

MEASUREMENT OF LATENT VARIABLE “CREATIVE SELF-EFFICACY” OF STUDENTS OF CHAPTER OF KUBAN STATE UNIVERSITY AT SLAVYANSK-ON-KUBAN

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Abstract: *The purpose of this investigation is to establish a unidimensional interval scale for measuring students' creative self-efficacy. Latent variable “creative self-efficacy” is defined operationally – by means of a set of indicators. Each of the indicators characterizes one of the aspects of creative self-efficacy. The creative self-efficacy construct is measured in framework of the theory of latent variables based on Rasch model. The questionnaire as the measuring tool possesses high differentiating ability. The analysis of variance of results of measurements is used for comparison of creative self-efficacy of students depending on their gender and department. It is shown that based on this latent variable there is no statistically significant difference between females and males; however, there is a statistically significant difference between departments. The least value of creative self-efficacy belongs to students of faculty of physical training and biology, while the greatest value belongs to students of philology. There is a possibility to correct the set of the indicators characterizing the latent variable and thus to specify the content of the construct “creative self-efficacy”.*

Keywords: *creative self-efficacy; measurement; latent variable; Rasch model;*

1. Introduction

The importance of this research stems from the rapid changes of life. Under the conditions of accelerated scientific and technological progress, a person is not capable of capturing the full spectrum of scientific knowledge. With the invention and popularization of computers and Internet, the necessity for it has disappeared. Now routine problems on which we needed a lot of time in the past can be carried out quickly and efficiently by computers and robots. Therefore, the necessity for human work in many professional fields has disappeared. There is a hard problem of preservation of competitiveness that most people face in the 21st century. One of the solutions for this problem is the development of personal creative abilities.

Development of creativity is a labor-intensive process demanding constant diagnostics, which allows to trace dynamics of the process and to select the most creative people. However, currently there are no reliable ways of measuring creativity. In many respects, it is caused by the absence of unequivocal understanding of the nature of creativity, its origin, and key characteristics.

Attempts to define creativity and to construct ways of its measurement and diagnostics were fulfilled by many famous scientists (Bandura, 2007; Beghetto, 2013; Guilford, 1967; Starko, 2014; Torrance, 2004).

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2. Problem statement

The purpose of this work consists in the formation and measurement of the latent variable “creative self-efficacy” on a linear scale. This latent variable is used for comparison of students of the Kuban State University depending on gender and department.

Many ways of constructing latent variables (the weighing method, expert estimations, indexes) are subjective due to experts and nonlinearity of a scale (Maslak, 2016). It complicates the application of statistical methods of the analysis assuming a linear scale of measurement. Therefore, the measurement of latent variables is carried out within the framework of the theory of latent variables based on the Rasch models (Maslak et al., 2005).

Creative self-efficacy is defined operationally – by means of a set of indicators (Abbot, 2010). Each indicator characterizes one of the aspects of creative self-efficacy (Maslak et al., 2015). The students were asked to rate the degree of agreement with each indicator. The rating criteria was a five-point Likert scale: 4 = strongly agree, 3 = agree, 2 = neutral, 1 = disagree, 0 = strongly disagree.

3. Data

Students of Chapter of Kuban State University at Slavyansk-on-Kuban (Russian Federation) took part in this survey. The respondents were 148 students of six departments of branch of Kuban State University at Slavyansk-on-Kuban, among them are 30 females, 104 males, and 14 students who did not indicate their gender.

4. Method

Measurement of creative self-efficacy was carried out within the framework of the theory of latent variables based on Rasch model (Rasch, 1960). The partial credit model (Masters, 1982; Wright & Master, 1995) was used for processing data available from the survey. The analysis was done by using the RUMM software (Sheridan, 1988).

One of the important problems arising in the process of measurement of latent variable is the analysis of quality of the measuring tool, namely a set of indicators. The estimation of adequacy of the collected data to model of measurement was carried out based on the Chi-square criterion. Chi-square statistics equals 69.34 with 56 degrees of freedom. The p -value equals .11, which testifies to the compatibility of the set of indicators and, therefore, suitability of data for measurement. The person separation index equals .88, which means that students substantially differ from each other.

5. Results

The location of estimations of students’ creative self-efficacy and indicators characterizing creative self-efficacy is presented in Figure 1.

