

Vladimíra Petrášková

Czech Republic

Pre-service Mathematics Teachers' Financial Literacy

Abstract

Pre-service teachers' knowledge in the field of finances is crucial as it is a pre-requisite to the development of students' financial literacy. This paper describes a quantitative study focusing on testing pre-service mathematics teachers' financial literacy at the start of their studies. 47 pre-service mathematics teachers were assigned a test of financial literacy within the frame of this study.

Keywords: *financial literacy, financial education, pre-service teacher training*

The need for improvement of financial literacy – background to the study

Over the last few years the number of indebted households has been continually growing in the Czech Republic. This growth goes hand in hand with the inability of these households to settle their debts, resulting in seizure or personal bankruptcy. The main cause of this unfortunate situation is often the low level of the debtor's financial literacy.

Governments all around the world have expressed concerns about the low level of financial literacy of their citizens. The potential magnitude of the consequences of lack of financial literacy has come to surface during the recent financial crisis. It comes as no surprise that the Czech government has also tried to address the issue of improvement of financial literacy. At the end of 2007 it published the document "The system of development of financial literacy in primary and secondary schools" (MEYS CR 2007). This document introduces concrete standards of financial literacy that establish the aims of financial education in primary and secondary schools in the Czech Republic. These standards have been implemented in cur-

ricular documents of the Czech education system, called Framework Educational Programmes (FEPs) for the particular type and level of school. The implementation of FEP in secondary general education (pupils aged 15–19) was carried out in the years 2008 and 2009 (MEYS CR 2008). The standards are reflected especially in the following two educational areas: 'Humans and the world of labour' and 'Mathematics and its application'.

"The area 'Humans and the world of labour' defines knowledge and skills related to management of financial resources, free market economy, national economy and the role of state in the economy, which are to be mastered by secondary school students. The area 'Mathematics and its application' introduces the mathematical apparatus prerequisite if the laws of operation of financial relations are to be grasped by the students and analysis of the offered products is to be possible." (Dvořáková et al. 2011)

The implementation of the standard of FEP in basic education (pupils aged 6–15) was carried out at the beginning of the year 2013 (MEYS CR 2013). The standards for basic education are classified in these areas: 'Humans and society' and 'Mathematics and its application'.

In 2009 representatives of faculties that train pre-service primary and secondary school teachers were called upon to incorporate the standards of financial literacy into the contents of relevant pre-graduate study programmes. The faculties answered this demand and implemented the issue in their study programmes. For instance, the Faculty of Education of the University of West Bohemia in Pilsen offers its students the subject "Financial mathematics", the Faculty of Education of Palacký University in Olomouc a course of "Personal and family finance" and the Faculty of Education at the University of South Bohemia a course of "Introduction to finances". Each of these subjects has a different conception, but their common goal is "obtaining competence of orientation in the field of money and price issue. The student is also able to manage his/her personal and/or family budget responsibly, including the management of financial assets and liabilities in consideration of changing life situations." (MF CR 2010). The students should also gain competence in improving the financial literacy of their future pupils.

The intention of this article is to briefly introduce the conception of the subject "Introduction to finances" and the results of the research. These results should contribute to the innovation of a digital tutorial environment within this subject. This could serve as an example of best practice to other universities. We asked the following questions for this purpose: What is the level of the newcomers' financial literacy in the study branch "Introductory teacher training course in mathematics"?

(“Introduction to finances” is a compulsory subject for students of this branch). Which of its components are developed sufficiently? Which components of financial literacy should be further developed in pre-service teacher training?

The need for the innovation of a digital tutorial environment has resulted from the fact that the students already familiarized with the world of finances at secondary schools started entering Czech universities in the 2011/2012 academic year. This means that their knowledge in the field of finance should be on a higher level than the knowledge of students entering universities in previous years.

The issue of the financial literacy of young people has been researched in many world studies (e.g., Lusardi et al. 2010, Regecová & Slavíčková 2010).

