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Introduction

This document provides the overview of the literature review covering the financial literacy concept (see section 1) and its development over time through different financial literacy measurement instruments (see section 2). It also provides an overview of instruments used in various countries regularly and instruments used in academic papers (see sections 3.1 and 3.2., respectively). The main takeaways from the reviews and related analysis are provided in section 3.3.

1. Financial Literacy Concept

The first definitions of financial literacy tended to focus on the level of financial knowledge (Hung et al., 2009). Since 2010, the term **financial literacy** has often been used interchangeably with **financial capability**. Allegedly, initially, the financial literacy term was used in North America and financial capability in Britain (Goyal & Kumar, 2021). The national reports indicate that the term “capability” has been more popular in the UK, Canada and the US. Very often, the definition of financial capability is the following: *“Financial Capability is a person’s ability to manage money well, both day to day and through significant life events, and to handle periods of financial difficulty”* (Financial Capability in the UK 2015 - Initial results from the 2015 UK Financial Capability Survey, 2015). Australia and New Zealand created instruments with roots in the UK tradition. However, they continued to call these financial literacy instruments.

To date, some authors continue to argue that financial literacy refers only to financial knowledge and financial capability goes beyond financial knowledge encompassing behaviour, with some authors also connecting it with access to financial products (Goyal & Kumar, 2021). In reality, many recent instruments that go beyond financial knowledge are called financial literacy instruments. Interestingly, the financial literacy term was also preferred by OECD even though one of the authors of the first version of the OECD INFE survey, Atkinson, had been involved in creating a financial capability instrument for the UK (Atkinson et al., 2007) that was also an essential basis for the OECD instrument (Atkinson & Messy, 2011). Kempson and Poppe (2017) claim that already in 2010, the OECD Expert Subgroup on the Measurement of Financial Literacy took a position that “financial literacy” and “financial capability” could be used interchangeably. Many authors have followed suit, treating these terms as synonyms (Goyal & Kumar, 2021).

OECD’s official definition for financial literacy that is used as a basis in the OECD INFE survey: “a combination of financial awareness, knowledge, skills, attitudes and behaviours necessary to **make sound financial decisions** and ultimately **achieve individual financial well-being**” (OECD) In reality, the **OECD INFE** survey instrument focuses on the three elements of the five: **knowledge, attitudes and behaviour** (OECD, 2022). The same three elements were outstanding in the conceptual financial literacy model of Goyal and Kumar (2021) developed based on a systematic literature review of 502 articles from 2000 to 2019. Still, as claimed by de Clercq (2019), the OECD INFE survey’s measurement of financial knowledge construct has a limited scope. This can be partly explained by the OECD instrument’s aim to provide cross-country comparability.

The five main components of the OECD definition of financial literacy are often used by different researchers when attempting to conceptualise financial literacy. Kempson et al. (2005) focused on the concept of financial capability that contained four components: knowledge and understanding (equivalent to OECD’s knowledge and awareness); skills; confidence and attitudes (equivalent to OECD attitude); and behaviour. Based on the work of FSA and the Basic Skills Agency in the UK, they also

provided a precise mapping of the associations between the financial literacy components and their links with experience and circumstances as well as personality (see Figure 1 below). This framework was the basis for the construction of the UK financial capability instrument (Kempson et al., 2005) and related questionnaire (Kempson & Collard, 2006) that were later used as a basis for Australian ANZ Adult Financial Literacy Survey (ANZ, 2011), Irish Financial Capability Survey (*Financial Capability and Well-being in Ireland in 2018*, 2018), Canadian Financial Capability Survey (*Initial Findings from the 2009 Canadian Financial Capability Survey*, 2010) and in modified form were applied in OECD INFE framework (Atkinson & Messy, 2011).

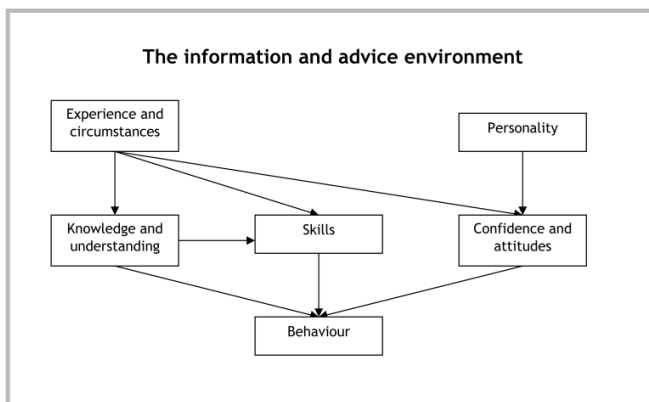


Figure 1. Financial capability framework (Kempson et al., 2005, p. 2)

The review by Remund (2010) covering financial literacy definitions of over 100 academic and professional sources from 2000 distinguished five financial literacy categories: knowledge of financial concepts; ability to communicate about financial concepts (refers to broader application of knowledge and is equivalent to awareness); skill in making appropriate financial decisions; confidence in planning effectively for future financial needs (equivalent to attitude); and aptitude in managing personal finances (referring to the ability to perform money-related tasks equivalent to behaviour). Huston (2010) concluded that the financial literacy concepts should include a knowledge dimension (knowledge acquired through education and/or experience) and an application dimension (ability and confidence to apply knowledge). This indicates that Huston’s definition disregards comprehension and puts three components into one. A pretty similar approach is introduced in Zait and Berteau (2014) who distinguish comprehension (covers knowledge and financial communication) and usage in practice dimensions of financial literacy (including ability, confidence and behaviour).

Considering the strong support for the five financial literacy components, we use the modified OECD conceptualisation, as depicted in Figure 2, as a basis of our investigation.

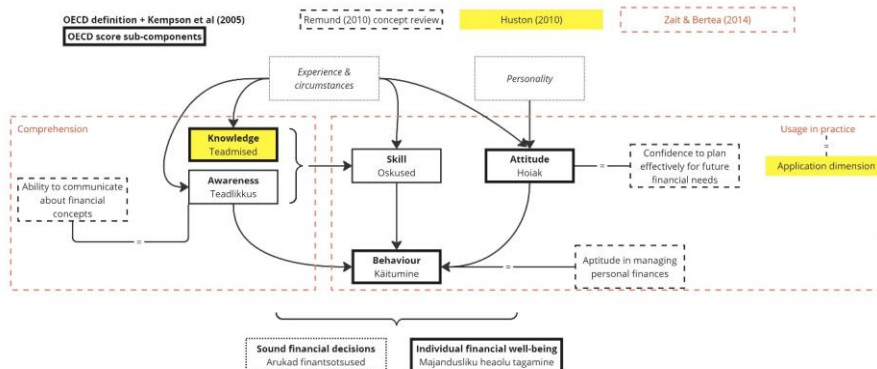


Figure 2. Our financial literacy concept

The five components can be interpreted as follows:

1. **Financial knowledge** – understanding of financial concepts needed for everyday functioning (Bowen, 2002). In some instruments, authors distinguish basic (e.g., inflation, compound interest) and advanced financial knowledge (e.g., risk diversification). We consider only basic financial knowledge. It can also be separated into objective (what the person knows) and subjective knowledge (what the person thinks he knows).
2. **Financial awareness** – a person’s ongoing consciousness of their financial situation and the external conditions (Abdallah et al., 2024).
3. **Financial skill** – numerical and cognitive abilities to manage finances effectively (Lone & Bhat, 2024). It is about applying knowledge and awareness (understanding) to gather financial information, keep records, and plan finances (save, spend, budget) (Kempson et al., 2005). It can encompass emotional, cognitive and behavioural skills (The Money Advice Service, 2013) In some instruments, skill and competence are used together (*Initial Findings from the 2009 Canadian Financial Capability Survey, 2010*).
4. **Financial attitude** – “the learner’s combination of concepts, information and emotions about learning that results in a predisposition to respond favorably” (Shockey, 2002, p. 39) Kempson et al. (2005) view this aspect as “**confidence and attitude**”, referring to the willingness to apply knowledge and skills, the ability to access information and the confidence to exercise their skills. It can be considered an expression of beliefs and values that are impacted by social norms (The Money Advice Service, 2013). In financial well-being models, it is sometimes titled as “**psychological factors**” composed of financial confidence, attitudes, locus of control, time orientation, impulsivity, social status, action orientation and self-control (*Financial well-being in Canada - Survey results, 2019*), or “**personality and attitudes**” (CFPB, 2017).
5. **Financial behaviour** – “Financial behaviour can be defined as any human behaviour that is relevant to money management” (Xiao, 2008, p. 70), including cash, credit, and saving behaviours. UK Financial Capability Survey 2018 distinguished two main types of behaviours – day-to-day and planning for life events. (*Financial capability in the UK: Results from the 2018 survey of adults, 2018*)

Different other conceptualisations of financial literacy add further components to the proposed model or merge some components. Added components include:

- **“Motivation”** as a way of thinking, covering reflective (conscious) and automatic (unconscious) mechanisms that affect behaviour, included in the financial capability tracker in the UK (The Money Advice Service, 2013).
- The “Financial responsibility” dimension refers to the ability to understand the impact of financial behaviour, sources of advice, and guidance, which are included in the Canadian Financial Capability survey. (*Initial Findings from the 2009 Canadian Financial Capability Survey*, 2010).
- **“Opportunity”**, referring to external factors that affect people’s behaviour, included in the financial capability tracker in the UK (The Money Advice Service, 2013). In the UK Financial Capability Survey 2015 and 2018, a similar aspect influencing behaviour was covered under the title “Connection”, which covered ease and accessibility dimensions and was considered capturing **“enablers and inhibitors”**. (*Financial Capability in the UK 2015 - Initial results from the 2015 UK Financial Capability Survey*, 2015; *Financial capability in the UK: Results from the 2018 survey of adults*, 2018) The US financial well-being model similarly considers the **“available opportunities”** referring to the options available (CFPB, 2017).
- **“Social and economic environment”** drives all financial literacy components and financial well-being in financial well-being models based on Kempson and Poppe (2017) and (CFPB, 2017) . In Canadian financial well-being models, these were separated into **economic factors** (income, home ownership, income to mortgage ratio, work status, income drop, income increase, expenditure drop, expenditure increase, university degree, region) and **social factors** (gender, age, in a coupled relationship, children under 18, financial help available from friends and family, parental impact on financial decisions, recent immigrant) (*Financial well-being in Canada - Survey results*, 2019).

Merged components include:

- **“Knowledge and understanding”** combining “awareness” and “knowledge” as the same construct. For example Kempson et al. (2005) treat it together, being formed through experience, education, family and friends or media. In their view, it covers different types of money and payments, income generation, income disposal, concepts of risk, inflation and probability, financial products and institutions (including information and advice sources).
- **“Knowledge, skills and experience”** puts the knowledge, skills and awareness dimensions into one in most financial well-being models based on Kempson and Poppe (2017).
- In the UK Financial Capability Survey 2015, the skills and knowledge components were merged into the **“abilities”** component (*Financial Capability in the UK 2015 - Initial results from the 2015 UK Financial Capability Survey*, 2015).
- Attitudes together with motivation can be treated as **“mindset”** (*Financial Capability in the UK 2015 - Initial results from the 2015 UK Financial Capability Survey*, 2015).

Self-efficacy can be considered as one sub-component of “attitude”, as in (ANZ, 2015). However, it is also possible to consider that it affects all five components, with people having greater self-efficacy and being more willing to update their knowledge (Robb & Chy, 2023), having more confident attitudes (Lone & Bhat, 2024), being more aware of their financial situation (Dare et al., 2023), being more willing to improve their skills (Robb & Chy, 2023) and being more likely to engage in positive financial behaviours (Dare et al., 2023).

Some authors distinguish basic financial literacy, referring to the competencies that are adequate for everyday financial decision-making, and advanced financial literacy, referring to competencies that go beyond everyday financial decisions (van Rooij et al., 2011b). The OECD INFE instrument focuses on

basic financial literacy (Schuhen et al., 2022). Many authors' definitions of financial literacy refer to the basic understanding of financial concepts (Goyal & Kumar, 2021; Hung et al., 2009).

2. Development of financial literacy concept over time

The literature review indicates that the historical development of the financial literacy concept has followed different schools of thought, which are summarised below. As these developments are also reflected in how survey instruments are designed, it is important to distinguish between them. A detailed discussion of schools of thought follows. The graphical summary of the schools of thought with respect to key financial literacy concept components is depicted in Appendix 1. Still, it is important to note that while the distinction between normative cognitive knowledge and positive/agnostic behaviour school is to some extent discussed in Holzmann et al. (2013) and Kempson and Poppe (2017), most academic papers and reports do not provide any links with the specific school of thought. Therefore, this synthesis should be taken as our conceptualisation based on the ideas from Holzmann et al. (2013) and Kempson and Poppe (2017), linked to the characteristics of financial literacy instruments emerging from the major national reports. Our overview of major national reports is provided in Appendix 2.

2.1. Financial knowledge school

Initially, financial literacy was viewed from the perspective of **financial knowledge**, with attention being paid to inflation, compound interest, applied numeracy, and the ability to read financial documents. The first attempts concentrated either on testing the knowledge of students (e.g. Jump\$tart, PISA financial literacy questions) or the testing of adults' knowledge occurred through a couple of questions included in more general consumer surveys (as in the US) or in surveys targeted at a specific group of people (e.g., people over 50 in the Health and Retirement Study in the US). The classical **Big3** questions were introduced in Health & Retirement Study in 2004 by Lusardi and Mitchell being expanded to **Big 5** in the National Capability Survey in 2009 (see Table 1). These questions were included in numerous studies, including the Netherlands, Japan, Germany, Chile, Mexico, Indonesia, and India (Hastings et al., 2013)(for questions, see the table below). These questions were based on the idea that saving and investment decisions in life cycle settings can be described by just 3 concepts – numeracy, understanding inflation and risk diversification – and such questions are simple, relevant, and capable of differentiation (Lusardi & Mitchell, 2014). Still, these questions have been criticised for not being ubiquitous (Knoll & Houts, 2012).

The two earliest general population financial literacy studies were Schagen and Lines (1996) in the US and Cutler (1997) in the UK, followed by financial literacy and financial knowledge surveys in Australia and New Zealand. Most instruments designed for this school of thought concentrate on the number of correct responses. The focus is on the improvement of knowledge by increasing the amount of available information.

Table 1. Big3 and Big5 financial literacy questions

Concept	Question	Answer options
Interest rates and compounding	Suppose you had \$100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?	<i>More than \$102</i> Exactly \$102 Less than \$102 Don't know Refused
Inflation	Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, would you be able to buy more than today, exactly the same as today, or less than today with the money in this account?	<i>More than today</i> Exactly the same as today <i>Less than today</i> Don't know Refused
Risk diversification	Do you think that the following statement is true or false: Buying a single company stock usually provides a safer return than a stock mutual fund?	<i>True</i> False Don't know Refused
Additional financial literacy questions in the 2009 NFCS		
Mortgages	Do you think that the following statement is true or false: A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest over the life of the loan will be less?	<i>True</i> False Don't know Refused
Bond pricing	If interest rates rise, what will typically happen to bond prices?	<i>They will rise</i> <i>They will fall</i> They will stay the same There is no relationship Don't know Refused

The answer categorized as correct is italicized in the last column.

(Hastings et al., 2013, p. 353)

The main theoretical underpinning for this school seems to be related to the **life-cycle theory** that was linked with financial literacy by Lusardi and Mitchell (2014). Life-cycle theory is an economics-based theory developed by Modigliani and Brumberg (1954) to capture how individuals plan their consumption and savings over their lifetime to maximise their utility. Financial literacy in this context is an investment in human capital that influences economic decision-making. The theoretical model Lusardi et al. (2017) also predicts that financial knowledge is the key determinant of wealth inequality.

