Numeracy as a Part of Financial Literacy: Student Case Study in Slovakia

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Abstract—The paper reveals the issue of financial literacy in school education in the Slovakia. We focus on key competencies of students from the perspective of the issue, also point out connection between numerical skills and financial literacy. We think that is necessary to increase numeracy skills because is a strong relationship between numeracy and financial literacy, means also to improve financial literacy. We are also considering improving the number and financial literacy, while conducting a questionnaire survey in two Slovak University. We focused on different parts of numeracy as a part of financial literacy for ex-ample financial knowledge, choosing and using financial products and services during created questions. The conclusions contain our findings and observations related to the support of numerical literacy in the teaching process.

Keywords—numeracy, financial literacy, MCQ test, item analysis, educational process

1 Introduction

Numeracy is much more than math facts and computation. If you not used mathematics knowledge can be lost. Numeracy is the ability to use basic mathematical skills and then these data interpret for a connection to everyday life and work [1]. Numeracy is an integral part of mathematics education, so development of numeracy requires that for students to experience the use math in different contexts of the real world (work, home, civic life, …) and also in all school subjects [2]. The development of early numerical skills affects not only later results in mathematics but also the future quality of life as well as the financial situation [3].

As stated in [4] achieving a reasonable level of numeracy is fundamental right of all pupils who leave compulsory school. In Slovakia, the opinion is supported that the development of students in numerical counting requires the deal with given topic an across the curriculum commitment of mathematics at all type and level of schools.

The relevance of numeracy skills in the work and everyday life becomes an increasingly relevant issue [5]. STEM (Science, Technology, Engineering and Mathematics)

education is considered necessary to support a modern knowledge of economy [6]. According to Jain & Rogers [5] critically to think and understanding and ability about numerical concepts and information is important for students in all academic areas [7]. Mathematical component of professional knowledge and global outlook reflects the skills of logical reasoning and heuristic thinking, because the task of mathematics does not consist in teaching calculus, but the methods of human thought in the calculation [8].

2 The present situation in education in Slovakia

Most of the styles are intuitive. However, we invite you to read carefully the brief description below.

The organization named INFE – International Network on Financial Education was established by the OECD in 2008. This organization is directly aimed at supporting financial education in OECD countries [9]. A growing number of countries recognized an importance of financial literacy have developed and have implemented national strategies for financial education in order to improve the financial literacy of their populations in general, often with a particular focus on younger generations [10], [11]. Ministry of Education, Science, Research and Sport of the Slovak Republic emphasized the importance of financial literacy development by formulating the National Standard of Financial Literacy in 2008 [12]. It was the initial document for incorporating financial literacy into the school education programs in the Slovak Republic. This document was updated to version 1.2 in march 2017 [13]. Under these documents [14]-[16]:

- Primary school pupils should know concepts: principal, simple interest, rate of interest, exchange list, foreign currency,
- Students in grade 10 learn exchange rate, foreign currency and elementary financial mathematics of households (deciding on the benefits of purchase or sales, insurance, various types of taxes and their calculation, account statements and invoices),
- Count basic tasks of simple and compound interest, to understand the principle of loan repayment, to compare the profitability of two loans by calculating the interest is knowledgeable for students in grade 11.

Methodology for incorporation and application of financial literacy topics into The National Education Programs – Mathematics ISCED 2 [14] and ISCED 3A [15] was also developed in that time for all Slovak schools the National Program of Education is official document in which are included main goals and requirements of the math education. Standards for lessons of mathematics in Slovak schools specifies this program (named ISCED 2 and 3A). According the National Education Program ISCED 3A, competencies for students studying mathematics in secondary school contributes to the development of following key:

- Competence to apply the basis thinking of mathematics and basic knowledge of science and technology,
- Competence to the problems solving,

- Competence in the information and communication technologies, in the field,
- Competence for learning to learn for lifetime,
- Competences for initiative and entrepreneurship,
- Competences to perceive and understand culture and to express themselves with the tools of culture,
- Social communication competencies,
- Working skills.

