



Lifelong
Learning
Programme

Med-Assess Pilot Evaluation Report



This project has been funded with support from the European Commission.

This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information.

Institution: UvA & KBS

Date: 30.09.2014

Version: 3.0

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Abstract

This report provides an initial evaluation of the Med-Assess System. On the basis of data that were obtained as part of the German pilot of the system, we set out to examine how do participants perform on and experience both, the General Mental Ability and Job Knowledge testing system. Moreover, we aim at making certain implications regarding whether two systems were interrelated in meaningful ways. Furthermore, this evaluation gauges initial user experiences with the system. Despite limitations imposed due to the rather small sample size in the pilot study, the results indicated some interesting trends in the data. Future research on the Med-Assess system, which is currently in the planning phase, will have to resolve whether these issues can be attributed to idiosyncrasies in the current sample, or whether there are issues with the system that need to be addressed.

1 Introduction

The main objectives of the Med-assess system refer to the measurement of knowledge of employees in the medical field regarding certain work related topics (e.g. treatment of patients suffering from neurological diseases). In the second place, the project strives at provision of recommendations for additional training courses, qualification measures or required learning material. An additional goal of the project is its practical utilization. Once the functionality of the system is scientifically evidenced, Med-Assess could be employed to support the management of a hospital or other medical and care-giving institutions in the process of recruitment and selection of new employees. For example, the system could be used for determining whether a foreign job applicant holds similar knowledge and qualifications comparing to a local applicant, or he/she will need additional training to fulfill the job related tasks.

In the prior steps of the project Med-assess system has been built and initial test of the system has been conducted. Therefore, the aim of this report is to:

- a) Present the working conceptual model that was derived on the basis of our state of the art literature review, insights from OntoHR project and various dissemination activities that we undertook as part of the Med-assess project;
- b) Empirically evaluate whether the developed system can be successfully employed to measure the targeted constructs. Moreover, we would try to provide implications on whether these constructs interrelate in theoretically meaningful and practically useful ways;
- c) Examine whether our pilot respondents rate the usability of the system in positive or negative terms, and ;
- d) Identify strengths and weaknesses of the system and areas in which the system may be further enhanced.

This report is structured as follows: Firstly, we will present the conceptual model that lies at the heart of the system. The second section is focused on the presentation of the empirical pilot study that is described and includes a description of the efforts that were undertaken to gather the data required for this evaluation, research

procedure, the sample, and the specific variables that were assessed. Subsequently, we examine whether the data that were gathered are in line with our conceptual model or not, after which we will end this evaluation report with a discussion of how users experienced the system.

2 Theoretical relevance of Med-Assess System

During the course of working on the Med-Assess project we developed and set out to empirically address the proposition that the relationship between General Mental Ability (GMA) and job performance, which stands at the heart of much of the personnel selection literature and which was illustrated within our previous project (OntoHR), is likely to be mediated by job knowledge.

Such premise is based on a review of the literature which pointed out, on one hand, that general mental ability as the single best predictor of job performance (Ones, Viswesvaran, & Dilchert, 2005; Schmidt & Hunter, 1998; Schmidt & Hunter, 2000) and, on the other, surprisingly little insight on underlying mechanisms that could explain this relationship. Almost lonely example in this striving is a stream of research led by Hunter & Schmidt developed in 80es (Schmidt, Hunter & Outerbridge, 1986; Hunter, 1986) who tried to tackle this problem, particularly investigating the role of job knowledge. The outcome was a considerable amount of empirical evidence which demonstrated GMA to be strongly related to job knowledge in different kinds of jobs. In this context, Schmidt and Hunter (Schmidt & Hunter, 2000, p. 4) have stated that: "...people who are more intelligent learn more job knowledge and learn it faster, the major determinant of job performance is not GMA but job knowledge".

Despite of this initial evidence, the role of job knowledge is frequently taken for granted, both in research and practice of recruitment and selection. Often being considered as an outcome of job design (Leach, Wall & Jackson, 2010), the exploration of job knowledge has been underestimated and the research focused on other individual and organizational factors that might stimulate job performance.

Since we assessed both GMA and the specific job knowledge required to perform the role of a nursing professional, we were in a position to make initial estimations regarding both measures. Below we explore both measures in light of the limited amount of data that was collected and provide an overview of user experiences with the system.

