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Evaluation of psychological content of work using the Graded Response Model (GRM)

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Abstract

The aim of this paper is to analyze the possibility of use of GRM in evaluating the psychological content of work among employees. The study was conducted on a sample of 500 employees with a use of JCQ questionnaire by Karasek. The study is based on adapting theories, according to which GRM is used for the purpose of solving problems, combined with the application of the GRM for the analysis of empirical material. In the study, GRM was used for an in-depth analysis of job content diagnosed by JCQ. Findings show that GRM can be useful in the employee assessment process. The model allowed to find relevant differences between employees who achieved the same results in JCQ. It led to establish a valid diagnosis in employee's resources and demands. It can be claimed that, in some cases, more detailed solutions were obtained with the use of GRM, facilitating in further stage making decision in HRM. The findings were successfully implemented during the health promotion program in the company.

Key words
GRM, latent trait model, employee potential, psychological content of work, Karasek

Introduction

The thesis that an employee is the main factor determining competitiveness and that human capital is one of the most important resources of an organization has already become the canon in the theories of human resources management. The activities supporting employee development in the scope of formal as well as interpersonal qualifications are obvious, however, not always adequately appreciated. That development, understood as an organization operation preparing an employee to learn, develop and hold more and more responsible positions (Armstrong, 1999; Torrington, Hall, Taylor, & Atkinson 2014), also includes care for the well-being and the optimum professional health level through examining and improving the psychological qualities of work affecting work motivation and dedication. The organizations, which realize the value of their motivated and dedicated employees, try to diagnose their possibilities and weaknesses as precisely as possible, and the decisions regarding their career path are corrected regularly on the basis of various employee assessments (Stor, 2007; Verbruggen, 2010). Such employee assessments are performed for the purpose of promotion, career path development, organization of trainings or company reorganization. One of the objectives of such employee assessments is to provide information. Organizations rely on such information and use it to improve the employee skills as well as try to make the most of their abilities (Armstrong, 1999; Dessler, 2014; Torrington, et.al. 2014). It is important then to develop measurement tools that apply to developing correct employee performance forecasts as well as to establish the facilitators and inhibitors of the employee development in work environment.

From the above arguments, the following hypothesis can be raised:

Hypothesis: The use of GRM model in the process of assessment of psychological content of work among employees can provide more precise and more detailed solutions than the use of standard tools of psychological diagnosis.

Method

Study participants and procedure

In order to present the practical application of GRM, a study was conducted on a sample of 500 employees holding worker's positions in a Polish mining company. The study was conducted within a bigger project, whose objective was to improve the working conditions of employees in a selected organization. As the company expressed its willingness to cooperate and interest in the research findings, the next step was the development of questionnaires and sending them to the company management board. The questionnaires completed by the employees were gradually sent back.

Tools – Job Content Questionnaire

A job content questionnaire with 32 questions diagnosing 4 aspects of work (job latitude, psychological demands, job insecurity, social support) was used in the study. The questionnaire is a translation of the American tool *Job Content Questionnaire – JCQ* by Robert Karasek (1979), which has been recently adapted for Polish conditions (Żołnierczyk-Zreda & Bedyńska 2014).

Tools – Graded Response Model

For this purpose primarily, the key developed by the questionnaire's author was applied. The responses were coded as follows: 1 – I completely disagree, 2 – I don't agree, 3 – I agree, 4 – I completely agree. Next, GRM was used to measure the traits being analyzed (in this paper: θ_i - parameter related to respondent *i*, indicating the degree of intensity of the analyzed latent trait) (Andersen, 1997; Bock,1997).

All calculations were made with the use of the ltm package in R program (Rizopoulos, 2010) (extended versions of the latent trait models are also available in the latest eRm package (Hatzinger & Mair, 2007; Koller, Maier & Hatzinger, 2015; Hatzinger, Mair & Maier, 2015). The questions presented to the employees were also analyzed with the use of the ltm package in R program – four parameters were estimated for each question: three parameters being threshold values of a given question (designated in the paper as $\alpha_{j2}, \alpha_{j3}, \alpha_{j4}$) and parameter β_j - describing question no. *j* discrimination parameter (Andersen, 1995; De Ayala, 1993).

