Financial Literacy Tasks for the Basic Level Mathematics Curriculum

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Abstract: Financial literacy, one of the most popular types of literacy, is a rising concept in education. Many countries which are partners of PISA such as the US, Canada, Singapore have initiatives to integrate financial literacy into education. Nevertheless, financial literacy has not been taken place in the education system of Turkey yet despite that Turkey is a partner of PISA as well. The aim of this study is to offer an onset for financial literacy tasks for basic level mathematics courses carried out in the 11th and 12th grades. The study designed as a document creation is shaped according to the learning outcomes and contents of the curriculum. The design is based on the fundamental task design parameters as well as the common processes between mathematical and financial literacies. In the study, tasks were discussed in terms of tasks design parameters and the basic level mathematics curriculum with similar studies. Accordingly, the tasks represent an example of a design in which the use of technology provides an opportunity for reasoning, and that can lead to conceptual understanding through manipulations. Besides, the tasks in this study consider the interaction between mathematics education and financial literacy. Therefore, the tasks sustain financial literacy beyond being a context for mathematical learnıng outcomes. This study expects to demonstrate that such tasks can be integrated into the mathematics courses without interfering with the curriculums.

Keywords: Financial literacy, Mathematics curriculum, Mathematical tasks, Task design

1. Introduction

Financial literacy (FL), one of the most popular types of literacy, is a concept that attracts interest in education (Aprea et al., 2016). FL can be defined as the conscious behaviors of individuals in financial decisions (Lusardi and Mitchell, 2014; Organization for Economic Cooperation and Development Countries [OECD], 2016). FL is a well-rounded skill which includes various contexts such as earning, spending, saving and investment, financial planning and management (Ozkale and Ozdemir Erdogan, 2020). Accordingly, FL is a wide range competency from budgeting to variating the investment tools. FL is not a specific qualification in finance, but a whole set of skills which everyone should be interested in and which influence their lives. Financial independence and well-being of individuals depend on financial responsibility because they deal with financial issues first themselves (Lucey, Agnello, and Laney, 2015).

Because of the importance of FL, many countries such as the US, Canada, Singapore, and Estonia have initiatives in order to integrate FL to education. In this manner, either there is a separate FL course or it has been integrated to curriculums of related courses like mathematics (Ministry of Education of Ontario, 2010). Because of this interest, FL has been included in Programme for International Student Assessment [PISA] since 2012. The PISA framework categorizes FL into three dimensions: (a) context in which these pattern questions are to be constructed, (b) content in which the conceptual bases are selected, and (c) processes in which students use problem-solving ways. The number of countries which are participated in PISA is few, 15, most of them are countries which also carry out financial literacy education. Turkey is a founding member of OECD and has participated in PISA since 2003, but has been not included in the FL domain yet due to lack of this education. Thus, there is neither a separate nor an integrated course of FL in Turkey. It is stated in several studies on the FL in education that financial concepts take place rarely in the curriculums in Turkey (Guvenc, 2017), there is a lack of consciousness and intention in the curriculums (Ozkale and Ozdemir Erdogan, 2017).

1.1. The Interaction between Mathematics Education and Financial Literacy

One of the basic domains with which FL are related is mathematics. OECD (2016) stated that mathematical literacy [ML] is a prerequisite for FL. Besides, it is stated that some skills of ML such as reasoning and comparing are influential on financial decisions (Lusardi, 2012). Besides the interaction is handled in National Council of Teachers of Mathematics [NCTM], in the domains of mathematical literacy and financial literacy in PISA, there is a significant correlation (0.83) (NCTM, 2011; OECD, 2014).