2.2. Normative/cognitive knowledge school

According to Holzmann et al. (2013), in the normative/cognitive knowledge school of thought, **the basis** for achieving **desirable financial behaviour** (e.g., putting money into savings) is **knowledge** (e.g., the purpose of saving and how to do it) that is transformed into **skills** (e.g., capacity to prepare a savings plan) and thereafter **into attitudes** (e.g., willingness to save). In

this step-by-step process, the individual is assumed to be entirely rational, utility-maximizing and operating in complete financial markets. These assumptions are strong and create a situation where the enabling environment (e.g., access to finance) and individuals' behavioural limitations that cannot be changed through learning are not considered. In reality, poor financial behaviour can be driven by psychological factors (e.g., peer effects and non-cognitive drivers). This school of thought assumes that to tackle financial literacy issues; the policy should focus on improving knowledge and skills arising from lack of information and inducing learning through financial education to affect attitude and behaviour.

The financial literacy instruments following this school of thought concentrate on items related to financial knowledge while also considering, to some extent, attitude and behaviour. The best examples are the ANZ 2008 and 2009 studies in New Zealand and Australia and FILSA in Germany (ANZ-Retirement Commission, 2009; ANZ, 2008; Schuhen et al., 2022). The main difference from the positive/agnostic school is that the behaviour is not on the centre stage in these instruments.

2.3. Positive/agnostic behaviour school

According to Holzmann et al. (2013), positive/agnostic behaviour school of thought emerged in the UK with the creation of the first financial capability survey instrument (Kempson et al., 2005). This instrument was not developed through a theory. Instead, it resulted from a literature review and input from experts and ordinary people. The concept, as depicted in Figure 1, was taken from the process model that had been developed by the Basic Skills Agency and the FSA. It was followed with focus groups with ordinary individuals to explore their understanding of financial capability and identify ways to capture financial capability in the questionnaire (Kempson et al., 2005). The focus groups showed that people thought about financial capability mainly in behavioural terms – “what you do” is more important than “what you know” (Kempson & Poppe, 2017).

This school focuses on the outcome – **financial behaviour**. The initial financial capability model of Kempson et al. (2005) distinguished four main content domains within it: managing money, planning ahead, choosing products and staying informed. In the World Bank's financial literacy instrument (Kempson et al., 2013), the content domains were named: managing money, planning ahead, making choices and getting help. In this approach, the assessment of financial literacy focuses on the comparison of the actual outcome (behaviour) with the desired outcome (behaviour) and a similar comparison is done for knowledge, attitude and skill (Holzmann et al., 2013).

The advantage of this approach over the normative one is that it allows considering the impact of different social, psychological, and emotional factors (e.g. cognitive biases, hyperbolic discounting, procrastination, self-control, etc.) and enabling environment (e.g. available financial products) on the behaviour, and it remains more context-specific, as the same concepts, behaviours, skills and attitudes may not be relevant for all countries (Holzmann et al., 2013).

The biggest disadvantage of this approach is related to measurement difficulty, as behavioural factors can interfere with the application of knowledge and skills, and some capabilities are so strongly driven by external factors that they cannot be disentangled (Holzmann et al., 2013).

This approach became very popular with the Kempson et al. (2005) survey instrument being adopted, in addition to the UK (*Financial Capability in the UK 2015 - Initial results from the*

2015 UK Financial Capability Survey, 2015; The Money Advice Service, 2013), in Australia (ANZ, 2011, 2015), Canada (*Initial Findings from the 2009 Canadian Financial Capability Survey, 2010; Managing Money and Planning for the Future: Key Findings from the 2014 Canadian Financial Capability Survey, 2014*) and Ireland (O'Donnell & Keeney, 2009). The World Bank also used it as a basis for developing a survey instrument that could be used in medium and low-income countries (Kempson et al., 2013). In the US, the FINRA Financial Capability Surveys seem to be based on Atkinson's ideas (no real reference to the UK survey is made in the reports), and it is difficult to tell to what extent the Kempson et al. (2005) work, in which he also participated, was taken as a baseline. Still, Kempson and Poppe (2017) claim that the US FINRA 2009-2015 surveys were replications of Kempson et al. (2005). The first OECD INFE instrument, where Atkinson was active, was clearly based on ideas from Kempson et al. (2005). However, Holzmann et al. (2013) placed the OECD INFE 2010 instrument in between the normative/cognitive knowledge and positive/agnostic behaviour schools. One possible explanation is that the OECD instrument was not so clearly focused on behaviour despite covering in addition to knowledge also attitudes and behaviour and it had minimal consideration of psychological factors and the enabling environment.

In this school of thought, policy measures should focus on interventions designed to influence individuals' behaviour.

2.4. Financial well-being school

The financial well-being school emerged from the work by Elaine Kempson on financial capability. The emergence of this school can be related to behavioural economics, highlighting the discrepancies between the actual consumer behaviour and behaviour predicted by standard economic theory, stressing the relevance of **psychological factors as drivers of behaviour**. The attention was drawn to financial well-being due to the need to meet people's social protection needs, which are also linked to financial behaviour, knowledge, psychological factors and attitudes (Kempson & Poppe, 2017). Kempson and Poppe (2017, p. 19) defined **financial well-being** as "*The extent to which someone is able to meet all their current commitments and needs comfortably, and has the financial resilience to maintain this in the future.*" Kempson realised that the work done to prepare instruments in Kempson et al. (2005) and Kempson et al. (2013) contained much input on which types of people are considered financially capable. It indicated that financial well-being should be measured with objective measures instead of subjective measures proposed by the CFPB (2015) scale (see the questions in Table 2 below). **Table 2.** Financial well-being scale

Questions	Response Options
How well does this statement describe you or your situation?	
1. I could handle a major unexpected expense	<ul style="list-style-type: none"> • Completely • Very well • Somewhat • Very little • Not at all
2. I am securing my financial future	
3. Because of my money situation, I feel like I will never have the things I want in life*	
4. I can enjoy life because of the way I'm managing my money	
5. I am just getting by financially*	
6. I am concerned that the money I have or will save won't last*	
How often does this statement apply to you?	
7. Giving a gift for a wedding, birthday or other occasion would put a strain on my finances for the month*	<ul style="list-style-type: none"> • Always • Often • Sometimes • Rarely • Never
8. I have money left over at the end of the month	
9. I am behind with my finances*	
10. My finances control my life*	
* Denotes questions for which the response options are "reverse coded"	

(CFPB, 2015, p. 9)

Therefore, Kempson and Poppe (2017) developed their own financial well-being scale that combined objective measures from Kempson et al. (2013) and subjective measures from Prawitz et al. (2006) with the questions being presented in Table 3 below.

Table 3. Improved financial well-being scale

Questions used to create our financial well-being scale

1. How often do you run short of money for food or other regular expenses? (frequency scale)
2. How often you are overdrawn on your bank account? (frequency scale)
3. Which one of the following statements best describes how well you are able to pay your bills and credit commitments at the moment? (Without any difficulty; It is a struggle from time to time; It is a constant struggle)
4. In the past 12 months, how often have you been unable to pay bills or loan commitments at the final reminder due to lack of money? (frequency scale)
5. How often do you have any money left over after you have paid for food and other regular expenses? (frequency scale)
6. How would you describe your current financial situation? (a 5-point scale from very bad to very good)
7. How confident are you about your financial situation in the next 12 months? (5-point scale from not at all confident to very confident)
8. How in control of your finances do you feel you are? (5-point scale from very little/no control to totally in control)
9. If, tomorrow, you had to meet an unexpected expense that is equivalent to a month's income for your household, how much of it would you be able to cover from money you have available?
10. Would you need to borrow, overdraw your account or use a credit card to meet an unexpected expense of a month's income? (scale 'all of it; some of it; none of it)
11. If your income fell by a quarter, for how many months could you meet all your expenses without needing to borrow?
13. Thinking about the total income of your household how many month's income do you have in savings?

(Kempson & Poppe, 2017, p. 21)

The main aim of this school is to **investigate the association between financial well-being and financial literacy concept components**. Kempson developed a conceptual model that was based on the empirical input gathered when preparing Kempson et al. (2005), Kempson et al. (2013) and previous empirical studies and presented it in Kempson and Poppe (2017) (see the Figure 3 below). In this figure, the “behaviours” represent “financial capability” and “knowledge, skill and experience” refer to “financial literacy” in narrow terms or “financial knowledge”, and “psychological factors” refer to “attitudes”. The size of each box refers to the importance of factors, with the socioeconomic environment being the most important positive or negative determinant of financial well-being.

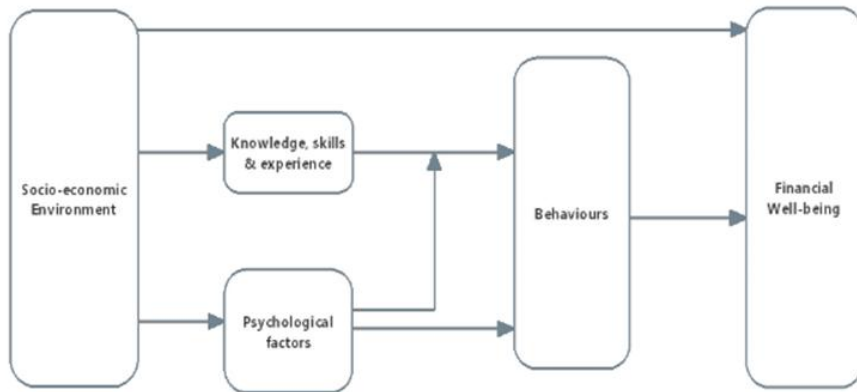


Figure 3: Financial well-being concept Kempson & Poppe

(Kempson & Poppe, 2017, p. 25)

It is similar to the financial well-being model of CFPB (see Figure 4 below), where available opportunities are added to mediate the impact of social and economic environment on well-being, and decision context is added alongside knowledge and psychological factors.



Figure 4: Financial well-being concept CFPB

(CFPB, 2017, p. 19)

Based on their conceptual model, Kempson and Poppe (2017) generated financial well-being measures alongside three sub-measures of financial well-being (meeting current financial commitments, feeling comfortable financially and having financial resilience for the future). The accompanying survey instrument became very popular in Australia, New Zealand, Canada and Ireland. It is also important to note that all the latest national financial literacy reports now carry the title “financial well-being”, reflecting the shift in thinking towards the final outcome of financial literacy (financial well-being). Some reports have used the slightly updated version

of Kempson’s work as a basis (see figure 5 below) that separates personality traits from attitudes and brings in additionally “financial confidence”, “financial locus of control” and specifies the contents of financial behaviours.

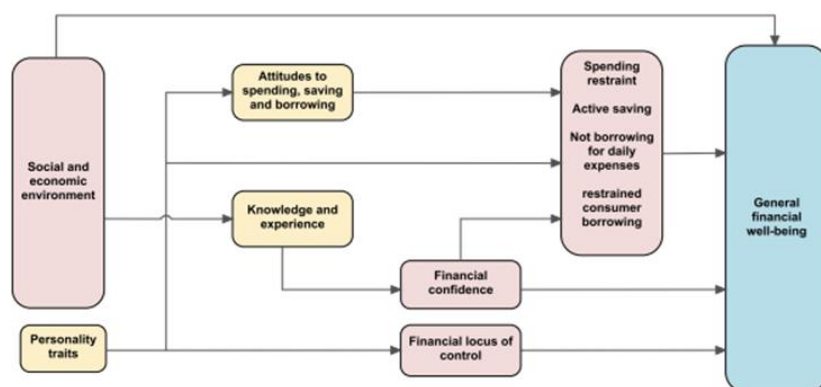


Figure 5: Updated financial well-being concept by Kempson & Poppe

(Kempson & Poppe, 2018a, p. 14)

On our map of financial literacy reports (see Appendix 1), we also distinguish **financial well-being 1.0** and **financial well-being 2.0**, with the latter referring to the conceptual thinking in line with (Kempson & Poppe, 2017). While financial well-being 1.0 captures the types of surveys that do map some aspects of financial well-being through survey questions, however, fails to buy into the financial well-being story completely, continuing to title the reports as “financial literacy” or “financial capability” (e.g., *Canadians and their money: Findings from the 2019 Canadian Financial Capability survey, 2019*; *Financial capability in the UK: Results from the 2018 survey of adults, 2018*). The instruments in financial well-being 1.0 contain most of the components listed for both normative/cognitive knowledge and positive/agnostic behaviour school. However, the linkages between these components differ depending on the approach of the specific report. OECD INFE report currently falls into the financial well-being 1.0 category, as the 2019/20 survey included for the first time five subjective financial well-being items from CFPB (2015) and the same questions were also used in the 2023 survey.

3. Overview of financial literacy instruments

One of the biggest obstacles in distinguishing different financial literacy instruments is the lack of information provided on their conceptual basis. Already the review of financial literacy measures by Huston (2010) indicated that from the reviewed 71 studies from 1996 to 2008, 72% did not include any definition of financial literacy, while 47% considered financial literacy and financial knowledge synonymous. We observed the continuation of this tendency in newer studies, with nearly half of the national financial literacy reports and academic papers failing to define the construct being measured.

We have separated the previous studies into two groups: national instruments and alternative instruments in academic papers. National instruments refer to those instruments that have

been used to generate national financial literacy reports at certain repeated intervals or that have been central to the development of different national instruments. In this group, we also cover the OECD INFE instrument's 2023 version. Alternative instruments refer to those that have been used in academic papers by researchers and lack regularity in their use.

3.1. Overview of national instruments

Our search for national instruments started in the UK, Australia and New Zealand that allegedly were using some tailor-made instruments instead of the OECD INFE instrument. While going through the instruments, it appeared that they had strong roots in instruments that could be considered groundbreaking due to their links with many different national reports. As seen in Appendix 2, the groundbreaking instruments identified include:

1. **the financial capability instrument Kempson et al. (2005)**
2. **a more universal instrument developed for and advocated by the World Bank** (Kempson et al., 2013) and
3. **financial well-being instrument introduced in Kempson and Poppe (2017) and modified in Kempson and Poppe (2018a).**
4. OECD INFE instrument's first version Atkinson and Messy (2011) and the CFPB (2015) The financial well-being scale can also be considered an important development; however, its application has remained more constrained to the OECD financial literacy mappings and the US.

The linkages were found between these instruments and also those national instruments used in Ireland, Canada, and the US (for details, see Appendix 2 & 3). Additional searches revealed some important measurements also in Germany (Schuhen et al., 2022; Schuhen & Schürkmann, 2014) and South Africa (Prawitz et al., 2006). In the process, we also identified some more specific instruments, e.g. Financial Behaviour Index used in New Zealand from 2011 to 2014 twice per year (example report [here](#)), Financial Capability Barometer used in New Zealand 2018-2019 (example report [here](#)), Financial Resilience Index by Financial Services Council in New Zealand (example report [here](#)), Australian Financial Attitudes and Behaviour Tracker issued between 2014-2018 every 6 months (example report [here](#)), ANZ Roy Morgan Financial Wellbeing Indicator Australia issued since 2019 every 6 months (example report [here](#)), TIAA Institute-GFLEC Personal Finance Index in the US issued annually from 2017 (example report [here](#)). As these indices, barometers, and trackers have, in some cases, ceased to exist by now, in others do not disclose details on their methodology and cannot be considered the most important instruments in the respective nation, we do not cover these in this analysis and do not provide them in the list in Appendix 3.

In this analysis, we cover 35 national instruments listed in Appendix 2 with the links to respective reports provided in Appendix 3. As almost half of these reports do not define the construct being measured and do not provide a complete list of survey questions, our overview remains subjective. When dividing specific survey instruments into schools of thought, we rely mainly on the references provided to the baseline instrument and the construct described in the report.

The instruments following the **knowledge school** assume that it can be easily determined what people should know, and then the instruments focus on these aspects' measurement (Kempson & Poppe, 2017). This list of reports in this group includes the first financial literacy

reports issued in Australia (ANZ, 2005; Roy Morgan Research, 2003), New Zealand (ANZ-Retirement Commission, 2005) and the US (Cutler, 1997).

The number of instruments that could be related to **normative/cognitive knowledge school** remained low, and only the ANZ surveys (ANZ-Retirement Commission, 2009; ANZ, 2008) were put into this category based on the detailed explanations provided by ANZ on the differences between different rounds of ANZ surveys provided in their latest reports.