Pre-service teachers’ financial literacy – a study

The conception of the subject *Introduction to finances*

There are two notions that form the background to our research: financial education and financial literacy. OECD materials from 2005 state the following:

“Financial education is the process by which individuals improve their understanding of financial products and concepts; and through information, instruction and/or objective advice develop the skills and confidence to become more aware of financial risks and opportunities, to make informed choices, to know where to go for help, and to take other effective actions to improve their financial well-being and protection.” (OECD 2005)

The definition of financial literacy as used in this paper was also developed by the OECD:

“Financial literacy is the combination of consumers’/investors’ understanding of financial products and concepts and their ability and confidence to appreciate financial risks and opportunities, to make informed choices, to know where to go for help, and to take other effective actions to improve their financial well-being.” (OECD 2005)

The above-mentioned definitions and considerations on the teacher’s role at different school levels became the starting point for design of the course “Introduction to finances”. Special teaching materials were created based on the standards of financial literacy and with respect to the fact that most people including pre-

graduate students find it difficult to get insight into the basic notions of the world of finances, into their interrelations and functions. One of the reasons for our failure to understand the world of finances is the permanently changing offer of financial products. Moreover, descriptions of these products are often unclear, insincere and confusing. Our effort to find possibilities to help students understand resulted in the question whether this process could be supported by a special, designed for these purposes, learning environment. An environment that would be interactive, that would demonstrate to students all the various needed calculations, but that would also enable them to carry out these calculations repeatedly, e.g., with different initial parameters; an environment that would be flexible enough to be easily adaptable to the current state of offer of financial products.

A comprehensive set of hypertext materials was created with the purpose of getting a clearer insight into the aforementioned problems. The objective of these teaching materials is to develop students' ability to solve model problems in the field of financial management. The substantial elements of this set are such teaching texts that can be updated at any time to reflect the current situation on the financial market, supplemented by examples of problems from everyday financial practice solved in the environment of computer algebra programme Maple 13 (the so-called smart documents). These allow the user to carry out repeated calculations with the original or altered values of the input parameters. Examples of these documents can be found in Hašek, Petrášková (2008, 2009, 2010a, 2010b).

Although the subject "Introduction to finances" is intended to be taught to pre-service lower secondary school teachers (for pupils aged 11–15), its structure was created in accordance with the standards of financial literacy for upper secondary school (pupils aged 15–19). The reason is that lower secondary teachers must be oriented in this field and they should be capable of preparing pupils for the development of their skills in this branch.

It is obvious that financial literacy is closely linked to mathematical literacy. If the level of carrying out arithmetical computations (mathematical literacy) is deficient, the person cannot be expected to be successful in the world of finances. Huston argues that 'if an individual struggles with arithmetic skills, this will certainly impact on his/her financial literacy' (Huston 2010).

The standards of financial literacy testify that mathematical literacy is prerequisite. Financial literacy standards for upper secondary schools include the following areas (MEYS CR 2007):

- **Money**

Content: payment (in both domestic and foreign currency), price generation, inflation.

Gained skills: the student is able to use the most frequent payment tools, to change money according to the actual exchange rate, to generate a price as a sum of costs, profit and VAT (value added tax), to explain the price differences with respect to consumer, place, period, etc.; the student recognizes the usual tricks hidden in prices (a price without VAT, etc.) and various false advertisements; he/she explains the nature of inflation and its fallout on incomes, deposits, loans and long-range financial planning; gives examples of defense against inflation.

- ***Household management***

Content: household budget.

Gained skills: the student differentiates regular incomes and expenses from the one-off ones and draws up a simple household budget with respect to them; he/she can offer a solution of the deficit household budget and knows what to do with the surplus household budget.

- ***Financial products***

Content: surplus money, money shortage, insurance.

Gained skills: the student offers a way of handling surplus money (saving, offers which include a state contribution, bills of exchange, real estate, etc.); he/she chooses the best product in which to invest the surplus money and gives an explanation; the student finds the kind of credit that suits him/her best; the student considers the way of ensuring the credit and explains a way of keeping from insolvency; he/she explains the ways of interest rate definition and the difference between the interest rate and the annual percentage rate (APR); he/she chooses the best insurable product with respect to his/her needs.

- ***Consumer rights***

Content: consumer protection rules; patterns of arrangements.

Gained skills: through an example the student explains the possibilities of claiming consumer rights (purchase of goods and services, including financial products); he/she shows the possible effects of ignorance of an arrangement including its general conditions.