Findings

In order to achieve the set goal, the collected data were analyzed twice. First, they were analyzed in compliance with the original procedure proposed by the questionnaire's author – Robert Karasek. In the second stage, the data were analyzed with the use of GRM. Only random results were presented to demonstrate the relation, similarities and differences in the application of two comparable methods and to draw conclusions.

Table 1 shows the score of two employees with the same number of points in three out of five subscales:

Table 1. Comparison and estimation of the results of two employees

category	*response pattern*	*points*	*estimation* θ
Employee no. 1			
Decision latitude	3 1 4 4 4 2 3 3 3	72	1.608
Demands	**3 3 2 2 3 3 2 3 3**	**10**	**-0.498**
Insecurity	**1 2 1 2 3 3**	**5**	**-0.141**
Superior support	**3 3 2 3**	**11**	**0.329**
Coworker support	3 2 3 3	11	0.791
Employee no. 2			
Decision latitude	3 2 4 4 4 1 4 2 4	70	1.528
Demands	**3 3 3 2 2 3 3 2 3**	**10**	**-0.204**
Insecurity	**1 2 1 2 3 3**	**5**	**-0.141**
Superior support	**2 3 3 3**	**11**	**-0.266**
Coworker support	2 2 3 3	10	0.21

Source: Own study

The application of GRM provides also an opportunity to conduct analysis of the questions included in the questionnaire. Table 2 presents the probability of choosing specifically the first, second, third or fourth category in questions from decision latitude subscale as example.

Table 2. Probability of choosing the first, second, third or fourth category for questions 1-9 (decision latitude)

Question no.	$P(X_{ij}=1)$	$P(X_{ij}=2)$	$P(X_{ij}=3)$	$P(X_{ij}=4)$
1	0.018847	0.089473	0.780633	0.111048
2	0.222547	0.720738	0.044011	0.012703
3	0.003156	0.041755	0.866865	0.088224
4	0.008123	0.140393	0.784564	0.06692
5	0.004534	0.079346	0.814357	0.101763
6	0.050683	0.350992	0.552502	0.045823
7	0.008837	0.073518	0.810543	0.107102
8	0.057155	0.496871	0.41082	0.035154
9	0.055963	0.395724	0.524242	0.024071

Source: Own study

Discussion of the findings

Table 1 shows the comparison of scores of two employees, which they received in five areas of the study. The points were calculated in compliance with the author's unique key. Next, the following were estimated for each employee with the use of the ltm package and GRM: level of decision latitude, psychological demands, job insecurity and social support (parameter θ). The situation where in spite of different responses given by the employees to the questions asked – they ultimately scored the same number of points was considered and analyzed .

When analyzing the responses of all 500 employees with the use of the 'key', the same score was often recorded. However, the employers wish to get all analyses as detailed as possible so that their results differentiated the respondents, most of whom present a very similar level of predisposition. Consequently, what is needed is the tools, which would differentiate employees. The application of GRM can be a kind of alternative solution in such situations.

When GRM is used, it is noticeable that the questions demonstrate various discrimination parameters and different threshold values. That is why, although the employees gave the same responses, they demonstrate different estimation levels for specific traits. The following values were achieved: the level of superiors' support for employee no. 1: 0.329, whereas for employee no. 2: -0.266. The estimated level of demands for employee no. 1: -0.498, whereas for employee no. 2: -0.204. The generation of such diverse results can be useful when conducting a more detailed psychological analysis of the employees.

Although most analyses focus on employees, it is also highly important to gain knowledge of the factors, which affect the employees (both negatively and positively.) Such an analysis can provide a lot of useful information for the organization and enable it to take proper steps to avoid any possible adverse effects.

It is possible to use GRM to estimate the parameters connected with the questions: threshold values (parameters $\alpha_{j2}, \alpha_{j3}, \alpha_{j4}$) and the discrimination parameter (parameter β_j). It is possible to calculate the probability of an average employee choosing category *i=1,2,3,4*. An average employee is a respondent with the trait which is analyzed at $\theta = 0$.