3 Measurement contribution: pilot of the empirical evaluation of the Med-Assess System

3.1 Method

3.1.1 Procedure

Prior to initiate the pilot, Beta Klinik and KBS have started contacting associated partners and also interested stakeholders of Med-Assess in Germany. The activities are classified in two categories as:

1. Direct contact with hospitals, clinics, nursing schools and individuals
 - a. Contact to regional and national hospitals and clinics (see Appendix I)
 - b. Participation in “Junge Pflege Kongress 2014” (the most well-known event and meeting point for young care-givers and nurses in Germany)
 - c. Presentation at Diakonie Nursing School in Siegen (Associated Partner of Med-Assess)
 - d. Presentation at Celenus Clinic in Hilchenbach (Associated Partner of Med-Assess)
 - e. Presentation at Beta Klinik
2. Indirect contact with target stakeholders via
 - a. Pilot-test flyer
 - b. Pilot-test poster
 - c. Posting announcements in social networks such as Facebook, Twitter, LinkedIn
 - d. Posting a video on YouTube
 - e. Posting news in website of Med-Assess

Table. 1 Summary of preparation activities for contacting nurses and nursing students in Germany in Spring and Summer 2014.

| Activity | Target group/organization | Number of contacted persons |
|---|--------------------------------|-----------------------------|
| Presentation at Diakonie Nursing School | Nursing students and Educators | 60 students |
| Presentation at Celenus Clinic | Nurses and wards | 100 nurses |

| Activity | Target group/organization | Number of contacted persons |
|--|---|---|
| Presentation at Beta Klinik | Nurses and wards | 10 nurses 10 wards |
| Participation in "Junge Pflege Kongress 2014" | Nursing students and nurses | 100 (visitors) 50 (registrations) |
| Contact to regional hospitals and clinics in the area of Siegen via post | Public and private clinics and hospitals | 18 hospitals and clinics (3 positive responses for associated partnership) |
| Contact to regional hospitals and clinics in the area of Bonn and other states of Germany via post | Public and private clinics and university hospitals | 7 hospitals and clinics (1 positive response for associated partnership) (5 interested clinics for future pilots) |

Table. 2 Recruitment strategies listed by results

| Strategy | Evaluated result |
|--|------------------|
| Project website / Twitter / Facebook / LinkedIn | Poor |
| Posters & 400 Flyers | Mediocre |
| Personally at job-fair | Excellent |
| Personally at hospitals, clinics and nursing schools | Excellent |

3.1.2 Participants

Participants in the pilot testing were nursing professionals employed within Beta Klinik hospital and Celenus Clinic in Germany. 23 nurses participated in the first round of the testing and attempted to fill in the questionnaires in the system. However, due to the aforementioned issues in getting respondents to complete the 2 hour assessment,

unfortunately, the final sample of respondents who completed the entire Med-assess test, including the GMA test, the job knowledge test and the Med-assess evaluation questionnaire was rather limited. Obviously the statistical power to conduct the analyses of the sort we were envisaging with our hypothesis too low to permit drawing any strong conclusions. Nevertheless, and more for reference purposes and as a guide to further research on the Med-Assess system, we provide the insights regarding the core variables that we assessed.

3.1.3 Core variables and measures

The test platform was designed in a way that facilitates simultaneous measurement of the core variables. Figure 1.0. provides a snapshot of online testing system which contains three separate sections, each dedicated for questions pertaining to measure one of these core variables that were assessed as part of the pilot. These variables can be distinguished in 5 types (refer to Kismihok, Vas, & Mol, In press, for further details on how the system and these measures were arrived at). The first type contained biographical variables such as age and gender. Secondly, the assessment of candidates involved testing of GMA. Thirdly, we assessed candidates' job knowledge pertaining to the following eight knowledge domains that comprise the Nursing Job and constitute the core of the ontology based selection system (Figure 2.0). Finally, we have assessed user evaluation of the system.

