitable (external) pages are presented to the users in a clear form for every topic. Although the information pages appear static, they are generated from the application database. Due to the separation from structure (system) and content (database) the information can be easily changed and updated. As additional motivation factor the information modules contain also multimedia elements, like 360°-photos and movie sequences about the university and the city.

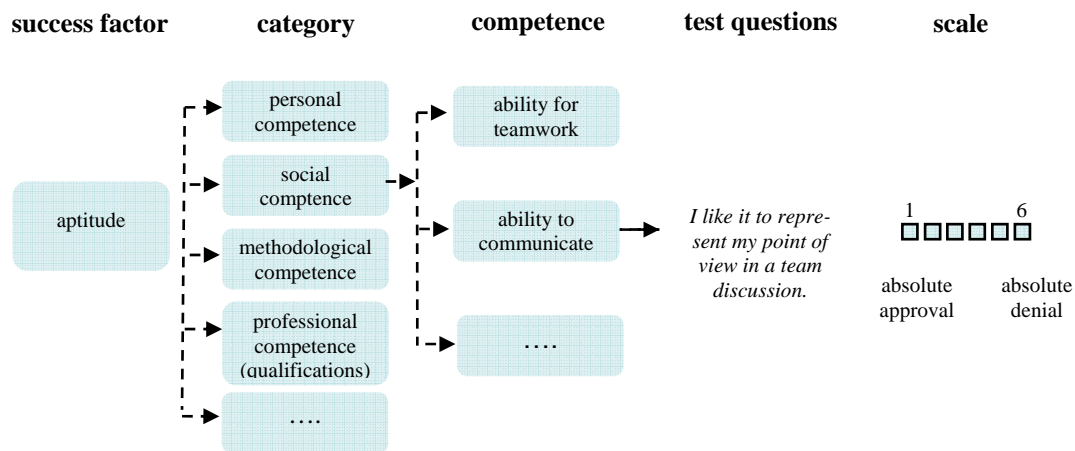
### 3.2 The tests modules

The aptitude test modules represent the most complex components of the system. Different types of questions are supported e.g. multiple choice or single choice questions with given answer list, free input mode with evaluated answer (correct or wrong), free input mode without automated evaluation. In addition, each question can be marked as facultative (no answer must be indicated) or mandatory (at least one answer must be indicated). Internally, the answers must be linked with evaluations (ratings) and characteristics and/or competences, so that after the execution of a test a result can be given. During the execution of the test a help function is available to explain the sense of the current question in detail. The test modules offer a free navigation (arbitrarily forward and/or back), so that the possibility of error corrections before conclusion of a questionnaire remains. Every test can be interrupted without the inputs given so far being lost. In order to intensify the aspect of information in the test modules underneath the question blocks thematically fitting quotations by well-known personalities, professors and students are indicated.

For the competence tests we chose a concept with 4 categories of competences. According to [6, 7] we distinguish among personal, social, methodological, and professional competence. Based on a literature research for existing competence profiles and student guidance literature we identified a list of competences for every category. With a survey of students and faculty staff, we identified those competences which are important for a successful study at our department. For every competence we developed about five test questions and choose a suitable scale to measure it (Fig. 1).

### 3.3 The analysis modules

The analysis modules evaluate and represent the results determined by the test modules. Both, graphical visualizations and text modules are used. The result overview shows a summary of the results of all test modules completed. The detailed results are linked to this overview. Furthermore the user has the possibility to request all results in a detailed report (about thirty pages containing all single results with text and graphical visualisation) in pdf-format by e-mail. If the user is logged in, he or she can obtain a detailed report automatically generated and send by e-mail.



**Fig. 1** Development of the tests

#### 4. Conclusion

Within 4 months more than 1100 users registered at our system. The acceptance and usability of the system was tested by 94 pupils of local schools. The evaluation shows that the usability of the described information system is very high. On a scale from 1 to 5 (“don't agree at all” to “fully agree”) we received mean 4,4 and modus 5. The test questions are understandable (mean 4,1 modus 4). The image of the faculty and the information status about the study programs has risen, stated more than 75 % of the interviewed pupils.

These results show that web-based aptitude tests are possible for a large number of users. They accept it, because they can inform themselves in an easy and interesting way. Even though, further improvements are planned. Web-based tools are convenient and will therefore improve the acceptance by the students. Individualisation and convenience of use supports the education as a core competence of the universities. In the long term the information system should support a multiplicity of course programs from different faculties of the university. The modular system makes it easy to adapt it for other faculties and even other universities. The implementation of IT supported aptitude tests for student guidance can be a step towards the eSociety.

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