The interaction between mathematics education and financial literacy cannot be limited to the dimension of financial context. Both of them have also common processes such as reasoning and manipulating and common contents such as percentage and decimals (Geiger, Goos and Forgasz, 2015; Jayaraman, Jambunathan, and Adesanya, 2019; Jayaraman, Jambunathan and Counselman, 2018). Considering the interaction in terms of

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conceptual, Ozkale and Ozdemir Erdogan (2020) developed a model that revealed the interaction of financial and mathematical literacies (Table 1). The model was designed similar to the PISA pattern, including financial contexts, contents and common processes. From the perspective on task design on FL, Sawatzki (2017) developed the tasks regarding FL expectations which were used in PISA questions. Sawatzki (2017) stated that students and teachers considered that the tasks were close to real life. In another study by Dituri, Davidson and Marley-Payne (2019), mathematics lessons designed to achieve financial learning outcomes were executed two semesters. The result of the study found out that the process provided a meaningful difference as well as students earned a positive attitude through FL behaviors. Regarding the result of the study, Dituri et al. (2019) stated that mathematics courses including systematic and in-depth implementations of personal finance can be particularly effective (Dituri et al. 2019).

Table 1. The Interaction Model of Mathematical and Financial Literacies

Content	Processes	Financial context
Mathematical content	Identifying financial situation	Earning
Quantity	Reasoning	Spending
Change and relationships	Problem solving and modelling	Investing and saving
Space and shape	Manipulating and estimating	Financial management and planning
Uncertainty and data	Reflecting and transfering	
Financial content	Representing	
	Communicating	
	Using technology	

It is seen that the reflections of the interaction are limited in mathematics education although mathematical knowledge and skills are used intensely in finance (Sole, 2017). However, it is seen that some countries such as Canada (Ontario) integrated FL into mathematics education (Ministry of Education of Ontario, 2010). From this point of view, the educational studies that deal with both fields are considered as valuable (Dituri et al. 2019; Sawatzki, 2017). Sole (2014) examined mathematics curriculums in the United States from the perspective of FL and stated that they had common cognitive skills which fed both literacy competencies. A similar study was carried through in Turkey. It is found out that the relationships were too weak and there was no consciousness about FL (Ozkale and Ozdemir Erdogan, 2017).

The aim of this study is to offer an onset of financial literacy tasks for the basic level mathematics courses carried out in the 11th and 12th grades in Turkey. As mentioned in the introduction, although FL is an important qualification, it has not sufficient status in the education systems of numerous countries including Turkey. On the other hand, there are very few studies about the interaction between mathematics education and FL despite the potential.

The study shines out in the field through some features. First, financial literacy studies in mathematics education generally focus on learning processes at elementary and secondary school (Blue, O'Brien, and Makar, 2018; Dituri et. al, 2019) along with evaluating the financial literacy level of university students (Sole, 2014; 2017). However, the study focuses on the basic level in upper secondary education, which is the most frequently related to real-life as well as the most intense relationship with financial literacy among the mathematics curriculums applied in Turkey (Ozkale and Ozdemir Erdogan, 2017). Second, while there is a tendency to evaluate mathematical contents in terms of financial literacy in similar studies, in this study mathematical contents are tried to be enriched with financial competencies. Another important point is that this study is not based solely on mathematical content or financial literacy skills, but uses common processes of mathematical and financial literacies. From this point, this study presents a sample for interaction tasks for mathematics education and financial literacy along with their design dynamics. The study may reveal that financial literacy education can be applied in mathematics courses. Also, it can be interested because it handles the interaction in a different part of a mathematics curriculum of Turkey that has more relationships with real-life.

2. Method

The study seeks to shed light on designing financial literacy tasks for mathematics lessons. For this reason, document creation methods are used (Leung and Bolite Frant, 2015). In this respect, the main dynamics of the study are (1) the basic level mathematics curriculum of Turkey and (2) task design parameters. In methods, it was indicated briefly these dynamics along with other considerations which were in the circle of the design. The circle was indicated in Figure 1. The basic level mathematics curriculum designed for the 11th and 12th grades aims to enable mathematics to take an active role in students' daily life and work experience after high school and to use mathematics as a good analysis tool in their decisions (Ministry of National Education of Turkey

[MEB], 2017a). About the implementation of the curriculum, it is stated that teachers should concentrate on process-oriented course design plans, real-life context, and communication skills of students.