The instruments following the **positive/agnostic behaviour school** tend to determine what needs to be measured empirically. They often find that no single measure of financial literacy exists. The behavioural questions use the scale from the least to most capable, and their aggregation is done through principal component analysis. For example, the Kempson et al. (2005) used factor analysis and Kempson et al. (2013) principal component analysis to develop the scores for discrete behaviours. In Kempson et al. (2013) these included budgeting/planning spending, monitoring finances, not overspending, living with ones means, making sure that unexpected expenses could be covered, savings, making informed financial decisions, choosing appropriate financial products, as well as core psychological factors (time-orientation, impulsivity and achievement orientation).

The instruments in the **financial well-being school** have a clear focus on financial well-being issues and the determinants of financial well-being.

Most national instruments, listed in Appendix 3, are prepared regularly and tend to have 3-year intervals (e.g., UK, US, Australia, New Zealand), except Canada has 5-year intervals. Ireland has had several rounds of country-specific instrument use earlier; however, their more recent measurements are based on OECD INFE. OECD INFE has a 4-year interval. The contents of the surveys vary significantly over time, with at least some minor modifications being made in every wave.

All more recent national instruments focus on people 18 or older, and the results remain nationally representative. The survey input is gathered mainly through phone or face-to-face interviews. Online surveys have been used in Norway (Kempson & Poppe, 2017, 2018a), in New Zealand (ANZ, 2018b, 2021b), in the latest Australian surveys (ANZ, 2018a, 2021a), in all US FINRA surveys since 2012, and one one-off Canadian financial well-being survey (*Financial well-being in Canada - Survey results*, 2019). The UK has used an online survey option occasionally and then in combination with the paper version (*Adult Financial Wellbeing Survey 2021 Technical Report*, 2021) or face-to-face interviews (*Financial capability in the UK: Results from the 2018 survey of adults*, 2018).

The length of the questionnaire varies, with most surveys based on Kempson’s work tending to contain over 100 questions. OECD INFE 2023 included 53 questions.

The characteristics of the baseline national instruments marked with a red border in Appendix 2 are presented with FINRA from the US in **Table 4**. Although the surveys share similarities regarding the targeted respondents, representativeness and weak theoretical basis, the questionnaires are very different in terms of structure, length and contents.

Table 4. Main characteristics of OECD and baseline national financial literacy instruments

	OECD INFE 2023 (OECD, 2023)	Kempson and Collard (2006)	WB - Kempson et al. (2013)	Kempson and Poppe (2017)	FINRA (2022)
Respondents’ age (years)	18-79	18+	18+	18+	18+

	OECD INFE 2023 (OECD, 2023)	Kempson and Collard (2006)	WB - Kempson et al. (2013)	Kempson and Poppe (2017)	FINRA (2022)
Nationally representative	yes	yes	yes	yes	Yes
Theoretical concept	weak	weak	weak	weak	weak
Questionnaire sections	6 sections: demographics, financial, products, attitudes & behaviour, knowledge, background	13 main sections: personal info, money man., planning ahead, making choices, mortgages, protection, savings, investments, credit cards, loans, getting help, money quiz, final demogr. + 7 recent purchase sections	Household information + 7 financial capability sections + 7 optional financial literacy sections	7 sections: opening module, day-to-day money management, planning, choosing products, roles, motivation, background variables	11 sections: demographics, fin. attitudes & behaviours, banking, retirement accounts, home & mortgages, wealth & income inequality, credit cards, other debt, insurance, self-assessment & literacy, additional classification
No. of questions	53	451	231	95	93
No. of questions obligatory to every respondent	53 (100%)	157 (35%)	145 (63%)	70 (74%)	71 (76%)
No. of Yes/no questions	4 (8%)	112 (25%)	67 (29%)	10 (11%)	35 (37%)
No. of knowledge questions	7 (13%) (incl 1 with y/n options, 5 in final score)	7 (2%) (money quiz)	5 (2%) (fin. lit. optional section 1)	10 (11%) subjective knowledge	11 (12%)
No. of other questions	5 attitude + 21 beh., incl in 2 attitude, 9 behav., 5 wellbeing score	? The authors provide no clear distinction	? The authors provide no clear distinction	20 behav & attitude, 3 psych. factors, 11 wellbeing	20 attitudes & behaviour, 7 wellbeing
No. of approximate claims for other	17 attitude, 49 behav.	13 attitude,	28 attitude,	32 attitude, 9 behav.	3 attitude, 44 behav.
Data collection	Face-to-face or phone interview	Face-to-face or phone interview	Face-to-face or phone interview	Online survey	Online survey
Clear distinction of concept attributes	yes	no	no	To some extent	Poor (only structure)
Aggregation	Total financial literacy score & sub-scores for knowledge, attitude, behaviour + digital financial literacy score & sub-scores	4 scores, separate for each domain (managing money, planning ahead, choosing products, staying informed)	10 separate scores (see below)	several separate scores	None
Quality of the survey, order best (1) to the worst (5)	1	4	5	3	2
Approximate number of national surveys using it as a basis	NA	8 in 4 countries (incl 3 in the UK where it was developed)	NA	10 in 5 countries (incl 2 in Norway, where it was developed)	1 US

Source: authors

Kempson and Collard (2006) instrument that was the basis for the first Financial Capability Survey in the UK (Kempson et al., 2005) Remains the longest and the most detailed of selected surveys, with much attention being paid to different financial activities of households, including the most recent purchase decisions concerning mortgages, insurance, savings, investments, credit cards, loans, and current accounts along with specific sections concerning disputes with financial companies, shops or suppliers, benefits or pensions. A total of 451 questions emerged due to the strange setup of the questionnaire that involves a lot of yes/no starting questions (25% of all questions) followed by more

specific questions. This creates a situation where many responses to this survey are not very useful for forming aggregate indicators as the questions have varying amounts of responses. The authors go very deep with the discussion of products (e.g., amounts of loans, number of loans held by the respondent) and at times, it creates a feeling that the aim was not to measure financial literacy/capability but to get an overview for banks on the behaviour of their customers or the survey investigates consumer behaviour.

In terms of aggregation of survey responses, a separate **measure of financial capability** was generated **for each domain** (managing money, planning ahead, choosing products, staying informed) using factor analysis with managing money having two scores, and these factor scores were then investigated through their distributions (Atkinson et al., 2007). A single score was not created as the multi-faceted nature of the concept did not allow the reduction. It does appear that the later iterations, applying modifications to the Kempson and Collard (2006) instrument in the UK involved a somewhat different aggregation approach. In 2015 report it involved the calculation of scores based on selected claims for each of the three core behaviours and each of the five financial capability factors (skills and knowledge; attitudes and motivations to the future; attitudes and motivations – confidence and self-efficacy; attitudes and motivations – responsibility; ease and accessibility) and these scores were used to generate bubble charts where the differences of specific population groups from the overall average were shown (*Financial Capability in the UK 2015 - Initial results from the 2015 UK Financial Capability Survey, 2015*). In the 2018 report, the components were derived directly from the structural coefficients (factor loadings) from principal component analysis and to aid the interpretation of the final components scores and enable comparisons across components, the components were rescaled onto a scale from 0 (not at all capable) to 10 (highly capable) (*Financial capability in the UK: Results from the 2018 survey of adults, 2018*).

Kempson and Poppe (2017) instrument, developed in Norway, appears to be the best of Kempson's work as the survey is of more reasonable length, has fewer yes/no questions, and is accompanied by some information on how the questionnaire matches their concept. Still, it should be noted that the survey questionnaire was not complete, with background questions for our review taken from Kempson and Poppe (2018b) that has, in turn, omitted the main questions. Based on the accompanying descriptions, Kempson and Poppe (2018b) questionnaire seems to be a bit longer than Kempson and Poppe (2017), however, due to a lack of data, the differences between the two cannot be thoroughly analysed. All the national surveys, using the same survey questionnaire as a basis, do not disclose the complete questionnaires either. Therefore, the precise contents of the recent ANZ financial well-being instruments used in Australia and New Zealand remain also unclear. From the descriptions of results in Kempson and Poppe (2017) it appears that they concentrate on 11 financial well-being components grouped into 3, 21 behaviour components grouped into 6, 10 financial knowledge and experience components grouped into 3 and 19 psychological influence components grouped into 5. The knowledge questions they use are not classical true/false questions (objective knowledge); instead, they are framed as questions measuring subjective knowledge.

In terms of aggregation, Kempson and Poppe (2017) followed a two-step process to derive **financial capability components** (*behaviours, knowledge and experience, psychological factors*): variable derivation and initial allocation against conceptual frameworks and identification of components within the different levels of the framework using principal components analysis. This indicates that variables (excluding psychological determinants based on validated psychological scales) were divided between levels, and the initial PCA was carried out at each level. PCA was then re-run to get loadings. After eliminating variables with a poor fit, the initial PCA and re-running PCA occurred. Once meaningful solutions were achieved, the higher-loading variables for each subset were tested. Obtained

components were rescaled from 0 to 100 using fake cases for minimum and maximum. **Financial wellbeing components** were aggregated separately using PCA, leading to a one-component solution based on 11 measures under three components: meeting commitments, feeling comfortable and resilience for the future.

Kempson et al. (2013) presented the instrument promoted by the World Bank, which appears to be of very low quality. It includes proportionally the most closed yes/no questions (29% of all questions), and some of these tend to be asked in a rather guiding manner, e.g. "Do you regularly use credit or borrow money to buy food or to pay for other necessary items or only sometimes?", "Do you plan exactly how you will use the money or only make a rough plan?". A similar tendency did not exist in other questionnaires by Kempson. Due to the focus of this instrument on poorer countries, it includes questions on remittances and consumer protection, and some questions do not presume that the person has a bank account. It is important to note that the aim was to promote the use of this instrument in low and middle-income countries. However, the instrument that has been published is in a PDF that contains questions as pictures with extremely poor resolution, making them difficult to read. The instrument within the pdf was structured unclearly and at least some parts of the questionnaire were repeated for unknown reasons. The survey questionnaire seems not to be publicly available in any other format. Overall, without knowing that the World Bank was involved somehow in its preparation, it would be hard to believe their involvement when just looking at the quality of the report introducing the instrument.

In terms of aggregation, Kempson et al. (2013) used principal components analysis. A single measure of financial capability could not be created, and it was also challenging to create identical domains across different developing countries. Therefore, they distinguished 10 components, referring to 10 scores ranging from 0 (least capable) to 100 (most capable). First, 7 discrete behaviours: budgeting/planning spending, monitoring finances, not overspending, living within one's means, ensuring that unexpected expenses can be covered, saving, and making informed financial decisions. Second, three discrete components are formed from psychological factors (time-orientation, impulsivity, and achievement-orientation).

FINRA 2021 Financial Capability Survey is quite comparable to the OECD survey, going similarly to Kempson and Poppe (2017) a bit deeper into some financial products. It seems that no scores within FINRA are created based on the input provided by respondents. Therefore, it is also quite difficult to link specific questions to attributes aside from the structure of the survey itself. The latest FINRA 2021 results have been used by Lusardi and Streeter (2023) to investigate the link between financial knowledge (measured by Big3 correct %, number, all knowledge correct %) and financial well-being measured by 3 indicators (retirement planning, financial fragility and heavy debt burden).

OECD INFE 2023 is the most compact and of the highest quality of the five instruments. Still, the presentation of attitudes and behaviour questions is peculiar as the claims are strangely disbursed between five questions, grouped in ways not seen in the previous surveys. Its overall setup in terms of attributes is quite similar to Kempson and Poppe (2017) with both enabling the measurement of financial behaviour, knowledge and attitude (psychological factors). Also, the newer financial well-being concept appears to be covered more comprehensively in both of these instruments, with Kempson and Collard (2006) and Kempson et al. (2013) including only a couple of questions sharing similarities with those used to measure financial well-being.

In terms of aggregation, the OECD INFE instrument is the most complex. From the total of 7 financial knowledge questions/claims, they use 5 questions to create a **financial knowledge score**, which is the number of correct responses ranging from 0 to 7 (from one question, they take 3 claims out of 5). Of

these 7 responses, 2 are numeric, 2 require selecting the correct response from a list, and 3 are true/false claims. All these components measure objective knowledge, meaning that the OECD INFE score calculations completely ignore subjective knowledge that is covered with one question in the survey instrument. **Financial behaviour score** ranging from 0 to 9 is based on a maximum of 2 points from 1 question with 7 claims concerning product choice (2 points if the specific selection has been made), a maximum 3 points from answers to 5 questions concerning “financially savvy” behaviours, maximum 4 points from 2 questions with 2 relevant claims from attitudes & behaviour section (each claim 1 if agreed). The **financial attitudes score** ranges from 0 to 4, and it is based on 2 questions from the attitudes section (3 claims 1/0 value summed divided by 2 and rescaled). The **overall financial literacy score** is the sum of the financial knowledge score, financial behaviour score and financial attitudes score, ranging from 0 to 20 (it can be normalised to 100 by multiplying by 100/20). A similar level of complexity is used to generate **digital financial literacy score** and its sub-components (OECD, 2022). The **financial well-being score** ranges from 0 to 100. It is generated from 3 questions from the attitudes & behaviour section (9 claims) and 3 questions from the financial section (3 claims), with each claim being evaluated 1/0. The claims are divided into objective financial well-being (4 claims) and subjective financial well-being (8 claims), each rescaled from 0 to 50 and, when added together, form the financial well-being score.

Overall, significant differences appear in the financial literacy instruments used in different countries. Significant variation appears in how the instruments have been compiled over time. The best-quality national instrument benchmarks seem to be Kempson and Poppe (2017) and FINRA (2022). Still, the OECD INFE survey remains at the most reasonable length, saving some of the survey administration costs.

3.2. Overview of alternative instruments in academic papers

Academic papers were searched through keyword searches, and the sample was broadened by tracking papers that were referred to in the papers found. The initial sample included 96 papers, excluding the academic papers that had been used as a basis for creating national survey instruments, as discussed in section 3.1. In the following subsections, we focus only on those 58 papers from which it was possible to retrieve the complete survey instrument, or the main parts of the instrument, were discussed with enough detail to draw specific conclusions on what was done. In this set of papers, some focus specifically on financial literacy measurement, while others have broader objectives involving financial literacy metrics.

When analysing questions, we distinguish questions related to knowledge, attitude, behaviour and financial well-being. Amongst knowledge questions, we distinguish questions measuring objective knowledge (actual knowledge measured with test-like true/false questions) as well as questions related to subjective knowledge (a person’s own evaluation of their level of knowledge). All knowledge-based questions are further divided into those covering basic financial knowledge (usually Big3 or Big5) and those related to advanced financial knowledge and numeracy (checking respondents’ understanding of probability and calculus).

We also track the aggregation methods used by the authors to reduce the responses to questions and/or claims into one number, characterising the whole construct.

3.2.1. Purely knowledge-based measurements

Here, we analyse 18 papers containing some financial literacy measurement confined only to the knowledge dimension (see Table 5). This means that in these papers, other dimensions of financial literacy (e.g., behaviour and attitude) are not considered at all.