Try out Med-Assess



Nursing Knowledge

- Status: Taken
- Last time on: 10.10.2014



General Mental Ability

- Status: Not Taken



Survey

- Status: Locked

**Back to
Information +
Awards**

Figure 1 Core variables are measured within the same online testing system

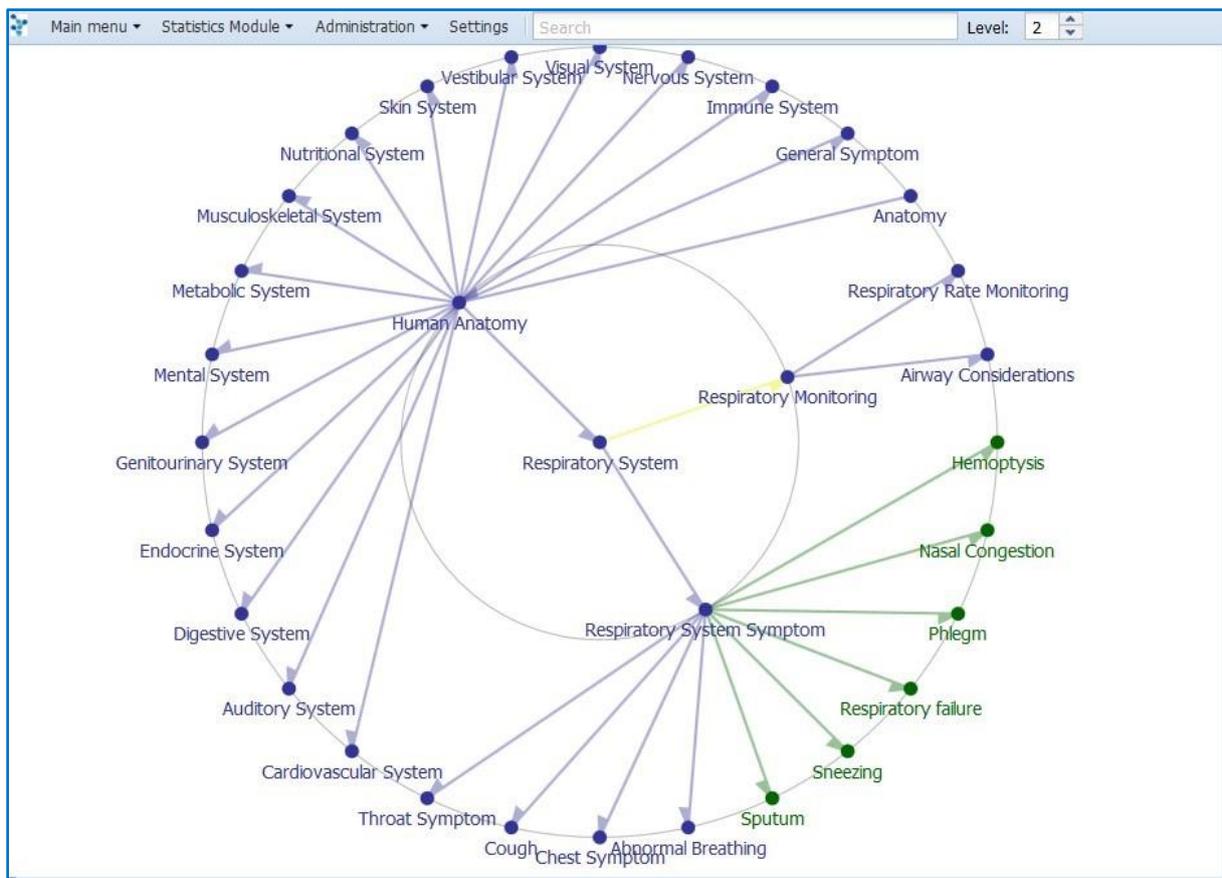


Figure 2 Domain Ontology: Major Knowledge Areas of Nursing

3.2 Results

3.2.1 GMA Test

The GMA test used consist six sections targeted at measuring different aspects of GMA. More specifically the test questions encompass following types of questions: 1) Number series targeted at investigating computation and arithmetic reasoning (10 questions); 2) Raven type of questions (20); 3) Verbal comprehension question that measure verbal ability (20 questions); 4) Clerical Perception (20 questions); 5) Paper folding (20 questions); and 6) Cube folding items that aim at measuring form perception (10).