Table 2 shows the probability of giving responses by an average employee specifically in the first, second, third and fourth category. These calculations were made for all questions in all subscales of the questionnaire. After their comparison it was concluded that:

— in the case of questions in the scope of decision latitude assessment, demands and superiors' support – the third category "I agree" had the highest selection probability,

— in the case of questions in the scope of insecurity assessment: the average employee selected the second category "I don't agree" with the highest probability, with the exception of question number 19 and 21 where the first response had the highest selection probability,

— in the case of questions in the scope of the coworker support assessment – the most often selected categories were the first category "I completely disagree" or the fourth category "I completely agree".

This is important supplementary information for the whole process of analysis of the factors favorable for the development of employees and those which prove difficult for them to perform their work duties. It regards the knowledge of what factors are perceived positively and which are perceived negatively in a group of employees. The identification of such factors can in turn contribute to the creation of the most favorable work environment and consequently increase the satisfaction and commitment of the employees.

Implications

A detailed analysis of the job content questionnaire results, with the use of GRM, enabled us to identify specific problems in the scope of the existing working conditions and the employee capabilities.

It was possible to analyze how the employees function with the use of GRM at two levels. The first area regards the problems at the organization level. The model provides a diagnosis of the difficulties in the scope of work qualities within the following individual subscales:

— freedom in making decisions regarding performing work (decision latitude subscale,)
— psychological requirements from the employees set by the employers and hob description (psychological demands subscale,)
— the sense of employment instability and unclear career path (job insecurity subscale,)
— the sense of getting support from both the superior and coworkers (social support subscale.)

The other area that could be assessed with GRM regards the individual level. The analysis provides a detailed look at the opinions and capabilities of those who cope very well with the work content and demands, as well as those for whom work is exceptionally challenging, causing tension and a sense of losing control over the operations they must perform. Some responses to the statements in the questionnaires greatly polarized these two groups of employees. A detailed analysis of those responses resulted in developing a kind of instructions for the employee development in the scope of specific competences and motivation in order to cope better with the work demands.

The conclusions and recommendations that resulted from the analysis of the findings were then described in detail with the use of GRM at the organizational and individual level.

Originality/Values

The analysis conducted with the use of GRM indicates a significant application value of the method in diagnosing and planning activities in the scope of human capital management and designing healthy workplaces.

It is worthwhile to add in conclusion the other articles, where the GRM model was used to the purpose of more thorough analysis the results of research. Xianhua, Rui, Xiaoling, Yanhong, & Yanbo from Shanxi Medical University in **„**Application of IRT Graded Response Model in Coronary Heart Disease PRO Scale**"** (2012) decided to explore the IRT graded response model and its application in the patient-reported outcomes scale of coronary heart disease. Conclusion was, that IRT is a more suitable method to select items for the scale development. Another example of using GRM model in medical sciences can be „Neuro-QOL: quality of life item banks for adults with neurological disorders: item development and calibrations based upon clinical and general population testing" (Gershon et.al., 2012). The authors used Samejima's Graded Response Model to calculate IRT parameters and then use them for measurements in neurological studies. Finally Ebesutani et.al. (2012) emphasize, that GRM model was used as a tool to get better results in psychometric analysis. As it can be seen above, model can be used in many scientific disciplines and enables more detailed analysis.

Conclusions

In the light of presented findings, the hypothesis was confirmed. The use of GRM model in the process of assessment of psychological content of work among employees can provide more precise and more detailed solutions than the use of standard tools of psychological diagnosis. The analyses presented in the paper demonstrated the possible application of GRM in the employee

development improvement process. In the light of the above thesis, the most important conclusions include the following:

— the analyses conducted with the use of the proposed method demonstrated the similarities between the results achieved with the use of the questionnaire key and with the use of the model
— the lists presented in the tables show that analyzing data with the use of GRM can improve the psychological analyses – especially in order to compare employees who scored the same number of points according to the key
— as the use of research methods to differentiate candidates is currently very popular, it seems reasonable to suggest the use of GRM for this purpose
— in order to address the needs of the people facing the decision making dilemma, the proposed model can support the process of identifying the factors affecting the employee development and health as well as the most favorable work environment.

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