3 Connection between numerical skills and financial literacy

This financial education should provide sufficient knowledge for better understanding of financial products and terms, and tools that would lead to make the correct decisions. The Slovak National standard of Financial Literacy defines financial security of yourself and your household" [13] financial literacy as "the ability to use knowledge, skills and experience to effectively manage their own resources to ensure lifelong. Financial literacy is a shifting ability conditioned by factors such as age, family, employment, culture, and place of residence [17]. It´s necessary to understand the linkage between financial literacy and financial well-being. People's knowledge, attitudes and habits can have a significant impact on their well-being and the quality of life [18] when it comes to money. Being able to make financial choices based on basic knowledge of financial concepts, is therefore an important life skill that is equally important for the society in which one is embedded [19]-[21].

PISA is an extensive worldwide study by the Organization for Economic Co-operation and Development (OECD), examines educational performance with regard to labor market requirements. PISA focuses on the results of 15-year-old students in what is known as functional literacy, which it tests and compares over time. The assessments are conducted every three years. The results allow each participating country to compare the functionality of its education system with other participating countries. This study identifies potential shortcomings, and determine the international competitiveness of the pupils [17]. Slovak students participated in the measurement of financial literacy. This was done with program for International Student Assessment (PISA) in 2012, 2015 and 2018. Slovak students participated during measurement of financial literacy under the Program for International Student Assessment (PISA) in 2012, 2015 and 2018. In this assessment, Slovakia have never achieved average score OECD countries participating in the assessment. Compared with the 2012 PISA results, financial literacy score for Slovak students in 2015 was significantly lower (by 25 points). According NBS [17] the PISA 2015 assessment shows that an alarming 34.7% of our students have lack the ability solving real-life financial issues and problems for basic nature.

According to Abylkassymova et al. [22] it should be noted that financial literacy can be formed not only by studying the subject of economics, the basics of financial analysis in the process of pre-profile and vocational training of students, but also on the basis of a separate set of subjects studied in high school. Mathematics plays a special role in

this process, providing a basic apparatus for describing, modeling, and predicting various phenomena in economics and finance. Thus, hand to hand goes the ability to use mathematical tools to solve numerical tasks in financial decision making (numerical literacy) with financial literacy [9]. Making financial decisions involves mathematical calculations, both simple and complex [23]. The correlation between financial literacy and mathematics across the 13 OECD countries and economies, was on average 0.83 [24]. Results of a study by Jayaraman et al. [23] show a strong relationship between numeracy and financial literacy too. Mathematical literacy is a skill that develops the ability to analyze, reason, express ideas, and solve problems in a variety of situations and its level can be influenced and enhanced through mathematics education and the use of digital media [25]. To develop proficiency in financial literacy some basic knowledge of mathematics is necessary [24]. Otherwise interest in financial matters and financial literacy competencies can also support the development of mathematics and reading skills as well as provide a potentially engaging, real-life context to other school subjects [26].

Skagerlund et al. [19] state in their work, that a central component of financial literacy can be traced to numeracy and the emotional attitude towards numbers (i.e. mathematics anxiety). According to their study, the ability to understand numbers and having an emotional attitude towards numbers and driving force behind becoming financially literate does not interfere with an individual's daily engagement in activities involving mathematics and financial decisions. Substantial portion of the "financial literacy" construct may in fact be explained by numeracy, whereby numeracy may provide the computational engine behind financial decision based on conceptual knowledge of finance. Ghazal et al. in research [27] showed that numerical literacy is a predictor of financial behavior.

4 Improving numeracy and financial literacy

National Bank of Slovakia [17], a member of INFE, was focused on potential consequences of inadequate financial literacy. This is points out the emergence of new trends indicating areas of potentially increasing risk (see Figure 1):

- In Slovakia households' is a new trend - housing loans uptake. At the end of 2018, Slovakia reports the highest growth in household indebtedness in central and eastern Europe, second highest in the European Union and the highest in euro area,
- One Indicator of economic stability is the amount of household savings. Slovakia has over a long period lower levels of household and financial assets reported, compared with the other European Union countries and also with other CEE countries,
- Demographic trends and people's increasing average longevity will result in significant aging of Slovakia's population. Given the fact of population aging, the accumulation of financial reserves and voluntary pension savings of Slovak households need to be strengthened significantly,
- Information technology is supporting the new business models innovation, applications, processes and products, the quality of existing products and services also

improving. Because of that increasing their availability and customization, and reducing the costs related to them. Ordinary consumers may not understand, new risks in this new environment with the upcoming financial services and may be liable to make bad decisions.