Table 5. Overview of knowledge-based financial literacy measures

General knowledge-based instruments

Reference	Instrument focus/name	Age group	Total Q	Obj. Knowl. Q	Subj. Knowl. Q	Aggregation
Lusardi and Mitchell (2007)	Financial literacy	Eldrely	3	1 basic+2 numeracy		% correct
van Ooijen and van Rooij (2016)	Financial literacy	Adults	3	3 basic		% correct, sum
Preston and Wright (2023)	Financial literacy	Adults	3	3 basic		sum, threshold
Lusardi and Streeker (2023)	Financial literacy	Adults	4	3 basic	1	% correct, sum
Sconti and Fernandez (2023)	Financial literacy	Adults	3	3 basic		% correct
Klapper and Lusardi (2020)	Financial literacy	Adults	5	5 basic		% correct
Lusardi (2015)	Financial literacy	Elderly	10	4 basic +6 advanced		% correct
van Rooij et al. (2012)	Financial literacy	Adults	17	6 basic + 10 advanced	1	factor analysis
Kunovskaya et al. (2014)	Financial literacy	Adults	6	5 basic + 1 advanced		% correct, factor analysis
Ćumurović and Hyll (2019)	Financial literacy	Adults	9	5 basic + 4 advanced		sum
Bajaj and Kaur (2024)	Financial knowledge scale	Adults	22	6 basic + 15 advanced + 1 numeracy		none
Knoll and Houts (2012)	Financial knowledge scale	Adults	20	6 basic + 14 advanced		sum, IRT
Walstad and Rebeck (2017)	Financial literacy	Young	45	45 advanced		sum, IRT
Ranyard et al. (2020)	Financial literacy	Adults	50	mix of basic & advanced		% correct, sum, IRT, PCA
Koh et al. (2020)	Financial knowledge	Eldrely	3	2 basic + 1 advanced		sum

Specialised knowledge-based instruments

Reference	Instrument focus/name	Age group	Total Q	Obj. Knowl. Q	Subj. Knowl. Q	Aggregation
Burke and Manz (2014)	Economic literacy	Adults	16	4 basic + 10 advanced + 2 numeracy		% correct
van Ooijen and van Rooij (2016)	Debt literacy	Adults	3	3 advanced		% correct, sum
Gathergood and Weber (2017)	Mortgage literacy	Adults	4	4 advanced		sum

Notes: Q refers to questions. Aggregation methods: % correct – proportion of correct responses, sum – total of correct responses, threshold – the initial result is transformed into grouping variable (e.g., high/low literacy), IRT – aggregation through item response theory, PCA - principal component analysis.

As seen from Table 5, the measures refer to financial literacy in most papers, indicating that these papers follow the knowledge school of financial literacy. However, only two papers refer to it as a financial knowledge scale (Bajaj & Kaur, 2024; Knoll & Houts, 2012). We also identified three papers that have created more specialised knowledge indicators. Burke and Manz (2014) generate economic literacy indicators using 16 questions, 4 of which are traditional basic financial literacy questions; the remaining questions go deeper into economic concepts of inflation and monetary policy. van Ooijen and van Rooij (2016) use the Big3 questions and add 3 questions specific to loans. Gathergood and Weber (2017) use a mortgage literacy indicator that contains 4 questions specifically targeting mortgage issues. It is also important to note that Sconti and Fernandez (2023) use in addition to the Big3 questions also 9 questions to measure ESG knowledge taken from Fernandez et al. (2023).

Most of the analysed surveys focused on adults, except Walstad and Rebeck (2017), targeting high school students and Lusardi and Mitchell (2007), Lusardi (2015) and Koh et al. (2020) focusing on people older than 50. The number of questions used to measure financial literacy varied from 3 to 50, with a mean of 12.5 and a median of 5.5. From the Big3 basic financial literacy questions, 12 (66%) papers used the inflation question, 10 (56%) used the interest rate question, and 8 (44%) used the stock risk question. The additional 2 questions, included in Big5 on mortgages and bonds, were used only in 2 studies (Knoll & Houts, 2012; Ranyard et al., 2020). The full distribution of topics covered in knowledge questions is presented in Figure 6.

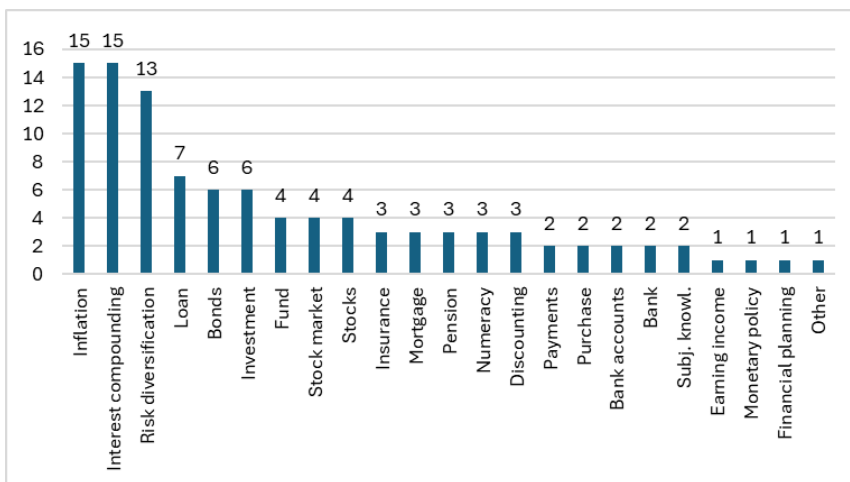


Figure 6. Topics in knowledge-based instruments by counts of papers

As can be seen from Figure 6, the topics of the Big3 basic financial literacy questions also dominate when considering alternative formulations used in papers. The remaining topics are represented in significantly fewer papers and cover very different financial literacy topics. We do not present here the counts of questions by topics as these numbers are strongly driven by longer questionnaires (Ranyard et al., 2020; Walstad & Rebeck, 2017) that used up to 10 questions covering the same topic. Only one paper also measured financial well-being (Lusardi & Streeter, 2023).

In terms of aggregation of responses into a single variable, the calculation of the proportion of correct responses was the most popular (10 papers), followed by the total number of correct responses (10 papers) with many papers doing both. More sophisticated aggregation techniques through factor analysis, principal component analysis, or IRT were used in only 5 (27%) papers.

3.2.2. Combined instruments

Here, we analyse 32 papers that include at least one question on financial knowledge in their survey instrument and cover some elements of financial attitudes, behaviour, and/or well-being. The summary table is in Appendix 4. 24 (75%) studies targeted adults aged 18 and older. Still, three papers in this group targeted more specific sub-groups of adults with Lusardi and Mitchell (2008) focusing on women, Sivaramakrishnan et al. (2017) on retail investors and Shockey (2002) on low-wealth individuals. There were three studies covering elderly people – aged over 50 (Lusardi & Mitchell, 2011) or 55 (Xue et al., 2019, 2020) and five studies concentrating on students at colleges or universities (Chen & Volpe, 1998; Potrich et al., 2016; Ramos-Hernández et al., 2020; Rieger, 2020; Xiao, Ahn, et al., 2014).

As seen from Appendix 4, 22 (68%) papers have the complete list of survey questions available, and the remaining papers provide partial input on the types of questions used. All covered papers had at least one **financial knowledge** question. From the existing information, we can see that 13 (41%) papers include both the basic financial knowledge questions (usually either Big 3 or 5) and advanced financial literacy questions, with the remaining papers containing either only basic, advanced financial knowledge questions or questions that were not distinctly positioned in either of the groups. 18 (56%) papers include at least one question covering subjective financial knowledge. As can be seen from Figure 7, the topics covered by the Big3 questions on interest compounding, inflation and risk diversification are covered in most papers. Compared to papers focusing only on the knowledge dimension, subjective financial knowledge is more strongly represented, followed by questions related to investments, loans, mortgages, bonds, financial planning and investment funds. 26 (81%) papers aggregate the responses to knowledge questions into a single score or index. In some papers, up to three different aggregation methods are used simultaneously. The most popular is adding the number of correct responses used in 11 papers, followed by % correct responses in 8 papers, mean of correct responses in 4 papers, correct response thresholds in 4 papers, factor analysis in 4 papers, IRT in two papers (Xue et al., 2019, 2020) and PCA in one paper (Garber & Koyama, 2016).

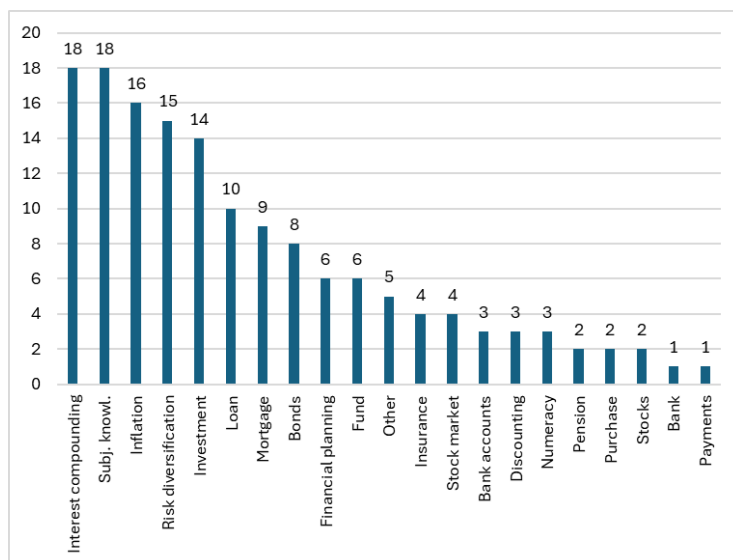


Figure 7. Knowledge topics in combined instruments by counts of papers

Counting the questions for attitude and behaviour dimensions contains potential errors as, very often, these questions include several claims to be evaluated by the respondents. Different surveys may treat these as stand-alone questions or as one of many claims under one question. Also, while creating this review, we re-classified some of the original questions or some claims under the question. This is because, often, the authors wrongly classify some questions as measuring behaviour, although these are worded as attitude questions. We tried to “clean” the dataset from such errors to ensure consistency. There remains a question concerning how and whether to distinguish traits from attitudes. Some papers distinguish it. However, the approaches used in different papers appear inconsistent; therefore, we view attitudes and personality traits as one construct labelled attitude in this review.

When looking at the **attitudes dimension**, 19 papers provide evidence of using at least one such question, with the maximum reaching 13 questions in Fernandes et al. (2014) and the mean remaining at 3.4 questions. When attempting to count claims, the 19 papers provide a total of 198 claims, an average of 10.4 claims per paper. As can be seen from Figure 8, the most popular are the claims related to risk preferences (e.g. “When thinking of your financial investments, how willing are you to take risks?”) or attitudes towards spending vs saving (e.g., “I am more of a saver than a spender.”, “I spend money when I am unhappy or frustrated”). Attitude towards planning takes very different forms, e.g., “Having my funds set out for the next 1–2 months feels good”, “It is important to establish financial targets for the future”, “I believe the way I manage my money will affect my future”. This topic is closely linked to claims surrounding money, e.g. “I am very organised when it comes to managing my money day to day.”, “I like to join conversations about financial matters”, “I am very prudent with money”. Impulsivity is linked more to the personality aspects, e.g. “I do things without giving them much thought”, “I am impulsive and tend to buy things even when I can’t really afford them”. The same applies to the time preferences that can be investigated more generally or in very different contexts (health, money, etc), e.g., “I tend to live for today and let tomorrow take care of itself.”, “I only focus on the short term”, “I always make sure I have money saved for a rainy day.”, “I have always tried to eat healthy because it pays off in the long run”. Decision-making can encompass different decision influencers, e.g. “I do not like to have to do a lot of thinking (reverse coded)”, “I try to consider how my actions will affect other people in the long run”. The remaining topics emerge less frequently, including attitude towards information, personality aspects, restraints, confidence, self-efficacy, attitude towards numbers, and tolerance.

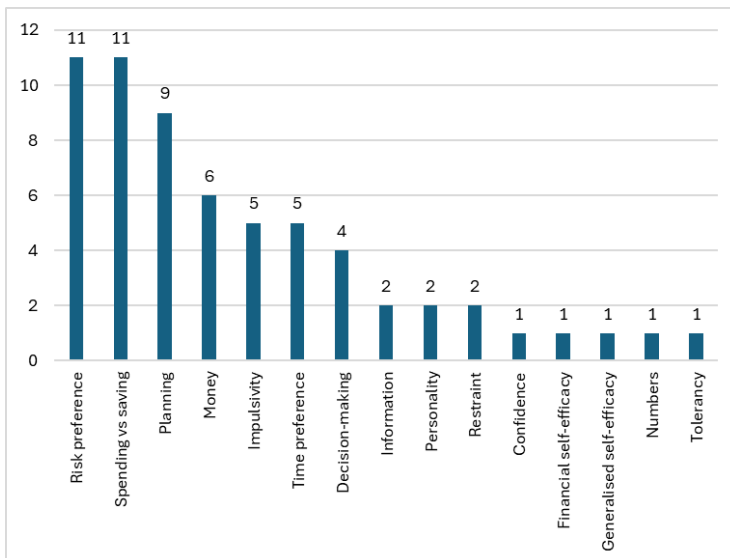


Figure 8. Attitude topics in combined instruments by counts of papers

Financial behaviour questions were present in 25 (78%) papers, indicating that this dimension is more frequently used than attitudes. The maximum number of such questions reached nearly 33 in Lusardi (2011), remaining on average at 10 per paper. When attempting to count claims, these reach a total of 371 and, on average, 14.8 per paper. As can be seen from Figure 9, over half of the papers with behaviour questions cover investment and consumption behaviour. Investments cover questions like

“What do you do with any money you have left over?”, “In the past three years, have you saved or invested money in any of the following instruments? ” and they also include specific questions concerning retirement (e.g., “How confident are you that you have done a good job of making financial plans for your retirement?”). Consumption covers different areas of spending including purchases (e.g., “When I go shopping, I compare prices”), financial planning (e.g., “I keep track of my money”, “I decide beforehand how my money will be used in the next 1-2 years”), or payment behaviour (e.g. “I paid my bills on time”). Information sources refer to questions where respondents specify where they obtained information for making different financial decisions, e.g., financial advisor, advert, etc. Risk comprehension covers questions targeting risk mitigation activities. A few questions cover decision-making, and a few papers consider borrowing and insurance behaviour.

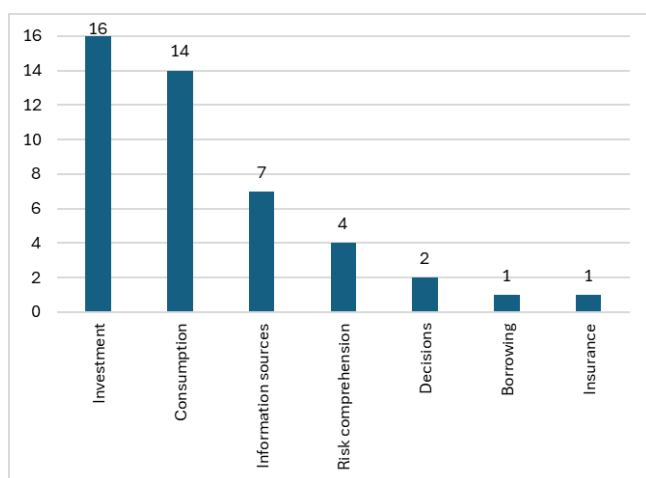


Figure 9. Behaviour topics in combined instruments by counts of papers

In line with the emergence of financial well-being schools, 13 (41%) papers consider financial well-being next to financial literacy as a separate construct. Questions in this group target either the respondents' current, emergency, or future financial situation and can be either objective or subjective. Almost all papers (12) contained a question focusing on the respondent's current financial situation (e.g., “How would you rate your level of financial stress?”, “Overall, thinking of your assets, debts and savings, how satisfied are you with your current personal financial condition?”). The remaining aspects were covered in up to two papers.

Regarding aggregation of the non-knowledge constructs, 12 (38%) papers create a composite indicator for behaviour, attitude or financial well-being. The most popular method for constructing these indicators is factor analysis, used in 8 papers. Still, Méndez-Prado et al. (2023) sum the response scores for attitude, behaviour and knowledge dimensions and Abdallah et al. (2024) calculate the mean scores for attitude and behaviour. Nițoi et al. (2022) used IRT; however, they did it only in the context of financial well-being scores.

While the OECD INFE instrument attempts to aggregate the different financial literacy dimensions into one single score, academic papers tend to avoid it. According to our review, the only paper that created an aggregate financial literacy score from the investigated sub-components is Méndez-Prado et al. (2023). They initially calculated the financial literacy score as the mean of subcomponents summed scores, each rescaled to 100. In the second step, they created the financial literacy score after running

SEM on financial knowledge, behaviour and attitude scores, finding that the estimated coefficient for knowledge should be 0.43, for behaviour 0.28 and for attitude 0.29.