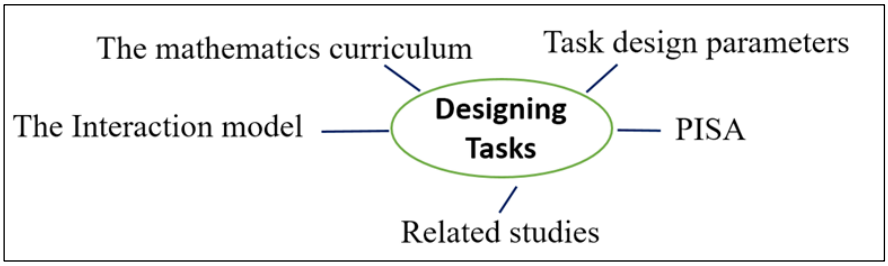

Figure 1. The dynamics of the tasks

The statements about these learning outcomes about FL were presented in Table 2 (Ozkale and Ozdemir Erdogan, 2017).

Table 1. The relationships on financial literacy in basic level mathematics curriculums of Turkey

		Learning area: Numbers and Algebra
Type: Basic Mathematics Curriculum	Grade 11	Learning outcomes • Make and progress a budget considering all members of the family and their needs. • Solve problems about the concept of percent and ratio. • Make an approximate cost analysis for a travel.
	Grade 12*	*There is no relation to FL in Grade 12

In the learning area of numbers and algebra, the focus is mainly on skills in providing information and conclusion development, budgeting and continuity of basic financial concepts such as shopping, currency, investment opportunities and taxation. In this chapter of the curriculum, it is seen that students are encouraged to actively use the skills of *comparing, relating and manipulating*. The tasks are aimed at the contents and learning outcomes of the current basic level mathematics curriculum of Turkey. Also, it is considered that the general objectives and fundamental approach of the curriculum and implementation possibilities in the classroom environment.

A task refers to directions their attention to specific aspects of knowledge and by remarking ways of processes. Tasks draw the paths of both knowledge and answer students need (Doyle, 1992). Secondly, it is important to say that in the design, some parameters which are the fundamental instructional task design parameters are considered (Doyle, 1992; Swan, 2007; Ozmantar and Bingolbali, 2009; Watson, 2016). These parameters are limited in the study with the following: *the purpose of tasks, implementation criteria (duration, instruction strategies etc.), students' pre-learning, the role of students and teacher, tools, misconceptions and difficulties.*

In the design, the learning outcomes in the curriculum played a role in determining the purpose of tasks along with the relevant financial expectations. In the designing of the tasks, it was aimed to provide discussions on possible misconceptions. Proper duration, teaching strategies and learning tools for each question were determined taking into account the concept's structure and grade levels. In the preparation of the tasks, it was taken into consideration that students should have built new knowledge on their pre-learnings. In addition, in each task, instructions for teachers and their limitations as well as the roles regarding student participation were detailed. The reflections of the parameters were detailed in the overview of the tasks and were discussed with other dynamics in conclusion, discussion and suggestions.

Although the mathematics curriculums of Turkey doesn't have any intention or emphasis on FL, this study tried to catch relationships according to some studies. One of them is the PISA documents on FL including not only a basic framework of FL but also information about what basic financial concepts are (OECD, 2020). Second, the design was examined according to the model considering the interaction between mathematical and financial literacies including contents, cognitive process skills and financial contexts (Ozkale and Ozdemir Erdogan, 2020). *Manipulating, reasoning, comparing, communicating and using technology* are some of the process skills. Third, similar studies on FL tasks in the mathematics courses were considered (Sawatzki, 2017; Yeo, 2016). Two tasks in the study were indicated with their images including the questions, then it was expressed how they were designed. In the discussion, the background of the design was handled with the circle related to the integration.

The tasks were peer-reviewed by three experts. The tasks were analyzed by the first from the field of mathematics education in terms of the curriculum and common processes, the second from the field of finance in terms of financial literacy competencies, and the third one from the field of instructional design in terms of task design parameters. With their feedbacks, the tasks were finalized.