Methodology

The survey was based on a questionnaire consisting of 5 questions (cf., Appendix). These questions were adopted from the national survey of financial literacy in the USA (FINRA 2011). Some of these questions were also used in national surveys of other OECD countries.

The questionnaire had a form of a multiple choice test. One of the options was always 'I don't know'. Only one answer was correct. No calculations were needed (with the exception of Question 1 – stating the proportion in percentage). The aim of the questions was to prove the following:

- Question 1 – Understanding interest rate and compound interest.
- Question 2 – Understanding inflation.
- Question 3 – Understanding the relationship between interest rate and bond price.
- Question 4 – Understanding the relationship among interest, maturity and amount of repayment (related to mortgage credit).
- Question 5 – Understanding diversification of risk.

The data were collected at the beginning of the course 'Introduction to finances'.

Studied sample

The research was carried out with 47 pre-service lower secondary school teachers of mathematics (for pupils aged 11–15). The pre-service teachers were in their 1st year of the teacher training branch "Introductory teacher training course in mathematics" at the Department of Mathematics of the Faculty of Education of the University of South Bohemia in České Budějovice and they were registered for the course "Introduction to finances". Their age range was 19 to 21.

The students participating in the survey were familiarized with the financial issue in the field corresponding to the demands of the Czech curricular documents for secondary schools. The subject matter is in accordance with the aforementioned standards of financial literacy for upper secondary schools.

Data processing

The study was quantitative. Data processing was carried out in the following steps:

- stating the absolute and proportional relative frequency of correct answers to each question,
- stating the mode of the random variable which is represented by the number of correct answers,
- stating absolute frequency of all combinations of correct answers,
- error analysis.

Results and observation

Table 1 shows absolute and proportional relative frequencies of correct and incorrect answers to the questions. It is easy to see that the respondents were most successful in answering question 1. Producing the correct answer to this question required that the students understood the principle of compound interest, but also a sufficient level of mathematical literacy – work with percentages. The respondents were also relatively successful in questions 2 and 4. Question 2 is based on their understanding of the concept of inflation and its relation to interest rates. If these variables are given in percentage, or as decimal numbers, they are easy to compare. Question 4 expected the students to have some idea of a repayment plan of a mortgage, or any loan. They should know: (a) what proportion of each payment goes to paying of the interest and which to repayment of the debt; (b) that prolongation of the payback period leads to a decrease in monthly instalments, but increase in the interest paid; (c) lowering of instalments is not directly proportional to the increase in interest. The successfulness in answers to questions 1, 2 and 4 may be attributed to the fact that secondary school students spend considerable time (in the curricular topic arithmetic and geometric sequence) deriving formulae for simple and compound interests, saving and for calculation of instalments when paying off a given debt. When deriving these formulae they start from real life situations and proceed to the common model. Thus, the students gain a general idea of functioning of some areas of the world of finances.

What the students found most difficult were questions 3 and 5. Both these questions are related to securities. It can be assumed that problems to find a correct solution are connected with the lack of the students' experience with these financial products. Their experience is most often limited to the use of student bank accounts and internet banking, choice of the best telephone operator or use of debit or credit cards.

Table 1. Test evaluation

Question	Number of correct answers (Percentage results)	Number of incorrect answers (Percentage results)	Answer 'Do not know' (Percentage results)
1 Compound interest	42 (89.4%)	5 (10.6%)	0 (0%)
2 Inflation	33 (70.2%)	11 (23.4%)	3 (6.4%)

Question	Number of correct answers (Percentage results)	Number of incorrect answers (Percentage results)	Answer 'Do not know' (Percentage results)
3 Bond price	5 (10.6%)	38 (80.9%)	4 (8.5%)
4 Mortgage credit	33 (70.2%)	13 (27.7%)	1 (2.1%)
5 Diversification of risk (share)	28 (59.6%)	9 (19.1%)	10 (21.3%)

Table 2 shows the number of students in proportion to the correctly answered questions. We can see that most frequently the students answered correctly 3 out of 5 questions. Number 3 corresponds to the mode, median and average of the random variable, which is in this case the number of correctly answered questions in the questionnaire. It is quite interesting to mention here that the average number of correctly answered questions was 3 also in the national survey in the USA (FINRA 2011), which worked with 28 146 respondents (approximately 500 per state, plus D.C.) of different age, sex, ethnic origin and education. However, the difference in the composition of the respondents in the two surveys makes any objective comparison impossible.