The test answers were scored in a way that the correct answer values one pint whereas incorrect answers lead to reduction of points. Negative points are used to penalize wrong answers or guesses. Such answers are typed as a negative percentage value for each incorrect answer. For example, in the section Number series, an incorrect answer is penalized by the assigning -0.33 points, whereas in the Cube-folding incorrect answer is penalized with -0.25 points.

Firstly, we analyzed the average number of answered, correct and incorrect responses within each section of the general mental ability test. The response rate was high in all the sections of the test meaning that the participants who have completed the test have mostly provided answers to the questions. The total percentage of responded question was 91.17 with the exception of a subset of questions focused on Paper folding. In case of this scale 21.67% of questions remained responded by the participants. Overall, participants responded correctly on 1/5 of the questions. However, the difficulty varies greatly among the subscales. As it can be seen in the Figure 1.0, about half (51.67) of the participants provided correct answers on the questions related to Numerical reasoning, whereas none of the participants responded correctly to none of the questions related to Cube folding. Therefore, in the future applications of the test it exclusion or reduction of this subscale could be taken into consideration.

Additionally, log-times provide the information regarding the test duration. Data illustrates that time needed to fill in the test varied from the minimum of 16 to the

maximum of 32 minutes. The average duration was 24.6 minutes. Unfortunately, low number of participants does not enable us to investigate whether the time needed to fill in the test is somehow related to the test result. It would be interesting to investigate these aspects within the future validation efforts.

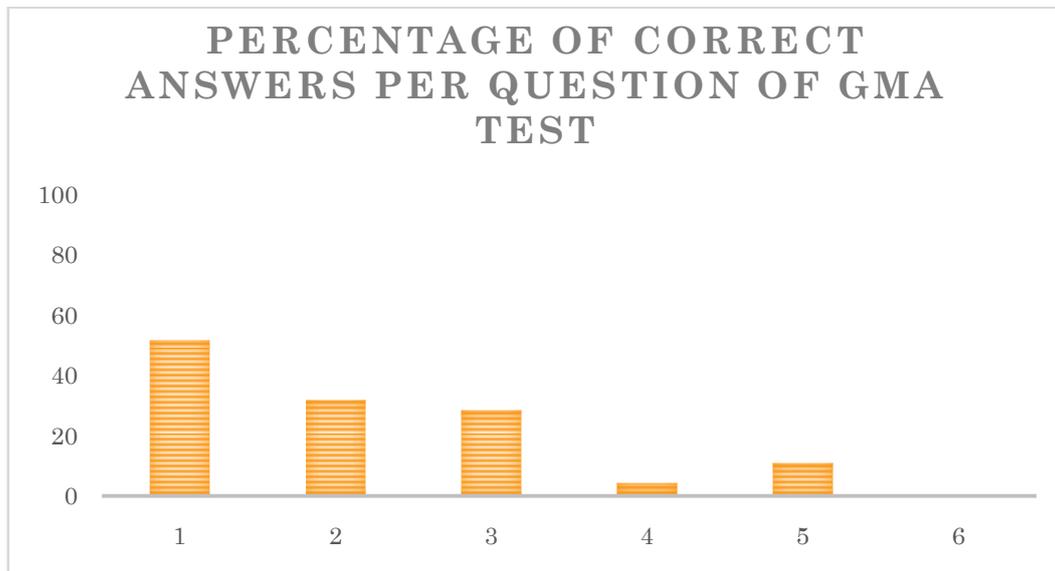


Figure 3 Overview of the correct answers in GMA test

3.2.2 Med-Assess Job Knowledge Test

Med Assess Job knowledge test consisted of 210 questions which assess knowledge relevant for performing nursing profession. The questions assess different knowledge areas that make part of nursing domain ontology (Figure 3.0.).

In order to vaguely estimate the difficulty of the test normality check was computed. Values of Skewness (-0.49) and Kurtosis (-0.767) illustrate that the distribution of the correct answers on the test is slightly negative skewed which indicates that the tail on the left side of the probability density function is longer than the right side. The distribution of the correct answers demonstrates that the percentage of the correct answers varies greatly among the questions.