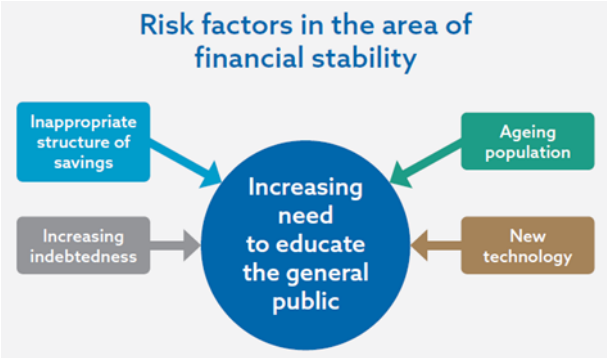

Fig. 1. Risk factors for financial stability according NBS [17]

According NBS [17], more financially informed population means a more stable economic and financial system therefore focusing its activities on institutional (formal) education of pupils at primary or secondary schools and informal education targeted at the adult population. The goal of the NBS in this area is to implement educational campaigns informing people on practical and current issues related to personal finances.

Non-profit organization Junior Achievement Slovakia, part of the Junior Achievement Worldwide network, is helping teachers develop entrepreneurship, economic thinking and financial literacy in their students, for more than 25 years. They offer above-standard business, economic and financial educational programs for primary and secondary schools. Trained teachers implement the acquired knowledge into subjects and develop financial literacy in schools through supplementary teaching. In the school year 2020/2021, 26 247 pupils, 800 teachers and 663 schools had experience with their experiential education. According to the information on the website of this organization, investing in Junior Achievement programs is an investment in the economic future of Slovakia [28].

People will invest in financial literacy if this assume to give them a positive re-turn, if the cost of acquiring financial skills is lower than the expected benefit of doing so [19].

5 Materials and methods

We conducted a questionnaire survey in two Slovak University in Nitra. The questionnaire survey was given to 160 first-year students. The examined group samples consisted of 97 students studying at the Faculty of Economic and Management, Slovak University of Agriculture in Nitra (SAU) and 63 students studying at the Faculty of

Natural Sciences, Constantine the Philosopher University in Nitra (CPU). The sample structure according secondary education is in Table 1.

Table 1. Numbers of students who participated in the research

	Female	**Male**	**Total**
SGS	36	29	65
SVC	73	22	95
Total	109	51	160

The questionnaires were given to the respondents face to face and therefore the response rate was 100%.

The questionnaires were developed through an iterative process, drawing on an OECD recommendation [26], national survey of the Slovak Banking Association [29] and the National Standard of Financial Literacy [13]. We focused on financial knowledge, choosing and using financial products and services during created questions: simple interest calculation, compound interest calculation, chart/data comparison and interpretation, average hourly wage, impact of inflation on spending power, profit, multiple discount, annual percentage rate of charge, credit card, annuity.

For each question according to selected determinants (type of secondary school, gender) we created index of respondents' successfulness (IRS). The highest possible IRS value can be 1, the lowest 0. It is an average score of correct answers of respondents according to determinants:

$$IRS = \frac{NCR}{NRD} \tag{1}$$

where *NCR* – the number of respondents' correct answers according to determinant, *NRD* – the number of respondents according to determinants.

The Financial Literacy Index (FLI) was also calculated as average knowledge of all items MCQs.

For realizing statistical analysis of obtained data we used SAS software and MS Excel. We created contingency tables, because they provide a basic view of the interrelation between two or more variables and can help find interactions between them. Analysis of contingency tables includes Chi-Square Tests of Independence, Fisher's Exact Test (in cases when 25% of cells have expected counts less than 5) and association measures (Phi Coefficient, Cramer's V).