In the top part of Figure 1, the histogram shows distribution of estimations of students’ creative self-efficacy. The bottom part shows the distribution of estimations of indicators on the same scale. Here persons correspond to students and items to indicators.

Results of measurement which are presented in Figure 1 contain the following information.

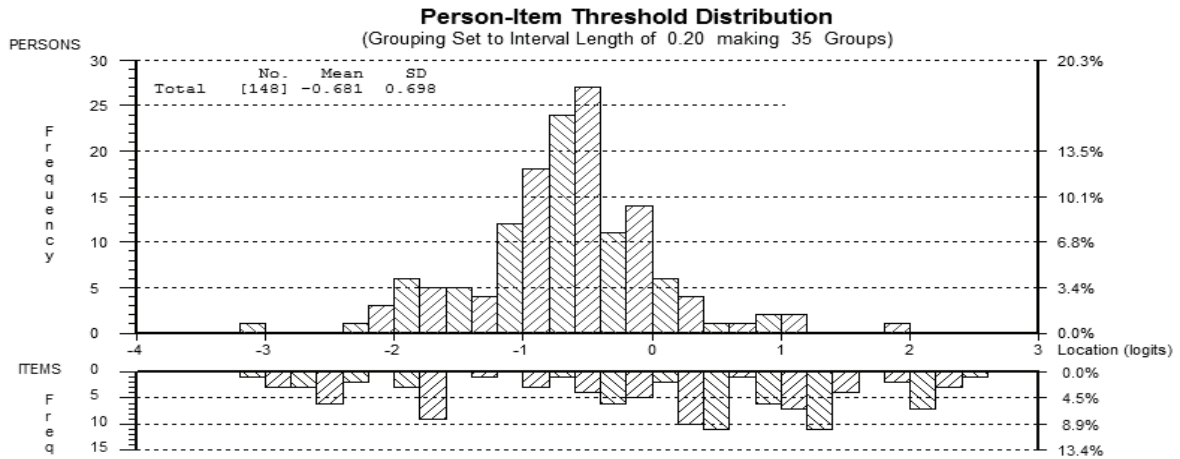


Figure 1. Location of estimations of students’ creative self-efficacy and indicators on the scale “creative self-sufficiency”

– Range of a variation of estimations of students’ creative self-efficacy is rather large and equals 5 logits (from –3.0 to 2.0 logits). It testifies that students considerably differ on the scale of creative self-efficacy. Moreover, as one would expect, distribution of estimations is close to the normal distribution.

– Estimations of indicators vary almost in the same range –5.5 logits (from –3.0 to 2.5 logits) and fully overlap the range of variation of students’ estimations. It provides high accuracy of measurement on the complete range of a latent variable.

– Between two of these sets (estimations of students and indicators) there is a small displacement of –.681 logits. It means that the chosen set of indicators is informative for measurement of creative self-efficacy.

As investigated factors, gender of students and their departments, are qualitative, ANOVA was used for their processing (Maslak & Pozdniakov, 2018).

Results of the ANOVA of creative self-efficacy of students depending on their gender are presented in Table 1.

Table 1. ANOVA of students’ creative self-efficacy depending on their gender

Sources of variation	Sum squares	of Degrees freedom	of Mean squares	F	p
Gender	.12	1	.12	.246	.621
Error	64.62	132	.49		
Total	64.74	133			

Results of the ANOVA (Table 1) testify that the factor “gender” is statistically insignificant ($p = .621 > .05$), i.e. there is no statistically significant distinction between females and males on the scale creative self-efficacy. Mean values of their creative self-efficacy are presented to Table 2.

Table 2: Mean values of creative students' self-efficacy depending on their gender

Gender	Mean (logits)	Volume of sample	Standard error (logits)
Females	-.734	30	.64
Males	-.699	104	.65

As it follows from Table 2, creative self-efficacy of males is slightly higher than that of females, but, as mentioned above, this distinction is statistically insignificant.

Results of the ANOVA of students' creative self-efficacy depending on their department are presented in Table 3.

Table 3: ANOVA of students' creative self-efficacy depending on their department

Sources of variation	Sum of squares	Degrees of freedom	Mean squares	F	p
Department	7.83	5	1.57	3.489	.005
Error	63.73	142	.45		
Total	71.56	147			

Results of the ANOVA (Table 3) show that the factor "department" is statistically significant ($p = .005 < .05$), i.e. there are statistically significant distinctions between departments.