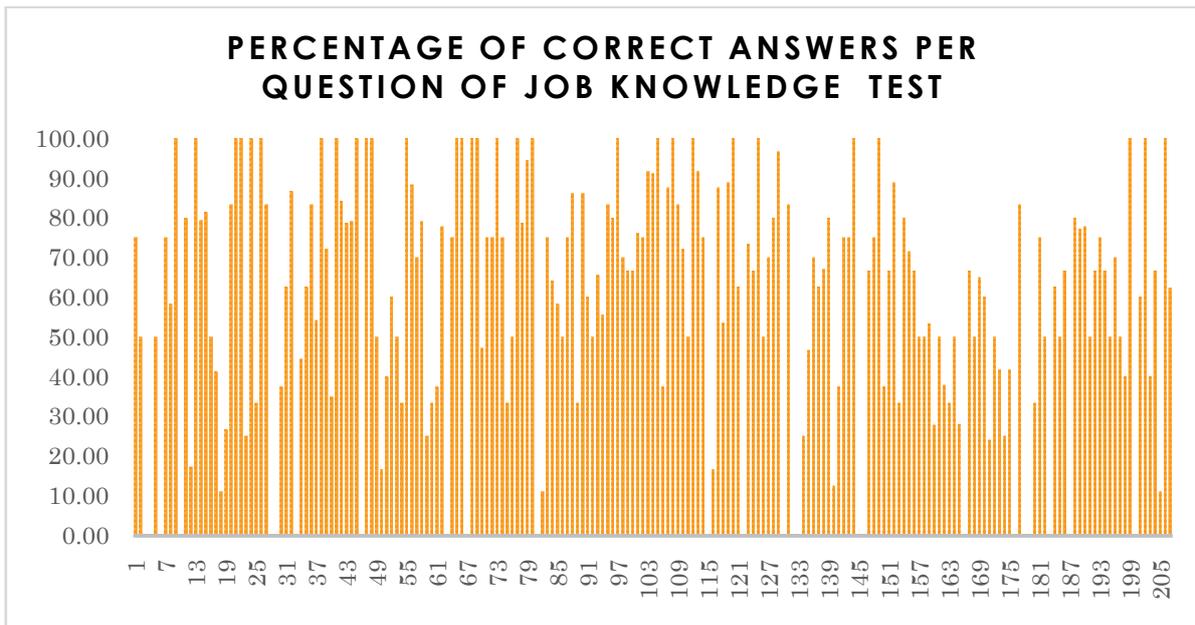


Figure 4 Percentage of the correct answers within Job Knowledge test

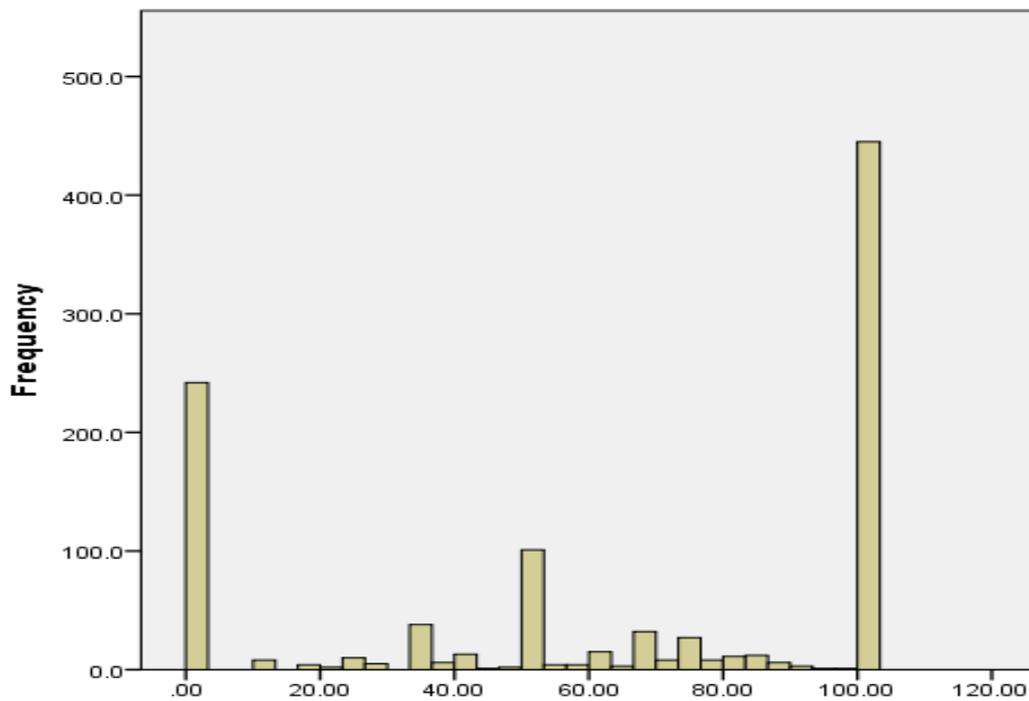


Figure 5 Answers rate in Job Knowledge Test

4 User evaluation of the system

In addition to the core variables respondents were also asked the questions pertaining to user experiences with the Med-Assess system. Moreover, this group of questions aimed at evidencing whether the users would consider system to be a fair instrument for evaluating candidates for real nursing jobs. Participants were instructed answer these questions imagining that that they have undertaken Med-Assess testing as part of the application process for a nursing job.

Unless indicated otherwise, participants provided their responses by selecting the appropriate answer on a 5-point Likert scale ranging from 1: Strongly disagree to 5: Strongly agree. The overall scale of 33 items consisted of 8 sub-scales, each targeting different aspect of user experience. Process fairness (2 items; $\alpha=.66$) assessed the degree to which respondents felt fairly treated during the simulated online application process and was obtained from Sylva and Mol (2009). An example item is "I perceive the online application procedure as a fair procedure, even if I do not get invited for further selection." Quality (9 items; $\alpha=.84$) was adapted from the Demos at work project¹ and assessed the degree to which respondents felt the system was of a good quality. An example item is "I would recommend the website to friends, colleagues etc." The measure for Job relatedness (4 items $\alpha=.81$) was adapted from Bauer et al. (2001) and assessed the degree to which respondents felt the assessment was related to the job of ICT Systems Analyst and predictive of job performance in that job. An example of an item on this scale is "Doing well on this test means a person can do the nursing job well". The degree to which respondents felt that they had been adequately informed about the test beforehand was assessed using a scale obtained from Bauer et al. (2001). An example of an item on the information known scale (3 items; $\alpha=.76$) is "I had ample information about what