Table 2. Absolute frequency of the number of correctly answered questions

Number of correctly answered questions – Number of students					
0–0	1–3	2–10	3–20	4–12	5–2

Table 3 shows that the most frequent triad of correctly answered questions was 1, 2, 4. The number of students who answered this way is presented in Table 3. Table 3 shows all the possible combinations of correct answers and the number of students who answered in each particular way.

Table 3. Combination of correct answers and the number of students

Correctly answered questions	Number of students	Correctly answered questions	Number of students	Correctly answered questions	Number of students
1, 2, 3, 4, 5	2	1, 4, 5	4	2, 5	0
1, 2, 3, 4	0	2, 3, 4	0	3, 4	0
1, 2, 3, 5	1	2, 3, 5	0	3, 5	0

Correctly answered questions	Number of students	Correctly answered questions	Number of students	Correctly answered questions	Number of students
1, 2, 4, 5	10	2, 4, 5	3	4, 5	2
1, 3, 4, 5	1	3, 4, 5	0	1	2
2, 3, 4, 5	0	1, 2	5	2	0
1, 2, 3	0	1, 3	0	3	0
1, 2, 4	7	1, 4	3	4	0
1, 2, 5	5	1, 5	0	5	1
1, 3, 4	1	2, 3	0		
1, 3, 5	0	2, 4	0		

Error analysis

As the students were relatively successful in questions 1, 2 and 4, the following error analysis will focus on questions 3 and 5. The absolute frequency of incorrect answers is shown in Table 4. Symbol * indicates the correct answer.

Table 4. Evaluation of wrong answers

Question	Answer- Number of answers				
3	(a)- 24	(b)*- 5	(c)- 6	(d)- 8	(e)- 4
5	(a)- 9	(b)*- 28	(c)- 10	-	-

Question 3: If the students marked the wrong answers (a), (c), they seemed to understand the effect of interest rate on the price of investment tools. But they did not know the direction of the change in price. Selecting the wrong answer (d) was more serious. One of the reasons why students chose this wrong answer can be the fact they have no idea of how financial markets work. It must also be taken into account when analysing these mistakes that it is possible the respondents do not understand the notion of bond.

Question 5: Incorrect answers signal that 40% of the students have no idea of how mutual funds function (diversification of risk). Again these problems might have been caused by ignorance of the notion of stock and shares and the notion of mutual fund. This hypothesis is supported by the relatively high frequency of answers (c) I don't know.

Conclusions of the survey

Let us now answer the questions posed at the beginning of the survey:

What is the level of the newcomers' financial literacy in the study branch "Introductory teacher training course in mathematics"?

The level of financial literacy of the mathematics students at the beginning of their studies at the Faculty of Education at the University of Bohemia is average. It can be assumed that this level corresponds to their experience with financial products – use of student bank accounts, debit and credit cards, payment for some services (e.g., for mobile phone). All these cases involve interest rates, inflation, ability to pay off a loan (credit card).

Which of its components are developed sufficiently?

The following components are sufficiently developed: (a) knowledge of the principle of simple and compound interest; (b) knowledge of the impact of inflation on savings; (c) principle of paying off a debt.

Which components of financial literacy should be further developed in pre-service training?

The results of the survey clearly show that it is necessary to focus the training of pre-service mathematics teachers on stock markets. As the existing interactive hypertext aid includes no interactive documents with model situations from the area of investments into stock and shares, they must obviously be created. Although there are some interactive documents tackling trade with debenture bonds, they presuppose that the student is aware of the fact that any change in the interest rate affects the price of the bond. The survey clearly shows that this is not always the case. In consequence, the existing documents must be appended by new documents showing solutions to model situations showing the factors influencing the price of a bond.