3.2.3. Instruments without financial knowledge

We analyse here 8 papers that contained either the measurement of financial attitude, behaviour and/or well-being and did not cover financial knowledge (see Table 6). All the studies tend to focus on adults. The number of questions relevant to our classification varies from 1 to 28, remaining on average at 11.6. The most versatile instrument is the one by Dare et al. (2023) that covers all three investigated dimensions. Tavares and Santos (2020) and Fünfgeld and Wang (2009) cover both attitude and behaviour. The remaining papers concentrate only on one selected dimension at a time, meaning that these instruments remain quite narrow in their focus, with most of the instruments concentrating on financial well-being.

Table 6. Overview of instruments omitting financial knowledge dimension

Reference	Survey instrument availability	Age group	Total Q	Attitude Q	Behaviour Q	Fin. well-being Q	Aggregation		Aggregation methods used
							1 single score	Components from dimensions	Other dimensions
Tavares and Santos (2020)	full	Adults	20	12 (12 claims)	8 (8 claims)	0	No	Several	Factor analysis
Fünfgeld and Wang (2009)	full	Adults	11	8 (13 claims)	3 (3 claims)	0	No	Several	Factor analysis
Lown (2011)	full	Specific - university employees	6	6 (6 claims)	0	0	No	Several	Factor analysis
Dare et al. (2023)	full	Adults	28	1 (5 claims)	17 (17 claims)	10	No	Several	Factor analysis
Johnson (2001)	full	Adults	1	0	0	1	No	None	No aggregation
Prawitz et al. (2006)	partial	Adults	8	0	0	8	No	1 score for financial wellbeing	Factor analysis
Taylor (2011)	full	Adults	7	0	0	7	No	1 score for financial wellbeing	Factor analysis
van Dijk et al. (2022)	full	Vary by study	12	0	0	12	No	1 score for financial wellbeing	Factor analysis

Notes: Q refers to questions.

As most of the instruments tend to have a narrower focus compared to the ones observed in section 3.2.2., the aggregation opportunities remain more limited. Still, quite surprisingly, all papers aside from Johnson (2001), which had only one question of interest, used factor analysis to combine the input from different questions or claims into components. This supports the tendency observed in the previous section showing that for the attitude and behaviour dimensions, aggregation through more advanced statistical methods is quite common.

Considering the limited number of papers in this group, we will not analyse the topic contents of the questions/claims as these would resemble quite strongly the tendencies observed in section 3.2.2. What is worth highlighting is the very specific financial self-efficacy scale created by Lown (2011) which is based on a generalised self-efficacy scale, composed of 6 items measured on a 4-item Likert scale. It provides a unique look at one aspect of financial attitude. Financial self-efficacy has also been addressed in Dare et al. (2023) and in Lone and Bhat (2024).

3.3. The main take-aways from existing instruments

We discuss the main takeaways from each of the three core dimensions of financial literacy in the following sub-sections. Here, we also provide the main preliminary conclusions from the comparison of the OECD INFE instrument with alternative instruments and generate preliminary recommendations for improvements to the existing instrument. Some important aspects may be missing from discussion and recommendations as the extensive literature review concentrated only on instruments and not simultaneously on the interplay of financial literacy dimensions, their determinants and their potential impact on instrument creation.

3.3.1. Financial knowledge

Issues with the measurement of objective knowledge

As seen above, to measure objective knowledge, most instruments use test-like true-false or multiple-choice questions containing one correct option. If the researchers do not use more comprehensive surveys, they often resort to using only Big3 or Big5 questions, often assuming that these are appropriate proxies for the whole financial literacy concept (argument in line with the knowledge-based school of financial literacy). OECD INFE considers only 7 financial knowledge questions/claims in its knowledge score generation, which cover the basic financial knowledge topics (covered by Big3) related to inflation, interest compounding and risk diversification. This represents a very narrow approach to knowledge measurement, vulnerable to validity and reliability concerns (Xin et al., 2024). For example, Gignac and Ooi (2022) recommend using a minimum of 13-15 knowledge questions to address these concerns.

Preliminary recommendation 1 – Determining whether the set of objective knowledge questions in the OECD INFE questionnaire should be increased to increase reliability and, if yes, with which questions.

Some attempts exist to use alternative methods to measure respondents' objective knowledge that could potentially provide deeper insights. For example, Kempson and Collard (2006) used showcards as part of their face-to-face interview survey, presenting the respondents with an example bank statement or a graph showing several investment funds' performance over several years. Some questions can also be framed so that the respondent has to respond numerically to a given problem, e.g., "You lend \$25 to a friend one evening and he gives you \$25 back the next day. How much interest has he paid on this loan?" (Kempson et al., 2013; OECD, 2022) or "Suppose you put \$100 into a <no fee> savings account with a guaranteed interest rate of 2% per year. You don't make any further payments into this account and you don't withdraw any money. How much would be in the account at the end of the 1st year?" (Kempson et al., 2013; OECD, 2022; Preston & Wright, 2023). Numerical responses are more commonly used for numeracy questions concerning disease or winning lottery probability that are often included in the separate numeracy section of the questionnaire (Fernandes et al., 2014; Lusardi & Mitchell, 2007).

Irrespective of the question format, the responses to objective financial knowledge questions often require rather complex calculations and thinking. In our opinion, the appropriateness of the interview (whether phone or face-to-face) survey method for gathering responses to more complicated knowledge questions is questionable. If the respondents were provided with the written material, it would be easier to grasp the concepts and do the math than just hearing a rather lengthy task description where you might just forget what you just heard at the beginning of the sentence and what you were expected to do. The varying ability of respondents from different age groups to adjust to such cognitively demanding survey settings may also create differences in the measured knowledge levels not caused by the actual knowledge differences (likely underestimating the knowledge for older

respondents). As the interview survey method significantly limits the length and complexity of the questions, it has led to the avoidance of case-like longer situation descriptions, which would allow more accurate measurement of knowledge, capturing, to some extent, the ability to contextualise and apply the knowledge. This indicates that although interview surveys seem to be the “gold standard” in national instruments, OECD INFE, and also quite frequently used in academic papers, alternative methods, e.g. online surveys or experimental settings, could potentially enable the gathering of more accurate input on the actual knowledge of respondents. Online surveys seem to be more likely alternatives due to lower costs. However, their use may jeopardise the generalisability of results due to difficulties reaching elderly people. The national surveys in the US (FINRA, 2022) and Norway (Kempson & Poppe, 2017, 2018b), both using only web-based survey designs, have maintained rather good representativeness, despite this drawback. Canadian Financial Capability Survey has resorted to using both online and phone survey options simultaneously (*Data Collection for the 2019 Canadian Financial Capability Survey - Methodology Report*, 2019). Also, the latest UK survey resorted to the use of three data collection methods due to the COVID pandemic: online panel providers, invitations sent by post and completed online or invitations sent by post and completed on paper (*Adult Financial Wellbeing Survey 2021 Technical Report*, 2021). This indicates that more extensive use of online surveys may improve the possibility of increasing the complexity of some knowledge questions, introducing scenario-like questions, and increasing the accuracy of objective knowledge measurement.

Preliminary recommendation 2 – Consideration of the possibilities to include more scenario-like objective knowledge questions if the use of online tools could be integrated into the survey design; if yes, determining which questions could/should be added.

Limitations of objective knowledge as the only financial knowledge component

Concentrating only on objective knowledge has also other limitations. As noted by Lind et al. (2020) most studies using objective knowledge as a driver of financial behaviour do not control for numeric ability and cognitive reflection. As seen from our reviewed instruments only 9 of 58 included some numeracy questions, while those using these more extensively treated it as a separate construct (e.g., Fernandes et al., 2014; Lusardi & Mitchell, 2007). OECD INFE includes one numeracy question (“Imagine that five brothers are given a gift of 1000€ in total. If the brothers have to share the money equally how much does each one get?”), which is not included in any of the scores generated. This indicates that numeracy should receive greater attention when investigating the associations between knowledge and behaviour, and to do that it should be more appropriately measured in the first place. The cognitive reflection aspect could be potentially covered with attitude questions.

Preliminary recommendation 3 – Determining whether the number of numeracy questions should be increased and if yes with which questions.

Preliminary recommendation 4 – Determining whether/how the numeracy question(s) should be integrated into the financial objective knowledge score and the overall financial literacy score calculation.

Aggregation limitations of objective financial knowledge questions

Most papers and reports aggregate the responses to objective financial knowledge questions using either % correct, sum, or mean linked to Classical Test Theory (CTT). Alternatively, one could consider the use of Item Response Theory (IRT) as an aggregation method. IRT can be used to construct measurement scales iteratively and compared to the Classical Test Theory (CTT based on summed score), it has the benefit of providing more precise estimates of an individual’s ability by considering the difficulty of the question, closeness to the ability estimates and allowing to construct more efficient

measurement scales from multiple items (Knoll & Houts, 2012). IRT has been used for financial knowledge measurement in several papers (Kunovskaya et al., 2014; Ranyard et al., 2020). Considering that most financial literacy instruments, including the OECD INFE instrument, use the summed score, IRT could potentially provide an improved financial knowledge measure.

Preliminary recommendation 5 – Employing IRT to generate the objective financial knowledge score and determining to which extent it behaves better or worse than the summed score.

Reaping the benefits of subjective knowledge

Objective financial knowledge questions do not capture whether the knowledge would be applied by the respondents. Usually, it is assumed that an important determinant of financial behaviour is confidence (Lind et al., 2020). This means that if a person with an excellent level of objective financial knowledge lacks confidence in his/her knowledge, the knowledge will not be reflected in their actual financial behaviour. To tackle this dilemma, from 2010 forward, many academic papers and national financial literacy instruments have often included at least one subjective financial literacy knowledge question in their survey, e.g. “On a scale from 1 to 7, where 1 means very low and 7 means very high, how would you assess your overall financial knowledge?” (FINRA, 2022; Lusardi, 2011; Lusardi & Streeter, 2023; Rieger, 2020; Stella et al., 2020) or “Could you tell me how you would rate your overall knowledge about financial matters compared with other adults in Estonia?” measured on a 5-point scale from very high to very low (OECD, 2022).

Preliminary recommendation 6 – Determining whether/how the existing subjective financial knowledge question response could/should be integrated into the financial knowledge score and the overall financial literacy score calculation.

It appears that subjective financial knowledge is treated as a separate construct from objective financial knowledge in all reviewed instruments. The same applies to the OECD INFE survey, which has the basis of its financial knowledge score entirely in the objective knowledge questions. Given that there is often a mismatch between objective and subjective financial knowledge (Anderson et al., 2017; Lusardi & Mitchell, 2014), subjective knowledge should not be overlooked in financial knowledge assessments. Moreover, considering that subjective knowledge as a stand-alone indicator can be driven by overconfidence (Lind et al., 2020), it should be investigated together with objective financial knowledge. The literature review revealed that there exist two alternative approaches in the academic literature that replace the one subjective knowledge question:

1. Wuttke and Aprea (2018) proposed a **situational judgement test** to bridge the gap between knowledge and doing where respondents are exposed to realistic hypothetical situations or scenarios to which they must respond. Such a test has been used in Wuttke et al. (2020) with the main focus remaining on one individual cognitive competence area of planning everyday financial matters (incl. evaluating one's own revenues, planning expenses in agreement with one's own needs and possibilities, and drawing up a budget). Due to the limited scope of the existing scenarios, implementing this alternative would require significant work on broadening it to all areas relevant to financial literacy measurement.
2. Cude et al. (2023) proposed a **confidence-adjusted financial knowledge score** where respondents are asked to indicate the correct response to a question, and then for each objective knowledge question, “On a scale from 1-5, with 1 = least confident and 5 = most confident, how confident are you that your answer is correct?”. Correct responses receive a score of +1 multiplied by the self-selected confidence value, and wrong responses a score of -1 multiplied by the self-selected confidence value. The results for each question are summed into a single confidence-adjusted financial knowledge score. They concluded that the

confidence-adjusted scores could be helpful in experimental settings to compare pre-post knowledge and better understand what lies behind the objective knowledge scores.

Given the interesting results from Cude et al. (2023) and the more straightforward implementation of this approach, it may be worthwhile to consider the possibilities of integrating objective and subjective knowledge measures. In the context of existing OECD INFE results, it might prove to be a bit problematic due to the wording of the existing subjective financial literacy question that currently focuses on the overall financial knowledge (not directly linked to the objective knowledge questions' areas). Also, the OECD INFE subjective knowledge question requires comparison to other Estonians (unlike the other popular subjective knowledge questions used in other instruments), which may somewhat alter the interpretation of that question.

Preliminary recommendation 7 – Determining the usefulness of the existing subjective financial knowledge question for integration with existing objective knowledge questions.

Preliminary recommendation 8 - If a new instrument validation exercise could be carried out, complementing each of the OECD INFE objective knowledge questions with similar subjective knowledge questions, as done in Cude et al. (2023), to calculate confidence-adjusted financial knowledge score and determine its usefulness.

Executing recommendation 8 would also allow for the appropriate testing of the Dunning-Kruger effect (Gignac & Zajenkowski, 2020; Xin et al., 2024) to shed more light on possible further improvements to the existing instrument.

3.3.2. Financial attitude

As noted earlier, different instruments have used very different approaches to measuring financial attitudes. Compared to financial knowledge questions, there exists a very low overlap in the attitude questions/claims used in different instruments, meaning that no “gold standard” exists in this area. For example, the three claims used in OECD INFE for the attitude score have overlaps only in two cases and only with the Kempson and Collard (2006) instrument's claims. Surprisingly, the OECD INFE survey uses only 3 claims out of 17 gathered with the survey. Most of the reviewed instruments tended to use on average 10 claims, meaning there is probably room for improvement within the existing instrument.

Preliminary recommendation 9 - Determine which of the existing 17 attitude-claims in the OECD INFE instrument could provide a better financial attitude score than the current one with 3 items.

Some recent financial literacy instruments have considered financial self-efficacy as a belief in one's ability to apply financial knowledge that eventually leads to financial well-being (Lone & Bhat, 2024). As it relates to confidence, it shares some similarities with subjective financial knowledge, as discussed above. Lown (2011) has developed a specific psychometrically tested financial self-efficacy scale, which has not been used in other instruments to the best of our knowledge. Instead, the other authors developed their own measures. Lone and Bhat (2024) found the mediating role of financial self-efficacy between financial knowledge and well-being. Dare et al. (2023) confirmed the strong positive impact of financial self-efficacy on financial well-being through financial behaviour. These results indicate that financial self-efficacy is an important factor influencing financial behaviour and should also be considered in financial literacy evaluations. From the national instruments, only FINRA uses one claim targeting financial self-efficacy.

Preliminary recommendation 10 - If a new instrument validation exercise could be carried out, complementing each of the OECD INFE attitude questions with questions from existing financial self-efficacy scales and determining its usefulness in the financial attitude score.

Most academic papers have aggregated attitude-related claims into a single score (Lone & Bhat, 2024; Méndez-Prado et al., 2023) or several scores using factor analysis (Abdallah et al., 2024; Shanmugam et al., 2022). The OECD INFE instrument is based on a simple sum of scores. Given the benefits of factor analysis in providing weights for different sub-components' contributions to the underlying factors, it would be worthwhile to understand whether factor analysis provides any significant benefits.

Preliminary recommendation 11 - Determine whether using factor analysis over the summing of scores provides a superior financial attitude score(s).

It might also be worthwhile to conduct a more focused literature review to determine more theoretically driven attitudinal factors of financial literacy. The current review has revealed that most of the instruments using attitude claims provide, in most cases, no theoretical explanations for their use and often use claims created by the authors themselves or drawn from previous papers where the authors created these themselves, with no psychometric validation. Shanmugam et al. (2022) remains one of the exceptions, using scales developed in psychology research while simultaneously confusing knowledge and behaviour aspects of financial literacy. We also observed that some instruments did attempt to distinguish personality traits from attitudes. However, there appeared to be no consistency in the claims being divided into one or another across papers. This shows that more research, in general, is needed in this area to specify which attitudinal factors should be considered in financial literacy measurement and how these should be measured appropriately. We do not propose it currently as a recommendation, as its fulfilment goes further from the pure application of current "best" practices and requires more fundamental research into behavioural aspects of financial literacy.