the format of the test would be." Change to perform was also obtained from Bauer et al. (2001) and assessed the degree to which respondents' felt the test gave them an opportunity to demonstrate their knowledge. This scale was assessed using 4 items ($\alpha=.89$), and example item being "I could really show my skills and abilities through this test". Feedback ($\alpha=.70$) was assessed using a three item ($\alpha=.70$) scale (obtained from Bauer et al. (2001) and assessed the degree to which respondents felt

¹<http://www.demosatwork.org/deliverables/D3.2%20-20Alpha%20Version%20Trials%20Results.pdf>

feedback was provided in a timely manner. An example of an item on this scale is “I was satisfied with the amount of time it took to get feedback on my test results”. Two way communication (5 items; $\alpha=.78$) reflected the degree to which respondents felt they could ask questions about the test, an example item being “I am satisfied with the communication that occurred during the testing process”. This scale was also obtained from Bauer et al. (2001). The final scale, appropriateness of questions (4 items; $\alpha=.79$) that was also obtained from Bauer et al. (2001) reflected the degree to which respondents felt the questions were appropriate and fair, an example item being “The test itself did not seem too personal or private”.

Generally participants evaluated the system in a relatively favourable way (Figure 4.0). Interesting results refers to the fact that the perceived fairness of the system was the most poorly evaluated (1.5 on the scale from 1: Strongly disagree to 5: Strongly agree) whereas appropriateness of the test questions was the most positively evaluated aspect (3.8 on the scale from 1: Strongly disagree to 5: Strongly agree). Therefore it can be implied that the most critical improvement could be made in terms of increasing its perceived fairness of the online system. On the other hand, it is very positive result that the participants felt the questions integrated in the system were appropriate and fair for evaluating their knowledge. Moreover participants evaluated that the content of the test was clearly tailored to the health and medical care.