Statistical test is needed determine if or not there is a link in between the row and column variables. The null hypothesis for contingency table test is that the two categorical variables are independent of each other. An easy method for computing expected frequencies is provided by equation:

$$f_e = \frac{Row\ Total \cdot Column\ Total}{Sample\ Size} \tag{2}$$

For the cell-by-cell comparisons is used chi-square statistic:

$$\chi^2 = \sum \frac{(f_o - f_e)^2}{f_e} \tag{3}$$

where f_o – observed frequency, f_e – expected frequency.

If the null hypothesis is correct, test value conforms to the chi-square distribution. To determine the specific distribution from which it is drawn, one must calculate the degrees of freedom using equation:

$$df = (r-1)(c-1) \tag{4}$$

where r – number of rows, c – number of columns.

As a measure of association for two binary variables was applied the phi coefficient:

$$\phi = \sqrt{\frac{\chi^2}{n}} \tag{5}$$

where χ^2 – chi-square statistics, n – the total number of observations.

Hypothesis testing for proportions from two populations we used to compare two sample on the basis of the proportion or percentage of their members that meet certain conditions (gender, type of secondary school). A one-tailed test was applied. We denoted the population providing largest sample proportion as population 1. If the difference between the sample proportions is close to zero, this supports the null hypothesis that the populations have the same proportion. If samples have very different proportions, null hypothesis will be rejected. The pooled estimate of population proportion (p) is computed by averaging the two sample proportions using equation:

$$p = \frac{X_1+X_2}{n_1+n_2} \tag{6}$$

where X_1 – the number of successes in sample 1, X_2 – the number of successes in sample 2, n_1 – sample size 1, n_2 – the size of sample 2.

The standard error of the difference is computed by using the pooled estimate of the sample proportion in equation:

$$\sigma_{p_{1-p_2}} = \sqrt{p(1-p)\left(\frac{1}{n_1}+\frac{1}{n_2}\right)} \tag{7}$$

where p – pooled estimate of sample proportion, n_1 – sample size 1, n_2 – sample size 2.

The z value is calculated using equation:

$$z = \frac{\overline{p_1}+\overline{p_2}}{\sigma_{p_{1-p_2}}} \tag{8}$$

where $\overline{p_1}$ – the proportion of success in sample 1, $\overline{p_2}$– the proportion of successes in sample 2, $\sigma_{p_{1-p_2}}$– the standard error of the difference between sample population.

If the test statistic z is less than critical value of the normal distribution, the null hypothesis is accepted. If it is greater than the critical value, the null hypothesis is rejected at the chosen significance level ($\alpha = 0{,}05$) [30].

We analyzed the psychometric quality of MSQs test by item analysis because we wanted to evaluated the effectiveness of items in our MCQs. The difficulty of a question in a test is the percentage from sample, when taking the test that answers that question:

$$FI = \frac{\bar{x}}{x_{max}} \cdot 100\ [\%] \tag{9}$$

where $\bar{x}$ – the mean credit obtained by all users attempting the item, x_{max} – the maximum credit achievable for that item.

Questions in our MCQs are distributed dichotomically (correct/uncorrect i.e. 1/0) so facility index coincides with the percentage of users that answer the questions correctly. High values of facility index (FI) is indication that the item is easy, while low values is indicating that the item is difficult [31].

Item discrimination is a measure of how well a question distinguishes between those with more skill from those with less skill. Discrimination index (DI) is measured by selecting two groups. We assigned the high skilled group with total score in the top 33% and the low skilled group in the bottom with 33%. The discrimination index is then the percentage between subjects in the high skilled group who answered the item correctly minus the percentage in the low skilled group who answered the item correctly:

$$DI = \frac{x_{top} - x_{bottom}}{N} \cdot 100\ [\%] \tag{10}$$

where x_{top} – the number of correct responses in the high skilled group, x_{bottom} – the number of correct responses in the low skilled group, N – the number of responses given to this question.