3.3.3. Financial behaviour

Similarly to attitude, the financial behaviour dimension is covered with very different questions in survey instruments. The focus remains on what people say they do, which may not be what they do. Very often, the questions are framed so that it is difficult to determine whether they measure attitude or behaviour. In the OECD INFE instrument, the behaviour questions deserve greater attention than questions from the knowledge or attitude domain. However, even in terms of the setup of the OECD INFE questionnaire, the behaviour questions are distributed across several different sections. In contrast, some claims from some questions are used to calculate the digital behaviour score. Similarly to the financial attitude score, the OECD INFE financial behaviour score calculation includes 9 questions from 21, meaning that not all available information is considered. This indicates that including specific questions/claims in the final score remains quite arbitrary.

Preliminary recommendation 12 - Determine which of the existing 21 behaviour-claims questions in the OECD INFE instrument could provide a better financial behaviour score than the current one with 9 questions.

Similarly to the attitude questions, many papers use factor analysis to generate a single financial behaviour score (Méndez-Prado et al., 2023; Shanmugam et al., 2022) or multiple scores (Kempson & Poppe, 2018b). As OECD INFE is based on summing the scores, the outcome could be improved with more sophisticated aggregation methods like factor analysis.

Preliminary recommendation 13 - Determine whether using factor analysis over the summing of scores provides a superior financial behaviour score(s).

As in the case of attitude, the financial behaviour side of the instrument creation seems to require more profound fundamental research than just applying the "best" practice approach.

3.3.4. Single financial literacy score

One of the most significant challenges in single financial literacy score creation is that if we assume it encompasses different sub-constructs, how should these be aggregated? Especially considering that the knowledge questions are not measured using a scale but are true/false questions. Looking at the literature summaries presented earlier, it appears that only OECD INFE and Méndez-Prado et al. (2023) have done it. OECD INFE takes the view that the sub-components can be summed up (weighted scoring model). However, Fessler et al. (2020) indicates that knowledge and attitude might be complements, not substitutes for most individuals. This also complicates the cross-country comparisons as the linkages between the three components might differ across countries due to differences in household portfolios, which, in turn, are influenced by cultural and institutional factors. Given that Fessler et al. (2020) using OECD data found that knowledge affects behaviour directly and also through attitude, so more complex modelling is needed to draw conclusions. For example, Méndez-Prado et al. (2023) used structural equation modelling (SEM) to combine different sub-scores into one financial literacy score. Alternatively, one might consider factor analysis on standardised responses or factor analysis on latent trait estimates with IRT for each sub-component.

Preliminary recommendation 14 – Determining whether creating a single financial literacy score from its sub-dimensions is appropriate, and if yes, whether other aggregation methods would be more appropriate than the one used currently by OECD INFE.

3.3.5. OECD INFE survey instrument and the next steps

Although the OECD INFE survey covered 39 countries in the 2023 wave (OECD, 2023), the discussion of this instrument remains modest in academic literature. Only de Clercq (2019) has tested the financial knowledge aspect measurement of the OECD INFE 2015 instrument of 12 countries, Fessler et al. (2020) has investigated the links between knowledge, attitude and behaviour using Austrian OECD INFE 2015/16 data, Garber and Koyama (2016) used Brazilian OECD INFE 2015 data to construct policy-effective factors based on financial knowledge, attitude, and behaviour and Bongini et al. (2018) used OECD INFE 2013 data for Italy to propose a valid financial literacy score. This indicates that the OECD INFE instrument has not undergone rigorous statistical testing in academic literature, especially in single-country contexts. It appears that some validity testing was done in the early stages of creating the OECD instrument. However, the desire to maintain some comparability over the years and the aim to generate an instrument comparable across countries may have led to a situation where the instruments' behaviour could be sub-optimal considering the advancements in the literature and within specific country contexts. We provided several recommendations in the previous sections that can be interpreted as research questions for the following activities. The proposed activities can be divided into 3 steps:

1. A deeper statistical analysis of the existing data of OECD INFE 2023 for Estonia to determine to which extent the existing data could be more efficiently utilised. This step is linked to recommendations 1, 4, 5, 6, 7, 9, 11, 12, 13, and 14. In our opinion, this would potentially be the most cost-effective way to attempt to obtain more insightful input without creating a new instrument from scratch. Given the resource-consuming nature of financial literacy instrument implementation, a completely separate instrument from OECD INFE is unlikely to be a viable solution.
2. Additional research into specific aspects of the instrument to improve the question set (recommendations 1, 2, 3, 10). Broadening the attitude and behaviour questions sets beyond listed aspects would require significant in-depth fundamental analysis of literature, which is likely to be very time-consuming considering the lack of “best” practices.

3. Creating and conducting a small-scale pilot survey containing the possible improvements of the OECD INFE questionnaire by adding some additional questions (recommendations 1, 2, 3, 4, 5, 7, 8, 10, 11, 13, 14). This would allow to compare the performance of the initial questions/claims in comparison to improvement and decide on whether the possible improvements would allow

Given the preliminary nature of the conclusions, further discussion is needed in the research group as well as with the customer to determine the most appropriate next steps. These discussions would also include the initial time plan and the modifications needed. This is because the initial time plan:

1. Did not account for the significant work needed to test the existing instrument (step 1) that could not be done before the finalisation of the review and the execution of which is directly dependent on the progress of the Master student. The work in this area will be started in January 2025.
2. The work needed to go deeper into the specific aspects of the instrument design listed in step 2 was omitted. The gaps listed under step 2 were revealed after finalising the literature review, requiring more in-depth analysis.
3. Without the proper testing of the existing instrument in step 1 and additional analysis done in step 2, step 3 cannot be executed.

4. Improvement of the existing instrument

4.1. Step 1- Statistical analysis of OECD INFE 2023 instrument in Estonia

4.1.1. Financial knowledge construct

Preliminary recommendation 1 is concerned with the reliability of the existing financial knowledge construct as the sum of 7 items. Composite score reliability testing is needed to determine whether the selected items consistently measure the same characteristic (e.g. knowledge). It is usually done through the assessment of the internal consistency reliability using standardised or unstandardised Cronbach alpha coefficient (Cronbach, 1951) that increases with the stronger positive correlation between items and with the increase in the number of items used for the composite score calculation. Its value ranges from 0 to 1, with the 0.7 level usually considered the desirable minimum threshold (Taber, 2018), while most studies tend to report values 0.8 or above (Greco et al., 2018). In the case of binary data it is also possible to use the Kuder-Richardson Formula 20 (KR-20) and 21 (KR-21) (Kuder & Richardson, 1937) or adjusted KR-21 formula (Wilson, 1979). These measures are also calculated on a scale from 0 to 1, with 0.7 considered the minimum acceptable level (Kuder & Richardson, 1937). The KR-20 is considered the most accurate of the three and can handle items with different difficulty levels (Lenke, 1977). When comparing KR21 with adjusted KR-21 formula exhibits lower underestimation compared to Cronbach alpha (Gignac & Ooi, 2022).

As noted by Gignac and Ooi (2022), not many papers developing financial knowledge instruments have tested the internal consistency reliability of financial knowledge scores. Still, Fernandes et al. (2014) reported KR-20 of 0.82 for their financial knowledge score from 13 items. Walstad and Rebeck (2017) reported Cronbach alpha of 0.87 for their 45-item knowledge score. Förster et al. (2017) reported a Cronbach alpha of 0.82 for their 44-item knowledge score and 0.85 for the 45-item score (both based on the share of correct responses). Kunovskaya et al. (2014) reported standardised and unstandardised Cronbach alpha values of 0.65 to 0.77 for the 6-item knowledge score applied in three different

Kommenteeritud [LL1]: KR-21 requires same difficulty level
Adjusted KR-21 requires the same difficulty level, but adjustments are made for specific conditions

Kommenteeritud [LL2]: Compared to KR-20, KR-21 underestimates reliability

countries. Keyser and Duvenhage (2019) obtained a Cronbach's alpha of 0.721 for their 18-item basic knowledge scale. Chen (2022) reported Cronbach alpha of 0.76 for their 23-item financial knowledge scale. Gignac and Ooi (2022) analysis of 52 different financial knowledge scores using Cronbach alpha, KR-20, adjusted KR-21 or coefficient **omega** (depending on data availability), showed that the internal consistency reliability indicators remained in-between 0.3 and 0.87, remaining below 0.62 in 3- to 6-item scores, on average 0.57 in 6- to 8-item scores and on average 0.78 in 10 or more item scores. Similarly, the analysis by Rieger (2020) applying 9 different 3-to 6-item knowledge scales reported in earlier literature, indicated that the Cronbach alpha varied between 0.292 and 0.655 with the best results being obtained with the 3- and 6-item scales from Čumurović and Hyll (2019).

When using the original OECD knowledge score with 7 items, the internal consistency reliability for Estonian 2023 data based on Cronbach's alpha (adjusted for binary data, equal to KR-20) is 0.689 which is somewhat lower than in several previous papers, remaining quite close to the 0.7 desirable threshold. As alpha increases with the number of items, the 7-item approach requires no significant modifications.

The Estonian survey included 2 additional optional items (QK7_1alt and QK7_3alt) that were not used in the OECD knowledge score calculation. When adding these responses to the original 7 items, the 9-item score's internal consistency variability increases to 0.732. This indicates that the consideration of additional items seems worthwhile.

Preliminary recommendation 4 concerns numeracy that is evaluated in the OECD INFE survey using one question. It does appear that some studies constructing financial knowledge scores have included in the score also responses to the numeracy questions when using just one or two of such questions (Bianchi, 2018; Burke & Manz, 2014; Nițoi et al., 2022; van Rooij et al., 2011b). However, at least some researchers have used it as a separate construct from financial knowledge if it contains several questions (Fernandes et al., 2014). This indicates that the OECD INFE numeracy question (QK2) could potentially be added to the set of knowledge questions. If it is added to the current 7-item knowledge score, the score's internal consistency variability is 0.701 and if it is added to the 9-item knowledge score, the score's internal consistency reliability is 0.738. This indicates that the addition of this question improves the internal consistency variability to a rather small extent (0.012 or 0.006 points). This indicates that the coverage of numeracy aspects could be potentially worthwhile if some other and broader set of numeracy questions would be considered. OECD INFE has excluded the score of this item due to too many respondents answering it correctly. The true/false properties of that question are analysed under the next recommendation.

Preliminary recommendations 6 & 7 focus on the subjective financial knowledge component and its integration possibilities. Given that the existing OECD INFE survey contains only one subjective knowledge question, we create a modified version of the Cude et al. (2023) confidence-adjusted knowledge score. This means that similarly to the original, all correctly-answered objective knowledge items receive value +1 and all wrong answers -1. The result for each objective knowledge question is multiplied with the subjective knowledge score (QK1) ranging from 1 to 5 and these scores summed into 1 total confidence-adjusted score. This indicates that for the official financial knowledge score that contains 7 items, the confidence-adjusted score would range from -35 to 35.

The descriptive statistics of the original and confidence-adjusted scores for the Estonian data are presented in Table 7. The original items show that over 70% of respondents got the knowledge questions correct irrespective of the questions, with the exception of item K4, and for 3 questions out of 7 (K1, K2, K6) 90% of respondents got them correct. This refers to knowledge questions being rather easy for the respondents. Subjective knowledge score of 2.979 shows that on average the respondents

Kommenteeritud [LL3]: Uses item-factor loadings to generate coefficient similar to alpha (used it in 2 cases due to lack of other data)

were a bit less than on average (would be 3.0) confident in their responses. As the means of confidence-adjusted items are strongly positive for all items, with the exception of K4, the respondents were confident in responding correctly. The differences between the original and confidence-adjusted scores are statistically significant at $p < 0.01$ for all items and scores. In terms of internal consistency reliability, the 7-item confidence adjusted score has a Cronbach's alpha of 0.746 and that for the 9-item score 0.789 which are somewhat greater than reported for the original scores earlier.

Table 7. Descriptive statistics of knowledge items and scores

Question	Original score (1119 obs)		Confidence- adjusted score (1065 obs)		Wilcoxon signed-rank test
	Mean	St.dev	Mean	St dev	
Observations					***
K1 - ...brothers have to wait for one year to get their share of the \$1,000 and inflation stays at 20% percent. In one year's time will they be able to buy? - More with their share of the money than they could today -The same amount -Or, less than they could buy today -It depends on the types of things that they want to buy	0.899	0.301	2.482	1.877	***
K2 - You lend \$25 to a friend one evening and he gives you \$25 back the next day. How much interest has he paid on this loan? - more than 110EUR -Exactly 110EUR- Less than 110 EUR - Or is it impossible to tell from the information given	0.902	0.298	2.487	1.869	***
K3 - Suppose you put \$100 into a <no fee> savings account with a guaranteed interest rate of 2% per year. You don't make any further payments into this account and you don't withdraw any money. How much would be in the account at the end of the 1st year? (Numeric) Big3	0.765	0.424	1.813	2.529	***
K4 - And how much would be in the account at the end of 5 years? - more than 110EU- Exactly 110EUR- Less than 110 EUR- Or is it impossible to tell from the information given	0.490	0.500	0.192	3.106	***
K5 - You lend \$25 to a friend one evening and he gives you \$25 back the next day. How much interest has he paid on this loan? (numeric)	0.841	0.366	2.223	2.178	***
K6 - High inflation means that the cost of living is increasing rapidly (T/F)	0.932	0.252	2.630	1.662	***
K7 - It is usually possible to reduce the risk of investing in the stock market by buying a wide range of stocks and shares (T/F)	0.719	0.449	1.535	2.707	***
Total knowledge score 7 items (sum)	5.548	1.570	13.362	10.253	***
K8 (QK7_1alt) - If someone offers you the chance to make a lot of money there is also a chance that you will lose a lot of money (T/F)	0.887	0.316	2.410	1.968	***
K9 (QK7_3alt) - It is less likely that you will lose all of your money if you save it in more than one place (T/F)	0.836	0.371	2.172	2.228	***
Total knowledge score 9 items (sum)	7.271	1.900	17.945	12.515	***
Subj. knowledge score (1 least confident to 5 most confident) Could you tell me how you would rate your overall knowledge about financial matters compared with other adults in Estonia? (1 very high -5 very low)	2.979	0.900			

Note: Correct responses for original items coded 1, incorrect 0, original scores for 7-item score ranging from 0 to 7 and 9-item score from 0 to 9. Responses for confidence adjusted items from -5 to +5, confidence-adjusted scores for 7--items ranging from -35 to +35 and for 9 items ranging from -45 to +45. Wilcoxon signed-rank test shows the statistical significant of the difference between the original and confidence-adjusted item/score. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

We analyse the correlations between the original knowledge scores and confidence-adjusted knowledge scores (see Appendix 5). It appears that the pair-wise correlations between the original and confidence-adjusted knowledge items vary between 0.443 (for K6) and 0.881 (K4), indicating quite strong positive correlations. On the aggregate level, the 7-item knowledge scores have a correlation coefficient of 0.886, and 9-item knowledge scores have a correlation of 0.839 with original scores, referring to the very strong correlations. This indicates that from the computational perspective, the modification of the existing OECD knowledge scores provides no real benefits. Potentially greater value could arise from the more precise measurement of subjective knowledge on the question level that would require the addition of new questions to the questionnaire.

Preliminary recommendation 5 focuses on the application of item response theory (IRT). The common approaches for constructing a financial knowledge index are either a simple sum of correct responses or % of correct responses, use of factor analysis on categorical data or the use of IRT. The summing of scores is based on classical test theory (CTT) that is based on the assumptions that the observed score is the sum of their “true” score and error score and all items contribute equally to the overall score. When using factor analysis, a larger set of knowledge items is taken and factor analysis is run to distinguish basic and advanced financial literacy questions and generate an aggregate index of the items (e.g., van Rooij et al., 2011a; van Rooij et al., 2011b, 2012). IRT is a psychometric theory that allows the analysis of item-level performance of a knowledge test to determine which questions should be included in the financial knowledge scale considering different properties of the questions. It does not focus on the performance of the total score (as in the case of CTT) but on the performance of individual items and thanks to the iterative estimation process, it avoids information loss that commonly occurs when aggregating financial knowledge items through a factor analysis (Xue et al., 2019).