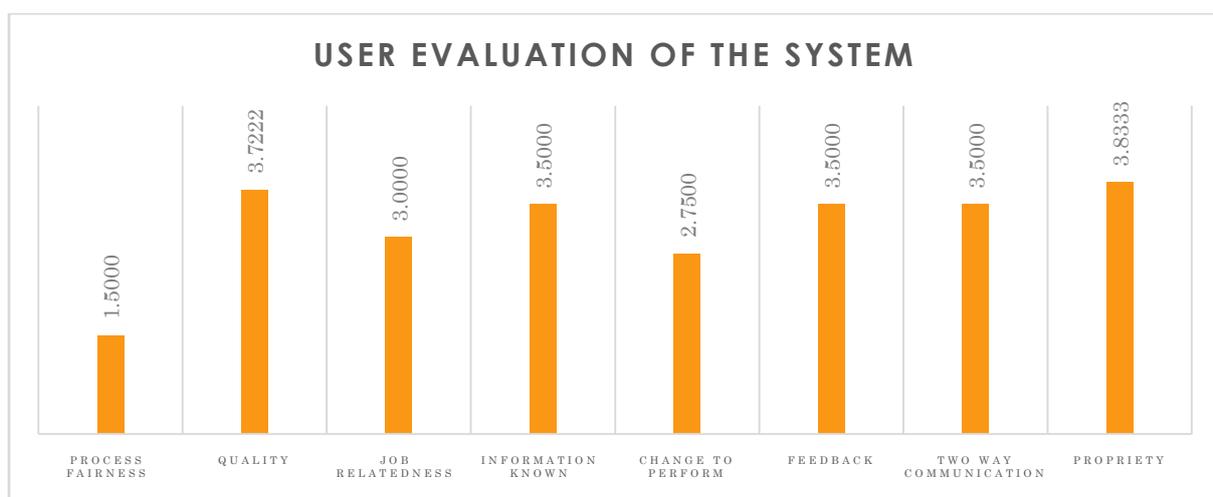


Figure 6 User evaluation of the system

Finally, respondents were also asked several open-ended responses pertaining to their experiences with the system. The open questions pertained to what respondents opinion of the questionnaire was, whether instructions were clear, if any and so which questions were unclear, whether they had any suggestions for improving the questionnaire, how long it took them to finish the questionnaire and whether they had any other comments. However, none of the respondents provided additional comments.

5 Beta test of usability and performance of Med-Assess test platform

Beta test of Med-Assess system was aimed on analysis of technical performance and usability of the test platform which is integrated in Med-Assess website². The usability test has been conducted within the Med-Assess consortium and also by analyzing technical problems of pilot test takers acquired via email or telephone contact.

Considering standard methods of software testing, we used Software Failure Modes and Effect Analysis (SFMEA). SFMEA is a detailed analysis of software components (functions and variables) (Neufelder, A. M. (2010)). SFMEA analyses component interaction, dependencies between data related failures. SFMEA is performed at two levels, which are functional level and variable level. Functional level FMEA is used in identifying structural weakness in the software design. It also helps reveal a weak or missing requirement and latent software. Software failure modes and root causes related to requirements (functional), design and code (detailed), and interfaces (see Table 3).

Table. 3 SFMEA related to functional, detailed and interfaces

| Failure mode | Description | Number of associated root causes | | |
|----------------------|---|----------------------------------|-----------|----------|
| | | Functional | Interface | Detailed |
| Functionality | Software does not behave as stated on the requirement | 5 | 3 | 1 |
| Timing | Events happen too late or too early | 2 | 5 | 0 |
| Sequence | Events happen in the wrong order | 2 | 2 | 1 |

² www.med-assess.eu

| Failure mode | Description | Number of associated root causes | | |
|--------------------------------|---|----------------------------------|-----------|----------|
| | | Functional | Interface | Detailed |
| Faulty Data | Data is corrupt, invalid, incomplete or incorrect | 0 | 3 | 0 |
| Faulty Error Handling | <ul style="list-style-type: none"> • Wrong message, wrong response when an error is detected • Software fails to detect an error when it should • Software detects an error when there is none | 2 | 0 | 0 |
| Framework | Failure modes specific to web explorer | 6 | 8 | 0 |
| Database related | Storing or retrieving data from database file | 3 | 8 | 3 |
| Faulty logic and ranges | Incomplete or overlapping logic | 1 | 2 | 2 |
| Incorrect algorithm | Formula implemented incorrectly for some or all inputs | 0 | 0 | 3 |

6 Limitations and further developments of the system

The conducted pilot study provided valuable insight in several terms. Firstly, one of the points for improvement refers to overall duration of the test process that might be too demanding for the participants. In this sense, initial evaluations of the scales identified certain questions that could be excluded without affecting the quality of the measures or the questions could be categorized under different concepts according to classification of curriculums and protocols of nursing. Moreover, further optimization and fine tuning of the system functionality might be advisable. Secondly, limited number of participants imposed constraint in terms of ability to conduct inferential statistical analyses and test whether theoretical underpinnings of Med-Assess system hold in investigated contexts.