Conclusion

Nowadays everybody must face the ever increasing offer of financial products and services that are often not transparent and confusing. Only a person with a satisfactory level of financial literacy is able to make the right decisions in this situation. Furthermore, the young generation, in contrast to the generation of their parents, must be more responsible in their decisions about investments in order to secure their pension and necessary healthcare. This puts demands on teacher training in this area as teachers must understand how the world of finances

functions. Only then are they able to prepare their students for being successful in the financial world.

References

- Dvořáková, Z. et al. (2011). *Finanční vzdělávání pro střední školy: se sbírkou řešených příkladů na CD*. 1. vyd. Praha: C.H. Beck.
- Hašek, R., & Petrášková, V. (2008). Teaching of financial mathematics using Maple. *Teaching Mathematics and Computer Science*, 6(2), 289–301.
- Hašek, R., & Petrášková, V. (2009). Web interactive tool to improve financial literacy. *South Bohemia Mathematical Letters*, 17(1), 61–70.
- Hašek, R., & Petrášková, V. (2010a). Issue of Financial Capability. *The International Journal for Technology in Mathematics Education*, 17(4), 183–190.
- Hašek, R., & Petrášková, V. (2010b). A Way to Improve Financial Literacy of Future teachers. In T. Bianco, & V. Ulm (Eds.), *Mathematics Education with Technology- Experiences in Europe*. (pp.199–218). Univ. Augsburg.
- Huston, S.J. (2010). Measuring financial literacy. *The Journal of Consumer Affairs*, 44(2), 296–316.
- Lusardi, A., Mitchell, O.S., & Curto, V. (2010). Financial literacy among the young. *The Journal of Consumer Affairs*, 44(2), 358–380.
- Regecová, M., & Slavičková, M. (2010). Financial literacy on graduated students. *Acta Didactica Universitatis Comenianae-Mathematics*, 10, 121–147.
- OECD. (2005). *Improving Financial Literacy: Analysis of Issues and Policies*. 1. printing Paris: OECD Publishing, 181 p. ISBN 92–64–01256–7.
- FINRA. (2011). Financial capability study [online]. [cit. 2013–05–13]. Available at <http://www.usfinancialcapability.org>.
- MEYS CR. (2007). Systém budování finanční gramotnosti na základních a středních školách [online, in Czech]. Praha: Ministry of education, youth and sports of the Czech Republic. [cit. 2013–05–13]. Available at <http://www.msmt.cz/vzdelavani/system-budovani-financni-gramotnosti-na-zakladnich-a-strednich-skolach>.
- MEYS CR. (2008). Rámcové vzdělávací programy oborů středního vzdělání [online, in Czech]. Praha: Ministry of education, youth and sports of the Czech Republic. [cit. 2013–05–13]. Available at <http://www.msmt.cz/vzdelavani/ramcove-vzdelavaci-programy-zaslani-do-vnejsiho-pripominkoveho-rizeni>.

MEYS CR. (2013). Rámcové vzdělávací programy pro základní vzdělávání [online, in Czech]. Praha: Ministry of education, youth and sports of the Czech Republic. [cit. 2013-05-13]. Available at <http://www.msmt.cz/file/26993>.

MF CR (2010). Národní strategie finančního vzdělávání. [online, in Czech]. [cit. 2013-03-17]. Available at http://www.mfcr.cz/cps/rde/xchg/mfcr/xsl/ft_strategie_finančního_vzdelavani_55251.html

Appendix – Test of Financial Literacy

1. Suppose you deposit CZK100 on a savings account with a guaranteed interest rate of 2% per year. You neither deposit nor withdraw any money after that. How much will there be in your account in five years? (a) More than CZK110. (b) Exactly CZK110. (c) Less than CZK110. (d) I don't know.
2. Suppose that the interest rate in your savings account is 1% per year and inflation is 2% per year. How much will you be able to buy with the money on your account in one year time? (a) More than today. (b) Exactly the same. (c) Less than today. (d) I don't know.
3. If interest rates rise, what will happen to bond prices? (a) Rise. (b) Fall. (c) Stay the same. (d) No relationship. (e) I don't know.
4. A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest paid over the life of the loan will be less. (a) True. (b) False.
(c) I don't know.
5. Buying a single company's stock usually provides a safer return than a mutual fund.
(a) True. (b) False. (c) I don't know.