3. Designing of the Tasks

3.1. Task 1. The Budget of Family Yılmaz and Their Needs

The family Yılmaz had a meeting about the needs of both the whole family and each member. Cem (father) and Ceyda (mother) work as a teacher and they have income. Kerem and Melek, the children of this family, receive monthly pocket money from their parents. Total income is used together in the family and Ceyda sets a budget showing income and outgoings balances monthly and annually. Also, outgoings made in a particular season are in the budget such as heating cost or taxes. The overall view to the budget is in Figure 2.

	Needs	Price
Family Yılmaz	A new television	5000
Ceyda	Roof of kitchen	1250
Cem	Watch	480
Melek	Computer	5500
Kerem	Game box	4800

May'21

salary of Ceyda	4800
salary of Cem	4800
Total income	9600
grocery	1600
apartment fees	200
credit of the house	3600
bills total	370
communication fees	170
pocket money (Ceyda)	400
pocket money (Cem)	400
pocket money (Melek)	200
pocket money (Kerem)	200
insurance	320
dining out	350
mall	1000
oil	400
Total outgoing	9210
Income-outgoing	390

Annual payments	
taxes	5000
holiday	8000
heating cost	3000

Seasonal incomes	
additional income (Cem)	
4 moths - per a month	800

Figure 2. The overview the budget of the family Yılmaz

According to the statements, fulfil the following tasks designed to supply these needs through savings at the end of the year.

(a) You see a monthly budget for May. Set the budget on a spreadsheet for a whole year.

(b) Display total outlook for annual of monthly fixed income-outgoings and seasonal income-outgoings in a spreadsheet environment.

(c) Arrange the annual budget with proper cuts in order to get some of the needs, and explain the rationales.

(d) Clarify which needs you prefer with the cuts and why you prefer them.

3.2. Task 2. The Ireland Travel

Professor Hale travelled to Ireland from Turkey for an international congress. For this trip, the needed spending and allowance via Turkish Lira (₺) and Euro (€) are shown in Figure 3. Professor Hale paid for the flight and the visa fee before leaving Turkey. She flew to Ireland with an estimated amount of € 1500 for her spending. According to statements and additional information about allowance and visa fee, perform the following tasks.

(a) Make a time schedule for the spending to be made on this journey.

(b) How much was Professor Hale's total spending as Turkish Lira?

(c) The allowance was given as Turkish Lira. The ratio of €/₺ is 9.85 before the trip. After the travel, this ratio was 10.25. During this time, how many per cent did the parity change? Note the direction, and explain the money situation of Professor Hale affected from the exchange rate.

Flight ticket(round trip)*	1280	₺	Accommodation	400	€
Registration fee	300	€	Meal and other needs	200	€
Allowance**	8000	₺	for gifts	150	€

** Ireland requires visa application for Turkish people. The application fee for the visa is 70 €.*

*** The allowance will be paid after the travel.*

Figure 3. The planned spending of Professor Hale for travel

4. The Overview of Tasks

Task 1, which was designed as a lesson duration (45 minutes), is presented to the students on a paper. For this reason, students should first make budget arrangements in their spreadsheets. Secondly, the teacher recommends students to use multiple worksheets to make many practices. The teacher gives feedback in order that the students can correctly express their works in the environment of spreadsheet and paper. The teacher states that there is not a single correct outcome of the task to the students. So, they are encouraged to work together. At the end of the task, the products produced by the students are evaluated together in the classroom. Once students fix their mistakes, they are expected to share their work in social networks and to express the next lesson feedbacks in the classroom.