Mean values of students' creative self-efficacy depending on their department are presented in Table 4.

Table 4: Mean values of students' creative self-efficacy depending on their department

Department	Mean (logits)	Volume of sample	Standard error (logits)
1. Physical training	-1.047	25	.51
2. Economics, history and law	-.640	12	.54
3. Graduation school	-1.015	15	.90
4. Mathematics, computer science and technology	-.550	12	.73
5. Philology	-.392	27	.70
6. Pedagogics and Psychology	-.604	57	.66

Table 4 shows that students of the philology department have the highest level of creative self-efficacy, and students of faculty of physical training and biology have the lowest level of creative self-efficacy.

6. Conclusions

This study appears to be the first attempt to construct a unidimensional scale for measuring latent variable "creative self-efficacy". The technique of measurement of a latent variable "creative self-efficacy" is presented.

Practice has shown that there is a danger in drawing too many conclusions from changes in a single indicator or from its relationship to other variables. The Rasch model approach to measuring creative self-efficacy has several important advantages. Firstly, a single measure of creative self-efficacy can be constructed from many different indicators. Secondly, the estimated Rasch measures are on a linear scale, so it is possible to quantitatively compare students on creative self-efficacy scale. Thirdly, more indicators lead to greater precision of students' measurement. Lastly, the estimated measures can be used to monitor the latent variable, find out statistical relationships between different variables, and provide information that would be useful for making decision in educational policy.

It is necessary to highlight that creative self-efficacy is defined operationally, i.e. through a set of indicators. The used set of indicators can be corrected, and thus, it is possible to specify the content of the concept creative self-efficacy.

References

- Abbott, D. H. (2010). *Constructing a creative self-efficacy inventory: a mixed methods inquiry*. (Doctoral dissertation, University of Nebraska - Lincoln, Denver, CO, 2010).
- Bandura, A. (2007). Much ado over a faulty conception of perceived self-efficacy grounded in faulty experimentation. *Journal of Social and Clinical Psychology*, 26(6), 641-658.
- Beghetto, R. A. (2006). Creative self-efficacy: Correlates in middle and secondary students. *Creativity Research Journal*, 18(4), 447-457.
- Guilford, J. P. (1967). Creativity: Yesterday, today, and tomorrow. *Journal of Creative Behavior*, 1, 3-14.
- Maslak, A. A. & Pozdniakov, S. A. (2018). Measurement and Multifactorial Analysis of Students' Patriotism // *SOCIETY, INTEGRATION, EDUCATION. Proceeding of the International Scientific Conference. Vol. I, Higher Education*, May 25th-26th, 2018. – Rezekne : Rezekne Academy of Technologies, 373–383.
- Maslak, A. A., Rybkin, A. D., Anisimova, T. S. & Pozdnyakov, S. A. (2015). Monitoring of pupils' imagination within the framework of creativity formation program // *Mediterranean Journal of Social Sciences*, Vol. 6, No. 6, Supplement 5, December 2015, Special edition, 150-158.
- Maslak, A. A. (2016). *Theory and practice of latent variables in education*. Moscow, Russia: Urait Publishing House.
- Maslak, A. A., Karabatsos, G., Anisimova, T. S. & Osipov, S. A. (2005). Measuring and comparing higher education quality between countries worldwide. *Journal of Applied Measurement*, 6(4), 432-442.
- Masters, G. N. (1982). A Rasch model for partial credit scoring. *Psychometrika*, 47, 149-174.
- Rasch, G. (1960). *Probabilistic models for some intelligence and attainment tests*. Copenhagen, Denmark: Danish Institute for Educational Research. (Expanded edition, 1980, Chicago: University of Chicago Press.)
- Sheridan, B. (1988). RUMM item analysis package: Rasch unidimensional measurement model. *Rasch Measurement Transactions*, 11(4), 599. (<http://www.rasch.org/rmt/rmt114d.htm>).
- Starko, A. J. (2014). *Creativity in the classroom: schools of curios delight*. Fifth edition. Routledge, New York and London.
- Torrance, E. P. (2004). Great expectations: Creative achievements of the sociometric stars in a 30-years survey. *Journal of Secondary Gifted Education*, 16(1), 5-13.
- Wright, B. D., Masters, G. N. (1995). *Rating scale analysis*. Chicago: MESA Press.