When using IRT, the researcher can choose different models: one-parameter logistic model (1PL or so-called Rasch model) that focuses on the difficulty of items; two-parameter logistic model (2PL, so-called Birnbaum model) that considers both the level of difficulty and discriminatory power of items; three-parameter logistic model (3PL) that considers each item’s level of difficulty, discriminatory power and probability of guessing the correct answer; and four-parameter logistic model (4PL) that considers each item’s level of difficulty, discriminatory power, probability of guessing the correct answer and inattention. In financial knowledge scale creation, several authors have used IRT with 2-PL (Bajaj & Kaur, 2024; Förster et al., 2017; Knoll & Houts, 2012; Ranyard et al., 2020) or 1-PL (Bongini et al., 2018; de Clercq, 2019; Kunovskaya et al., 2014; Schuhen et al., 2022). More complex approaches have been used in the form of 2PL-PCM to account for the three categories (correct, partially correct, false response) in Xue et al. (2019) and 4-PL in Walstad and Rebeck (2017).

Initially, we used 1-PL model (see Appendix 6). It appears that from the original 7 knowledge items, the difficulty indicator of K4 is not statistically significant. This indicates that this item does not effectively differentiate between the ability levels of respondents. The same result pertains if the additional two knowledge questions are included. The difficulty indicators range between -3 and +3, with those below 0 referring to questions below-average difficulty and above 0 to questions with above-average difficulty. The easiest is the question K6, followed by K2, K1 and numeracy. All questions, except for K4, are on the easier side of the scale. The best fit model is the original knowledge scores without K4 (log-likelihood -2514), followed closely by original scores without K4 and together with the numeracy question (log-likelihood -2844). Assuming that all questions are of similar difficulty, the discrimination of questions remains at 1.5, which refers to a high level of discrimination, indicating that small differences in ability lead to significant differences in correct responses.

We also run 2-PL models (see Appendix 7) that allow the discrimination of each question to vary alongside their difficulty level. Similarly to 1-PL results, the K4 response creates problems in the convergence of the IRT model, indicating that this item behaves too differently from all others. Although K4's difficulty parameter is significant in the 2-PL model with the original 7 questions, its difficulty parameter turns statistically insignificant in the model with 2 additional knowledge questions. Similarly to 1-PL results, all questions, except K4, have below-average difficulty levels with K6 remaining the easiest, followed by Numeracy, K8 and K1. In terms of discrimination, the values above 1 refer to high discrimination (small changes in ability result in large changes in the probability of correct response). This indicates that these questions enable to create a valid scale. From all questions besides K4, K3 and K2 are the most vulnerable to potential overfitting as their discrimination coefficients is above 2 in several models. When comparing whether to prefer 2-PL over 1-PL, the LR test refers to the superiority of 2-PL model in all cases. Also the log-likelihood indicators refer to better fit of the 2-PL models compared to 1-PL models.

IRT models allow to estimate IRT scores that provide a more nuanced measure of respondent's ability compared to the traditional summed score. We calculated correlations between the standardized summed knowledge scores and standardized IRT scores. The results in Table 8 show that the pairwise correlation coefficients are above 0.97, indicating that the summed scores are closely aligned with IRT scores. This refers to the classical summed scores providing a reasonably good measure of ability.

Table 8. Correlations between standardized summed scores and IRT scores

	Summed vs 1-PL	Summed vs 2-PL	1-PL vs 2-PL
Original knowledge scores wo K4	0.9864	0.9775	0.9891
Original knowledge scores wo K4 + Numeracy	0.9839	0.9709	0.9841
Original knowledge scores wo K4 + Numeracy + 2 additional	0.9770	0.9755	0.9977

Overall, the IRT analysis reveals that **K4 and potentially also K3 may not be the best questions for distinguishing the ability levels of respondents**. This indicates that when using OECD scores, their exclusion from aggregate knowledge scores could be considered. Still, the exclusion of K4 from the 7-item score would reduce the internal consistency reliability measured with Cronbach's alpha from 0.689 to 0.643 and the further exclusion of K3 would lead to alpha 0.5643. this indicates that even if the exclusion of K4 is reasonable, the further exclusion of K3 may not be. The remaining knowledge questions tend to be rather easy for respondents, however, their discrimination is very good. As the IRT scores behaved rather similarly to summed scores, the simpler summed scores remain appropriate measures of financial knowledge. Still, if the inclusion of additional knowledge questions were to be considered, the IRT analysis would provide a very useful approach for developing the best knowledge scale.

We also investigated whether the existing knowledge items can be appropriately captured with one score. Therefore, we ran initially exploratory factor analysis (EFA) using tetrahoric correlations and then confirmatory factor analysis (CFA) using tetrahoric correlations. As the K4 variable exhibited correlation coefficient 1 with variable K3 and its inclusion created also problems in estimations, indicating serious data problems, we excluded this variable from further estimations. **Table 9** summarises the results.

Table 9. Main findings from EFA and CFA using knowledge items

Model	Alt1	Alt2	Alt3	Alt4	Alt5
EFA items	6 from original OECD score (K1, K2, K3, K5, K6, K7)	9 items (K1, K2, K3, K5, K6, K7, K8, K9, Num)	9 items (K1, K2, K3, K5, K6, K7, K8, K9, Num)	8 items (K1, K2, K3, K5, K6, K7, K8, K9)	8 items (K1, K2, K3, K5, K6, K7, K8, K9)
Items remaining after eliminating variables with low communalities	All 6	All 9	All 9	All 8	All 8
Factors identified	1	1	3	1	3
Factors in CFA	F1 incl K1, K2, K3, K5, K6, K7	F1 incl. K1, K2, K3, K5, K6, K7, K8, K9, Num	F1 incl. K1, K2, K3, Num; F2 incl K5, K6, K8; F3 incl. K7, K9	F1 incl K1, K2, K3, K5, K6, K7, K8, K9	F1 incl. K1, K2, K3, Num; F2 incl K5, K6, K8; F3 incl. K7, K9
RMSEA	0.166	0.188	0.113	0.194	0.104
CFI	0.890	0.768	0.926	0.792	0.949
TLI	0.817	0.691	0.888	0.709	0.916
R2	0.858	0.882	0.986	0.874	0.985
AIC	16814	25053	24330	22213	21579
BIC	16874	25144	24435	22293	21675
Composite factor reliability					
F1 (factor 1)	0.837	0.874	0.831	0.871	0.825
F2 (factor 2)			0.795		0.795
F3 (factor 3)			0.802		0.803

As seen from the table, most combinations of knowledge items lead to either a 1-factor or 3-factor solutions. When both 1- and 3-factor solutions emerged, the 1-factor solution seemed more viable in terms of content. Still, the 3-factor models do exhibit slightly better fit statistics in terms of CFI and TLI, with the best fit being reported for the 8-item case in model Alt5 that exhibits also the best RMSEA. The fit statistics seem to indicate that the inclusion of numeracy question to 1-factor models decreases model fit. Still, the original 6-item factor provides the best 1-factor solution in terms of fit and the AIC and BIC refer to the comparatively best fit across all models, indicating that there is no need to consider further items besides the original 6 with such simple 1-factor structure. In terms of reliability the original OECD INFE knowledge score exhibited Cronbach alpha of 0.69 that is lower than in any of the composite factor reliabilities reported in Table 9. This indicates that the reliability of the construct was better with factorisation in all tried models.

Conclusion on knowledge construct - the results presented above indicate that concerning:

- **Recommendation 1 & 4** - The consideration of all knowledge questions, including numeracy and K8, K9 remains important for improving internal consistency reliability and their inclusion also supports the creation of a better overall knowledge construct. At the same time, the inclusion of additional items in the factor structure provides no significant improvement in the overall score reliability. This indicates that there is no significant need to consider further items in the form of numeracy, K8 or K9. Compared to K8 and K9, existing numeracy question provides less additional value.

- **Recommendation 5** - Creation of knowledge score through IRT does not seem to provide significant advantages over the simpler summed score, however, this method may be useful for determining the best combination of questions if some additional knowledge questions would be included in the survey. CFA confirms the viability of a 1-factor structure that is assumed for the creation of knowledge score by the OECD INFE.
- **Recommendation 6&7** - The consideration of subjective knowledge could be worthwhile only if a separate set of subjective knowledge questions is added to the survey. The existing subjective knowledge question in OECD INFE provides no significant improvement possibilities in measurement.

4.1.2. Financial attitude construct

The original two items forming OECD INFE attitude score QS1_1 and QS3_9 have Cronbach alpha 0.427 that is rather low. Therefore, the consideration of additional questions may be worthwhile.

Preliminary recommendation 9 focuses on the possibilities of widening the set of attitude items in the attitude score creation. The original OECD INFE questionnaire contains 17 items that have not been included in other constructs and can be classified under attitudes. All these items are measured on the same scale of 1 to 5. The items are summarized in Table 10. As seen from the table, 5 items have nearly 1/3 of responses missing. Therefore, EFA using polychoric correlations was done on two different sets of items: the first set focused on all 17 items and the second on those 12 items that had less than 20% of responses missing.

Table 10. Descriptive statistics of attitude items

Code	Question (1 completely agree to 5 completely disagree)	Missing responses	Mean	St. dev
QS1_1*	<i>I find it more satisfying to spend money than to save it for the long term</i>	13%	3.331	1.367
QS1_2	<i>I am prepared to risk some of my own money when saving or making an investment</i>	12%	3.607	1.330
QS1_3**	<i>Money is there to be spent I believe that money in a bank will be safe</i>	6%	3.001	1.095
QS1_8	<i>I believe that money in a bank will be safe even if the bank fails</i>	10%	2.881	1.411
QS1_10	<i>If I borrow money I have a responsibility to pay it back</i>	9%	1.289	0.479
QS1_11	<i>I believe that banks should check the ethics of companies before providing them with banking services</i>	11%	1.822	0.946
QS2_9	<i>Before I buy something I consider whether the company strives to improve its social or environmental impact</i>	0%	3.959	1.084
QS3_3	<i>I am honest even if it puts me at a financial disadvantage</i>	9%	1.946	0.977
QS3_4	<i>I am happy to discuss my financial situation with people I know well</i>	7%	3.163	1.667
QS3_5	<i>I trust financial service providers to treat me fairly</i>	14%	2.912	1.243
QS3_6	<i>If a shop keeper gave me too much change, I would probably keep it</i>	13%	4.097	1.264
QS3_9*	<i>I tend to live for today and let tomorrow take care of itself</i>	6%	3.654	1.316
QS4_5	<i>I trust the financial services provided by online banks and FinTechs (such as)</i>	33%	3.151	1.543
QS4_6	<i>I believe that financial service providers should use a wide range of non-financial personal data, including from social media, in decisions about granting credit</i>	29%	3.685	1.578
QS5_1	<i>It is more important to invest in companies that are making a profit than in companies that strive to minimise their negative impact on the environment</i>	33%	2.655	1.212
QS5_2	<i>It is more important to invest in companies that are making a profit than in companies that strive to improve their social impact</i>	32%	2.663	1.150

QS5_3	<i>It is more important to invest in companies that are making a profit than in companies that strive to improve their risk management, ethics and accountability</i>	32%	3.013	1.120
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Notes: *included in OECD INFE calculation of attitude score, ** alternative indicator not used in official score.

The results of EFA and CFA for the most reliable outcomes are summarized in Table 11. We do not report here the results for 1-factor solutions with 2 items due to difficulties in estimating their fit statistics and/or perfect fit. The factors encountered in the omitted models resemble the factors covered in the summarized results in Table 11. The best-fit model based on CFI and TLI Alt2 has 2 factors with factor 1 (F1) capturing the attitude towards ESG investing and factor 2 (F2) focusing on attitude towards spending. The items of F2 are 2 of the 3 items that OECD INFE uses for the calculation of its attitude score. The 3rd item in OECD INFE attitude score focusing on time-preferences did load into the same factor (F4) with the remaining two items in Alt1 5-factor model. Still, it did not emerge as an important item in any other factor combinations. Although the Alt1 5-factor model exhibits somewhat poorer fit than other models based on CFI and TLI, its RMSEA is the best together with Alt3 model. Model Alt1 provides very interesting insight into which items are more closely related, with F2 associated with risk-taking, F3 with trust in financial institutions and F5 with honesty and responsibility. Similar factors emerge in Alt3 and Alt4 with slight modifications.

Table 11. Main findings of EFA and CFA using attitude items

Model	Alt1	Alt2	Alt3	Alt4
EFA items	17	17	12	12
EFA excluding	-	-	QS4_5, QS4_6, QS5_1, QS5_2, QS5_3	QS4_5, QS4_6, QS5_1, QS5_2, QS5_3
Items remaining in factors	14	5	6	7
Factors identified	5	2	3	3
Factors in CFA	F1 incl QS5_1, QS5_2, QS5_3; F2 incl QS1_2, QS3_4; F3 incl QS1_8, QS3_5, QS4_5; F4 incl QS1_1, QS1_3, QS3_9; F5 incl QS1_10, QS3_3 QS3_6	F1 incl QS5_1, QS5_2, QS5_3; F2 incl QS1_1, QS1_3	F1 incl QS1_8, QS3_5; F2 incl QS1_2, QS3_4; F3 incl QS1_1, QS1_3	F1 incl QS1_8, QS3_5, QS3_4; F2 incl QS1_1, QS1_3; F3 incl QS3_3 QS3_6
RMSEA	0.097	0.110	0.097	0.102
CFI	0.860	0.980	0.945	0.894
TLI	0.810	0.951	0.862	0.797
R2	1.000	1.000	1.000	1.000
AIC	40182	13204	17979	21178
BIC	40373	13259	18054	21263
Composite factor reliability				
F1 (factor 1)	0.898	0.896	0.661	0.637
F2 (factor 2)	0.631	0.754	0.536	0.736
F3 (factor 3)	0.701		0.782	0.639
F4 (factor 4)	0.678			
F5 (factor 5)	0.572			

Overall, the results show that the existing items do not converge into a single attitude factor and the factor structure, in terms of the number of factors and their contents, varies depending on which items are considered and which choices are made when running EFA. Still, it is clear that there exist several items in the existing OECD INFE instrument that are not included in the attitude score but could deserve attention. Therefore, the score could potentially include 11 additional items like QS5_1, QS5_2, QS5_3, QS1_2, QS3_4, QS1_8, QS3_5, QS4_5, QS1_10, QS3_3 and QS3_6 next to the existing three (QS1_1, QS1_3, QS3_9). If one excludes the less popular items in terms of responses, there would be 7 new items to include (QS5_1, QS5_2, QS5_3 and QS4_5 would be omitted).

In terms of **recommendation 11** concerning the aggregation method of responses. The comparison of the descriptive statistics of the original OECD INFE behaviour score with factor scores or the correlations between them is not possible due to the use of correlations in the factor estimation that does not allow the use of the original dataset. The only easy way to compare the behaviour of final scores is to focus on the reliability estimates. Cronbach alpha of all the original claims used in OECD INFE attitude score calculation is equal to 0.62, which is rather good given that only 3 items were used. The composite factor reliability estimates provided in Table 11 indicate that the reliability estimates are somewhat better in most models. In the Alt 1 model, only factor 5 and in the model Alt 3, factor 2 have somewhat poorer reliability. This indicates that the inclusion of additional items with factorisation does allow to capture the underlying constructs better.

What complicates the use of factor-based scores for aggregation purposes in practice is the use of polychoric correlations that does not allow to easily transform the factor results obtained from correlations to the original items. Given this complexity, the summing of scores may appear easier solution. If one would include the additional 11 items with original 3, the Cronbach alpha would be 0.505 which is lower than for original 3 items. It seems to indicate that the addition of items may need to be considered together with simultaneous factorisation to improve the construct.