Our one variable was dichotomous so we calculated the point biserial correlation coefficient. The point biserial correlation is the value of Pearson's product moment correlation when one of the variables is dichotomous and the other variable is metric. This coefficient is also used as measure of item discrimination. It is the point-biserial correlation between the scores on the entire test and the scores on the single item. Values range from 1 (a perfect positive relation) through zero (no association at all) to −1 (a perfect negative correlation). Value of r_{pb} can be calculated directly from [32]:

$$r_{pb} = \frac{\overline{Y_1} - \overline{Y_0}}{s_y} \cdot \sqrt{\frac{N_0 \cdot N_1}{N(N-1)}} \tag{11}$$

where $\overline{Y_0}, \overline{Y_1}$ – means of the metric observations coded 0 and 1 respectively, s_y – standard deviation of all the metric observations, N – total number of all observations which $N = N_0 + N_1$.

Reliability is an index that estimates dependability (consistency) of scores. We calculated Kuder-Richardson Formula 20 (KR_{20}). The KR_{20} is used for items that have varying difficulty as a measure reliability for a test with binary variables. Scores for KR_{20} range from 0 (no reliability) to 1 (perfect reliability). In general, a score of above 0,5 is usually considered reasonable. The value of KR_{20} can be calculated directly from [33]:

$$KR_{20} = \frac{k}{k-1}\left(1 - \frac{\sum_{j=1}^{k} p_j \cdot q_j}{\sigma^2}\right) \tag{12}$$

where k – number of items in the test, σ^2 – the test-score variance, p_j – the proportion of respondents answering an item j in the keyed direction, q_j - the proportion of respondents answering an item j in the non-keyed direction.

6 Results and discussion

The overall index of all students' financial literacy (FLI) was 0.55. It means that, on average, each respondent answered correctly more than 8 questions out of 16. We have not noticed a statistically significant difference in FLI values with respect to completed secondary school. For example, the FLI of secondary grammar school stu-dents was 0.60.

The index of successfulness of respondents in each question according type of secondary education or gender is shown in Table 2. We observed better scores of secondary grammar school students in compound interest calculation (question 2), calculation of the increased price (question 7) or multiple discount (question 12).

We also examined the effect of respondents' gender on the IRS. Our obtained values show a beneficial effect of male gender on ability to solve financial tasks in our MCQs. FLI of men was 0.64 and the FLI of women was 0,51. Bhushan & Medury [34], Krechovská [9], Tóth et al. [35] in their research sample found higher financial literacy of men than women. Fonseca [36] argue that gender has in the United States affect the level of financial literacy because men usually carried out within the household financial decisions, while women are generally focus on other responsibilities in the home. Also Franczek and Klimontowicz [37] and Mancebón et al. [38] concluded that gender has an effect on financial decision according to their research.

Table 2. Values of calculated item indicators

	IRS[%]		IRS[%]		FI	DI	r_{pb}
	Female	***Male***	***SGS***	***SVC***			
Q1	86*	100	92	89	0,91	0,23	0,31
Q2	30*	49	52*	25	0,36	0,36	0,38
Q3	47*	63	57	48	0,52	0,28	0,26
Q4	63*	80	77	63	0,69	0,32	0,40
Q5	69	76	71	72	0,71	0,26	0,33
Q6	86	90	86	88	0,88	0,21	0,34
Q7	64*	82	78*	64	0,70	0,57	0,52
Q8	69	82	80	68	0,73	0,51	0,51
Q9	42*	75	60	47	0,53	0,30	0,56
Q10	50	65	58	52	0,54	0,55	0,47
Q11	39	55	43	45	0,44	0,43	0,42
Q12	21*	57	48*	22	0,33	0,51	0,48
Q13	12	16	17	11	0,13	0,17	0,29
Q14	21*	37	31	23	0,26	0,26	0,27
Q15	39	27	32	38	0,36	0,15	0,07
Q16	72	75	74	72	0,73	0,34	0,30 [2]

[2] SGS – secondary grammar schools, SVC – secondary vocational colleges, IRS - index of respondents' successfulness, FI – facility index, DI – discrimination index, r_{pb} - point biserial correlation coefficient, * - statistically significant differences at the alpha level of 0.05.