In the design of Task 1, it is focused that the learning outcome of "Make budget and progress considering members of a family, and their needs" (MEB, 2017a p. 48). The questions of the task and their instructions are clear. The task, having intensely arithmetic skills, gives opportunities to manipulate for students to use in the design of the budget. Secondly, the task focuses on setting priorities that is a skill of FL (Schuchardt et al., 2009). It requires the skill of reasoning for the arrangement. Students decide which need is the most important or which needs are reasonable and priority. Thirdly, the task contributes to developing the skill of communicating of students such as organizing their tasks with together and in both a spreadsheet and a paper, participating in class discussions, sharing their tasks and considering the feedback. The working as a group mentioned in task promotes the communication skill as well. In the arrangement of Task 1, a problem was devised on the based on the use of a spreadsheet that referred to the view of the curriculum on *technology utilization*. Also, in the task, using a spreadsheet is preferred instead of a calculator. In this way, not only students' skills in using technology can increase but also they can perform more transactions in less time and less effort. Teachers have a role of a guide. Besides they should help students fix their spreadsheet organizing. The students are asked to explain their reasons for reducing spending such as pocket money or dining out. In this way, it is aimed to discuss not only financial and mathematical processes but also social concepts such as *positive discrimination, the necessity for demands, equality or domestic democracy* (Lucey et al., 2015). One of the expected issues is that students may have difficulty with spreadsheet activities. Especially, dragging and generating dynamic cells are very important for the task (Mays, 2015). For this reason, the teacher should give knowledge and guide. Finally, students should be focused to make a budget, so teachers should care for students not to be demoralized when they make mistakes on the spreadsheet. It is also expected that students can make and follow up a budget, interpret it holistically through the four instructions in the task. Students should have the main skills in the spreadsheet before the task. All the financial concepts that mentioned in the task are ordinary for students of grade 11 in everyday life. The students which can make reasonable manipulations and explain their options are successful. In the task, the students which use irrational values should be cautioned. As mentioned before, teachers should provide flexibility about manipulating for students. So, students are free as they manipulate the budget.

In Task 2, a problem was devised based on travel plans and currency changes (MEB, 2017a p. 49). It emphasizes that students should feel that travel planning, adults often do it, should consider spending time and money (Sole, 2017). Secondly, the task has opportunities for students such as comparing the currencies of countries, realizing the value of their currency and thinking about the importance of the value of money in an abroad travel. It also shows how to make currency conversions mutual. The teacher is a guide for students to prepare the schedule and is an evaluator for exchange transactions as well. However, teachers shouldn't force students to make a fixed plan, various plans should be evaluated together and they lead students to follow up the changes in the rates and to calculate parity (Swan, 2007). Teachers express that students can use a calculator. Then, students are asked to record their explanations and results on a paper. One of the expected difficulties is that students make mistakes in the exchange of currency. This issue can be fixed through the question of teacher that "which currency is more valuable?" For this task, students should be close to the concepts of currency and

allowance. Also, they should be familiar to use the concept of per cent and other ratios. Even if there are different ways for the plan, the correct answer emerges in the calculations. For this reason, the students can glance at other students' paper to control their papers. It is expected that students focus on the value of the currencies. So they should touch it in their explanations. It is important that students clarify accurately in their paper how the professor is effected by the exchange. Even if students cannot prepare the right schedule, they should be allowed to think about her loss in the exchange.

5. Conclusion, Discussion and Recommendations

The tasks are a basis for similar patterns. When examining Task 1 in terms of the task design parameters, it reflects clearly its aim referred to learning outcome in the curriculum. Task 1 was designed to use technology through spreadsheets. This provides students' workloads to reduce and students to reason. The students have active roles and rich interactions with the spreadsheet. The teachers are guides for the students, they help students to solve troubles about the implementation. Also, it can be said that Task 1 has a flexible structure as well as precautions for misconceptions or other difficulties. In terms of the curriculum, instructions of Task 1 overlap with the learning outcomes of the curriculum. In a similar example in the book used in schools, the fee of products and services are interpreted, but it has not manipulations on changing of the products and total amounts (MEB, 2017b, p. 136). However, in Task 1, the manipulations and students' reasons are more determinative. Also, using the spreadsheets and social media for teaching and learning support to one of the main parameters of the curriculums stated as "the information and communication technologies should be used in the teaching and learning process" (MEB, 2017a, p. 4).

As Task 2 is examined in terms of the task design parameters, it focuses on what means of the values which emerge after the calculations. From this point, it can be said that it reflects the principle that the aim should be noticed clearly. In the explanations of the task, the reasons for using a calculator, the roles of the teachers and the pre-learning of the students are detailed. Besides, the difficulties for the students are seen as an opportunity for students to compare the values of the currencies. Task 2 focuses on one of the learning outcomes of the curriculum as well. There are examples intended for trip planning both domestic and abroad in the book (MEB, 2017b, p. 49). But the directions to currency exchange in this task reflect real-life situations better.