Besides, type of a pilot, duration and allocated HR and physical resources are important parameters for conducting a successful pilot and encouraging nurses to participate in. Particularly, nursing is a quite tough and time-intensive job and therefore our target group needs enough motivation and also acknowledgement. One of the lessons in pilot of Med-Assess is to conduct a supervised pilot coordinated by team members and by ontribution of a senior nurse. Another lesson is to motivate test takers by offering awards and certification of attendance. This could be handeled through finding sponsors or collaborating with national or European nursing agencies. Last but not least, conducting a successful pilot could be managed within a motivating public event (open day for nurses) which is currently in the planning phase in cooperation with Beta Klink.

On the other hand, an important result refers to quite positive evaluation of the test content appropriateness and alignment with job tasks of nursing professionals. This provides positive feedback on the process of job knowledge test development through multiple stage process that involves expert evaluation. Together with evidenced tendency of the applied test to discriminate between different participants, this can provide additional motivation for future test improvement and validation endeavours.

Further validation of the Med-Assess system will be the goal of future empirical efforts in the context of exploitation activities that are already in the planning stage. More specifically, such validation would involve assessment of convergent relationships between Med-Assess job knowledge test results and alternative job knowledge measures. Simultaneously, discriminant relationships of job knowledge test results with unrelated constructs, such as personality features, will be identified. Finally, the construct validity of job knowledge test results is planned to be assessed in terms of its relation to job performance of nurses. Due to combined complexity of nursing profession and the developed online testing system, test validation represents a procedure that needs to be done in several stages. The conducted pilot evaluation represents an informative first step in the process.

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Appendix I: List of contacted hospitals and clinics in Germany

| | Name | Reply |
|----|--|--------------------------------------|
| 1 | Krankenpflegeschule des St. Marien-Krankenhauses Siegen | |
| 2 | Kinderkrankenpflegeschule der DRK-Kinderklinik Siegen | |
| 3 | Krankenpflegeschule des Kreisklinikums Siegen | |
| 4 | Kreisklinikum Siegen GmbH Klinik für Neurologie | Yes -> Associated partner of project |
| 5 | Krankenhaus Bethesda | |
| 6 | Berhard-Weiss-Klinik | |
| 7 | Dill-Kliniken | |
| 8 | Klinik Eschenburg KG | |
| 9 | Katholische Hospitalgesellschaft Südwestfalen gGmbH Olpe | |
| 10 | Fortbildungsakademie für Gesundheitshilfe | |
| 11 | St. Josefs-Hospital | |
| 12 | Krankenhaus St. Barbara Attendorn GmbH | |
| 13 | Celenus Fachklinik Hilchenbach GmbH | Yes -> Associated partner of project |
| 14 | Caritas Siegen | |
| 15 | Am Puls Siegen, Burbach | |
| 16 | Mobile Pflege Münker GmbH | |
| 17 | AWO Siegen | |
| 18 | Krankenpflegeschule der Diakonie Südwestfalen | Yes -> Associated partner of project |
| 19 | Universitätsklinik Bonn | Interested in future pilots |
| 20 | Uniklinik Köln, Zentrum für Neurologie und Psychiatrie | Yes -> Associated partner of project |

| | Name | Reply |
|----|---|-----------------------------|
| 21 | Karl Borromäus Schule für Gesundheitsberufe gGmbH | |
| 22 | Universitätsklinik Münster | Interested in future pilots |
| 23 | LVR-Kliniken Bonn | Interested in future pilots |
| 24 | Johannes Krankenhaus Troisdorf-Sieglar | Interested in future pilots |
| 25 | Universitätsklinik Kiel | Interested in future pilots |