The Slovak Banking As-sociation noticed minimal differences in correct answers of women and men when examined financial literacy of the population of Slovakia [29]. In our survey, we de-tected higher scores of men in 15 questions out of 16. Up to 50% of founded differences were statistically significant (see Table 2).

Index that estimates dependability (consistency) of scores KR_{20} reached value 0,56. So we can consider used MCQs to be reliable.

Indication of the item difficulty level for each item are presented in Table 2. Very high or low values of facility index indicate that the question is not useful as an instrument of measurement. We identified only 1 difficult and 2 easy items in MCQs (Table 3). Instructional Assessment Resources (IAR) recommending, test items classified into three categories in terms of level of difficulty: easy (above 0.90), moderate (0.20 - 0.90), difficult (below 0.20) [39]. 87.5% of items in our MCQs can be classified as moderate category.

Table 3. Distribution of items in terms of level of difficulty in categories

Item facility (difficulty) index (FI)	Total item
extremely difficult (5 or less)	0
very difficult (6 – 10)	0
difficult (11 – 20)	1
moderately difficult (21 – 34)	2
about right for the average student (35 – 65)	6
fairly easy (66 - 80)	5
easy (81 – 89)	1
very easy (90 – 94)	1
extremely easy (95 – 100)	0 [3]

[3] Source: Butcher [31].

The absolute values between -1 and +1 are taken in discrimination index. Values near zero indicate that the question does a poor job of discriminating between high performers and low performers. Values close to +1 indicate that the item does a good job of discriminating between high performers and low performers. Values near -1 indicate that the item tends to be answered correctly by those who perform the worst on the overall test and incorrectly by those who perform the best on the overall test [40]. Each item discrimination coefficient is indicated in Table 2. Test items are classified into five level of discrimination in terms with discrimination coefficient based on recommendations by Ebel [41] in Ovwigho [42] is presented in Table 4.

Table 4. Distribution of items in terms of level of discrimination in categories

Index of discrimination (DI)	Item evaluation	Total item
0.40 and above	very good items	5
0.30 – 0.39	reasonably good but subject to improvement	4
0.20 – 0.29	marginal items usually need and subject to improvement	5
below 0.19	poor items to be rejected or improved by revision	2 [4]

[4] Source: Ebel [41] in Ovwigho [42].

The findings suggest that necessary improvement need to be done in order to measure students' performance effectively. Very good evaluation of DI obtained only 5 items. Should review items with poor discrimination index.

One of the most accepted ways to evaluate an item is to calculate a correlation. The deciding factor between a good or bad question is its ability to "discriminate" respondents who have mastered the material from those who have not. Point-biserial correlation coefficient is way of measuring consistency of the relationship between a candidate's overall score and a candidate's item score. Values of 0.25 or higher mean that the item is performing well [43]. Where an item's point-biserial is < 0.15, the question is probably written poorly and should be examined for a possible incorrect key. The values of point-biserial correlation coefficient of each item are presented in Table 2. Only one items had a point-biserial coefficient below 0.10 in our MCQs. The concept of an annuity should be examined in another form of question, because this question also had the lowest DI.

7 Conclusion

Educational policy should consider increasing numeracy skills because is a strong relationship between numeracy and financial literacy, means to improve financial literacy. We agree with the opinion Jayaraman et al. [23] that as part of the curriculum should be promoted numeracy (e.g., interest calculations, chart/data comparisons, and interpretations) as it relates to financial literacy. The all researched students overall index of financial literacy was 0.55. We found out a beneficial effect of male gender on ability to solve financial tasks in our research sample. In terms of the difficulty of the questions was 87.5% of items in our MCQs can be classified as moderate category. But very good evaluation of discrimination index obtained only 5 items. One items had a point-biserial coefficient below 0.10 in our MCQs. The findings suggest that in order to measure students' performance effectively, necessary improvement need to be done in our MCQs.

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