Task 1 focuses on both the skill of setting a budget as a fundamental skill of FL and the skill of acting consciously about needs and purchasing power. It also considers some universal values such as the structure of family and democracy (Ministry of Education of Ontario, 2010; Sawatzki, 2017). In the tasks, some of the common skills, *manipulating, comparing, using technology, communicating* stand out. (Ozkale and Ozdemir Erdogan, 2020). It is seen that the design considers what skills mean. For instance, the skill of manipulating described as understanding and following of the changes was placed detailed in Task 1. Students are given the idea of what items might be on a budget, and at the same time, they are allowed to make changes to the budgets. It provides students to realize the mathematical structure following many changes. Also, the spreadsheet environment is utilized in this task. Thus, manipulations and other calculations are facilitated and student can view the budget as a whole (Geiger et al., 2015). It seems that sharing of students work on social media and the discussion of feedbacks in the class are important in terms of developing communicating skills. Also, the arrangements designed by students on the budget and their explanations to reason show that financial decisions include not only mathematical operations but also different dimensions such as needs, demands, and balances within the family. Task 1 includes financial planning and management, spending and saving as context as well as a lot of financial concepts such as budget, income and outgoings, along with a credit, insurance and tax. Thus, Task 1 reflects the financial contexts along with offers to students what they need in the near future (OECD, 2020).

Task 2 is an example for understanding the financial situation about time, cost and spend planning for a journey. The processes on comparison and conversion of currencies aim to gain financial awareness about the value of a currency to students (Duveen, 2013). The focus point of the task is to detail the financial situation of travel planning and currency rather than calculations. For this reason, the use of calculators can ease to focus on the problem. In many countries which have less valued currency such as Turkey, people are used to saving their money as foreign currency like Euro. For this reason, comparing and converting in currencies are important for all people from young ages (OECD, 2016). The money conversions in this task can contribute to students in terms of FL skills.

Regarding the related studies, the tasks of Yeo (2016), using a matrix consisting of financial skills mathematical contents and strategies, directed students to solve financial problems through mathematical knowledge and strategies. However, our tasks considered task design parameters as well as used both financial and mathematical skills together. Sawatzki (2017) and Dituri et al. (2019) have implementation phases and positive result to FL tasks. So, they have results on the progress of students. For this reason, we should go ahead towards the implementation phase to measure the effect of the tasks. However, if we look at another perspective,

our tasks were designed according to the learning outcomes to apply without interfering the curriculum. This can lead to applying the tasks in schools in a wide range, unlike a specified restricted study.

As the tasks are examined in terms of PISA, the tasks consider identifying financial situations like PISA. Also, this study used similar questions to PISA to reflect simple manipulating processes to the tasks for the proper options (OECD, 2013; 2020). While PISA exams are executed in a limited environment, the tasks are more flexible. So, the tasks can provide classroom interactions and communication process more effectively.

In this study, only the relationships in the curriculum were considered. But new relationships between financial concepts and learning outcomes also can be designed. For example, a task can be designed in the context of painting a wall in the learning area of geometry (OECD, 2016).

It is a major lack that there are no initiatives on financial literacy education in Turkey while many countries have carried out initiatives and practices on it. The integration of FL into mathematics education can inspire that not only the context circle of mathematics education enrich but also students use their knowledge and skills to make financial decisions effectively. In this respect, integrating of FL into mathematics curriculums is seen as a useful study. This study just lights on the integration of mathematics courses. As a next step for the study, it is aimed to design tasks for all grades of mathematics courses. Also, it needs to apply them in classes.

As a conclusion, it is thought that these studies on financial literacy education in Turkey would reverberate positively on students' real-life skills. However, these are little steps for financial literacy education when comparing to other countries. So, Turkey needs significant initiatives for this integration. In this area, it is first proposed a curriculum study on separate FL course, and an integration study of FL into mathematics curriculums. The examination of the result of the integration along with teaching and learning documents for the integration will be valuable studies after the initiatives.

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