Conclusion on attitude construct - the results presented above indicate that concerning:

- **Recommendation 9** – indicate the attitude construct could be more comprehensively captured by including at least 7 and maximum 11 existing items to the 3 used currently by OECD INFE.
- **Recommendation 11** – results show that complexities involved in the use of factor analysis may favour the use of summed score on more items. However, the reliability estimates indicate that the addition of items may require the use of factorisation to reap full benefits from the added items.

4.1.3. Financial behaviour construct

Preliminary recommendation 12 focuses on the possibilities of widening the set of behaviour items in the attitude score creation. The OECD INFE questions related to financial behaviour can be divided into three groups:

1. 16 Yes/no questions.
2. Questions focusing on information sources used when choosing financial products – yes/no answer provided to each listed information source.
3. 9 behaviour-related claims measured on a scale of 1 to 5.

The 2nd group of questions was not analysed, as no meaningful approach to run factor analysis on them exists. In the 1st group, EFA and CFA using tetrachoric correlations will be used, and in the 2nd group, EFA and CFA using polychoric correlations will be used. This means that for factor analysis, the questions/items are clearly split into two parts.

The summary statistics of the analysed items for yes/no questions are presented in Table 12. As can be seen from the table, only two questions have some missing values, the remaining items have responses from all respondents. Both of these questions relate to the questions who makes the financial decisions and in the original OECD INFE instrument the two questions are both used as input. All items are in some form covered by the OECD INFE behaviour score.

Table 12. Descriptive statistics of analysed yes/no behaviour items

Code	Question (options Yes/No)	Missing responses	Mean	St. dev
QF1*	<i>Who is responsible for making day-to-day decisions about money in your household? (converted to 1 you or you with someone else or 0 someone else)</i>	1%	0.949	0.221
QF1_a*	<i>Do you make day-to-day decisions about your own money?</i>	2%	0.962	0.192
QF2_1*	<i>Do you do any of the following for yourself or your household? Make a plan to manage your income and expenses</i>	0%	0.550	0.498
QF2_2*	<i>Do you do any of the following for yourself or your household? Keep a note of your spending</i>	0%	0.515	0.500
QF2_3*	<i>Do you do any of the following for yourself or your household? Keep money for bills separate from day-to-day spending money</i>	0%	0.199	0.400
QF2_4*	<i>Do you do any of the following for yourself or your household? Make a note of upcoming bills to make sure you don't miss them</i>	0%	0.166	0.372
QF2_5*	<i>Do you do any of the following for yourself or your household? Use a banking app or money management tool to keep track of your outgoings</i>	0%	0.228	0.420
QF2_6*	<i>Do you do any of the following for yourself or your household? Arrange automatic payments for regular outgoings</i>	0%	0.456	0.498
QF3_1*	<i>In the past 12 months have you [personally] been saving money in any of the following ways. Saving cash at home or in your wallet</i>	0%	0.417	0.493
QF3_2*	<i>In the past 12 months have you [personally] been saving money in any of the following ways. Paying money into a (savings/deposit) account</i>	0%	0.434	0.496
QF3_3*	<i>In the past 12 months have you [personally] been saving money in any of the following ways. Giving money to family to save on your behalf</i>	0%	0.035	0.183
QF3_4*	<i>In the past 12 months have you [personally] been saving money in any of the following ways. Saving in (an informal savings club)</i>	0%	0.013	0.111
QF3_5*	<i>In the past 12 months have you [personally] been saving money in any of the following ways. Buying bonds or time deposits</i>	0%	0.046	0.209
QF3_6*	<i>In the past 12 months have you [personally] been saving money in any of the following ways. Investing in crypto-assets or ICOs</i>	0%	0.050	0.218
QF3_7*	<i>In the past 12 months have you [personally] been saving money in any of the following ways. Investing in stocks or shares</i>	0%	0.195	0.396
QF3_8*	<i>In the past 12 months have you [personally] been saving money in any of the following ways. Saving or investing in some other way, other</i>	0%	0.082	0.275

Notes: *included in OECD INFE calculation of behaviour score indirectly

When calculating tetrachoric correlations, it appears that item QF1_a has a perfect correlation with items QF3_4, QF3_6 and QF3_8. This indicates that QF1_a cannot be included in factor analysis and only the remaining 15 items of the 16 listed in Table 12 will be used. As can be seen from Table 13, the factor analyses tend to lead to perfectly fitted comparatively superior 1-factor models. Although based on AIC and BIC the Alt4 model with 1 factor and 2 items is the best, the Alt1 model with 1 factor and 4 items leads to a model with acceptable fit based on CFI and TLI. In terms of RMSEA, the best model is Alt2. All analyses indicate that one factor is formed from items connected to investment behaviour. In Alt2 a separate factor for budgeting and in Alt3 for items related to everyday money management including payments emerges. Alt2 is superior to Alt3 as the composite factor reliability of the money management remains below 0.7 and lower than for budgeting in Alt2.

Table 13. Main findings of EFA and CFA using yes/no behaviour items

Model	Alt1	Alt2	Alt3	Alt4	Alt5	Alt6
EFA variables	15	14	15	15	15	14
QF1 details	QF1 included	none	QF1 included	QF1 included	QF1 included	none
Variables remaining in factors	4	6	6	2	3	3
Factors identified	1	2	2	1	1	1
Factors in CFA	F1 incl QF3_5, QF3_6, QF3_7, QF3_8	F1 incl QF3_5, QF3_6, QF3_7, QF3_8; F2 incl QF2_1, QF2_2	F1 incl QF1f, QF2_6; F2 incl QF3_5, QF3_6, QF3_7, QF3_8	F1 incl QF3_6, QF3_8	F1 incl QF3_5, QF3_6, QF3_8	F1 incl QF3_6, QF3_7, QF3_8
RMSEA	0.124	0.102	0.144	0.000	0.000	0.000
CFI	0.967	0.936	0.867	1.000	1.000	1.000
TLI	0.902	0.881	0.750	1.000	1.000	1.000
R2	0.780	0.934	0.889	1.000	0.711	0.741
AIC	11686	17704	17865	6074	9071	8801
BIC	11726	17769	17930	6094	9102	8831
Composite factor reliability						
F1 (factor 1)	0.758	0.758	0.518	0.736	0.656	0.741
F2 (factor 2)		0.625	0.757			

The summary statistics of the analysed items for scaled items are presented in Table 14. As seen from the table, more missing values occur for the last 5 items. From the 9 items 4 are currently covered in OECD INFE behaviour score creation. When running EFA and CFA on ploychoric correlations, only one solution emerges. It contains one factor and two items (QS1_5 and QS1_7) that are both covered in the present OECD INFE score creation. The CFA using these items provided RMSEA equal to 0, CFI equal to 1, TLI equal to 1, AIC 6072 and BIC 6092, referring to perfect fit of the model. Composite factor reliability of that factor is 0.737.

Table 14. Descriptive statistics of analysed scaled behaviour items

Code	Question	Missing	Mean	St dev.
QS1_5*	<i>How much you agree or disagree that each of the statements applies to you, personally. I keep a close personal watch on my financial affairs</i>	4%	2.175	1.019
QS1_7*	<i>How much you agree or disagree that each of the statements applies to you, personally. I set long term financial goals and strive to achieve them</i>	8%	2.916	1.142
QS2_3*	<i>Before I buy something I carefully consider whether I can afford it</i>	0%	2.157	1.012
QS2_5*	<i>I pay my bills on time</i>	0%	1.247	0.577
QS2_10	<i>I buy goods and services that I do not need</i>	0%	3.903	0.842
QS3_1	<i>For each statement could you let me know whether it describes your situation. I tend to ignore the small print unless something goes wrong</i>	14%	3.915	1.151
QS3_10	<i>I sometimes buy a lottery ticket when I feel like I don't have enough money</i>	6%	4.136	1.226
QS4_4	<i>Digital tools facilitate the management of my personal finances</i>	11%	2.027	1.048
QS4_7	<i>I am more likely to buy impulsively when I buy online than in person in a shop</i>	10%	3.858	1.283

QS4_8	<i>It is more likely that I would read the small print of a contract if it is on paper than online</i>	15%	2.959	1.353
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Notes: *included in OECD INFE calculation of behaviour score indirectly

Overall, the results show that the use of very different types of questions to measure financial behaviour complicates the possibilities to identify factors. In our analysis we were forced to omit quite significant portion of items related to financial products. The two sets of analysed items, show that investing and budgeting factors emerge as more relevant. The items under these factors are already covered in the current OECD INFE behaviour score calculation, i.e. no new potentially interesting items were identified from the existing questionnaire.

Preliminary recommendation 13 focuses the aggregation method of claims. The comparison of the descriptive statistics of the original OECD INFE behaviour score with factor scores or the correlations between them is not possible due to the use of correlations in the factor estimation that does not allow the use of the original dataset. The only easy way to compare the behaviour of final scores is to focus on the reliability estimates. Cronbach alpha of all the original claims used in OECD INFE behaviour score calculation is equal to 0.546, which is rather low given the number of claims used. It remains significantly lower than the composite factor reliability scores calculated for factors (see Table 12 and the previous discussion accompanying scaled indicators). All factor solutions except for the Alt3 behave significantly better than the original score and, in most cases, provide composite factor reliability scores above the desirable minimum of 0.7. This indicates that our simple factors are apparently able to capture the underlying constructs somewhat better.

What complicates the use of factor-based scores for aggregation purposes in practice is the use of tetrachoric and polychoric correlations that does not allow to easily transform the factor results obtained from correlations to the original items. Given this complexity, the summing of scores appears more viable solution. Still, the extremely complex behaviour score calculation used in OECD INFE could be potentially be replaced with something significantly simpler. The investigation of these possibilities remains outside of the scope of the current project.

Conclusion on behaviour construct - the results presented above indicate that concerning:

- **Recommendation 12** – indicates that there are no meaningful items in the existing OECD INFE instrument that could be considered for behaviour score calculation in addition to the ones used already.
- **Recommendation 13** – show that the summing of scores may be the easiest approach considering the varying characteristics of the behaviour questions (yes/no vs scales). However, as the aggregation method for behaviour items in OECD INFE is not a simple sum of responses, the consideration of alternative and more intuitive approaches may be worthwhile. Still, the current setup of the construct does not allow factorisation, meaning that alternative approaches would require a complete makeover of the construct and questions.

4.1.4. Single financial literacy construct

Preliminary recommendation 14 focuses on whether the construction of a composite financial literacy score is justified. We follow the approach used in Potrich et al. (2016) that considered three models to determine how financial literacy should be measured (see Figure 10).

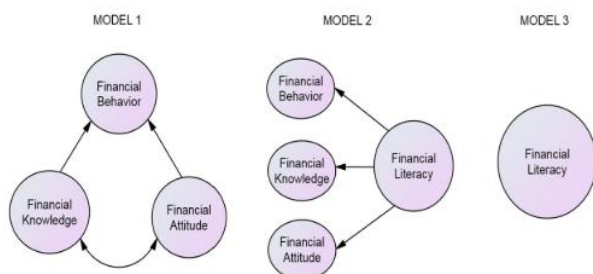


Figure 10: Alternative models for financial literacy measurement

Source: Potrich et al. (2016, p. 363)

Model 1 is based on Hayhoe et al. (2005) and it assumes that the precondition for a change in financial behaviour is a change in financial knowledge and attitude (the latter being correlated with each other). Model 2 assumes that financial literacy is a combination of financial behaviour, financial knowledge and financial attitude constructs, the view taken also by OECD INFE instrument. Model 3 is based on Shockey (2002) arguments referring to the existence of one financial literacy construct that contains elements of financial behaviour, attitude and knowledge (are not separate constructs underneath the one construct). In all three models the individual evaluations of items knowledge (K1 to K7); attitude (QS1_1 and QS3_9) and behaviour (sub-scores of B1 to B8) are used. Due to the binary and Likert-scale items, the GSEM in Stata was used. This estimation approach does not provide other fit statistics besides AIC and BIC (see results in Table 15).

Table 15. Comparison of model fit

	AIC	BIC
Model 1	22214.66	22430.52
Model 2	22221.58	22437.45
Model 3	22597.15	22802.98

These results indicate that Model 3 has the worst fit. LR test between Model 2 and Model 3 confirms that Model 2 is significantly better than Model 3 (p-value 0.000, Chi2 statistic 379.57). Model 1 is slightly better than Model 2 (based on AIC and BIC), however, the difference remains rather small. It has to be also borne in mind that both Model 1 and Model 2 suffer from serious convergence problems, indicating that the structure of the model could be potentially improved and the fit statistics are likely to contain some level of error.

Overall, it means that based on OECD INFE data, there are clearly three different latent constructs: attitude, behaviour and knowledge. Whether they should be viewed as connected to each other (as in Model 1) or parts of the single financial literacy construct (as in Model 2) remains an open question requiring separate investigation that would also entail the deeper analysis of the considered items. As shown earlier, the individual items may behave somewhat differently from the behaviour components used in OECD INFE.

4.2. Step 2- Improving the questionnaire

Based on the conclusions drawn in the analysis phase (see section 4.1.), a decision was made to create a pilot survey. The following principles were used as a basis:

- The pilot survey would be carried out only in Estonian and targeting the same group as OECD INFE age 18 to 79 years.
- All claims from the existing OECD INFE that were needed to calculate OECD INFE knowledge, attitude, behaviour, and financial well-being scores should be included along with background information questions.
- Claims identified as potentially relevant (7 in total) in the existing OECD INFE instrument for improving the measurement of attitude should be added.
- The instrument should include additional elements to improve the usability of the instrument in Estonian context.

In line with the last point, 11 new constructs containing 52 claims were identified based on the following arguments:

- **Subjective financial knowledge** (1 item) - alternative formulation provided by several authors incl. (Lusardi, 2011).
- **Preference for numerical information** (8 items from Fernandes et al. (2014)) – this is a personality trait that describes cognitive abilities predicting the development of financial knowledge and behaviour. Numeracy has been shown to be an important control variable when investigating financial behaviour (Fernandes et al., 2014) .
- **Future orientation** (3 items from Joireman et al. (2012)) – this reflects a cognitive trait characterizing personality that involves planning one's activities in the long term. Future orientation has been shown to influence financial behaviour (Howlett et al., 2008) as well as well-being and risk-taking (Kooij et al., 2018).
- **Impulsivity** (5 items from Paaver et al. (2006)) – is an important personality trait that predicts the level of self-control and is also reflected in decision-making styles (DeYoung & Rueter, 2010; Leshem & Glicksohn, 2007).
- **Sensation seeking** (3 items from Paaver et al. (2006)) – is an important personality trait that predicts the likelihood of risky behaviour (Qianlan et al., 2025; Zuckerman, 1994). It can be considered a sub-trait of impulsiveness (Leshem & Glicksohn, 2007).
- **Risk-avoidance** (3 items from Li et al. (2021)) – is a cognitive trait of personality that characterizes the avoidance of failures in behaviours and decision-making (Huber et al., 2014).
- **Risk-taking** (3 items from Li et al. (2021))- A cognitive trait of personality that characterizes calculated risk-taking and achievement orientation in behaviours and decision-making (Mata et al., 2018).
- **(Positive) financial behaviour** (9 items from Dare et al. (2023)) – financial behaviours that enable the person to improve their financial well-being.
- **Intention** (7 items created by the authors based on positive financial behaviours) - The realization of attitude in behaviour, which is an important component in the Theory of Planned Behaviour and predicts the likelihood of behaviour corresponding to the attitude and the presence of intention is crucial for the occurrence of behaviour (Ajzen, 1991; Ajzen & Sheikh, 2013).
- **Financial stress** (5 items Dare et al. (2023)) - A trait describing anxiety and stress due to financial status, which stems from a more general level of personality anxiety (Ryu & Fan, 2023).

- **Financial self-efficacy** (5 items Dare et al. (2023)) - A cognitive trait of personality that describes a person's belief in their ability to successfully complete a financial task (Mindra & Moya, 2017). It is based on the concept of self-efficacy (Bandura, 1977).

Some of these elements overlap with the OECD INFE constructs. For example, behaviour items in OECD INFE have been prepared using a different approach compared to the set of behaviour items and as representations of positive financial behaviours in this pilot. When combining the original and added items, the expected associations are depicted on Figure 11.

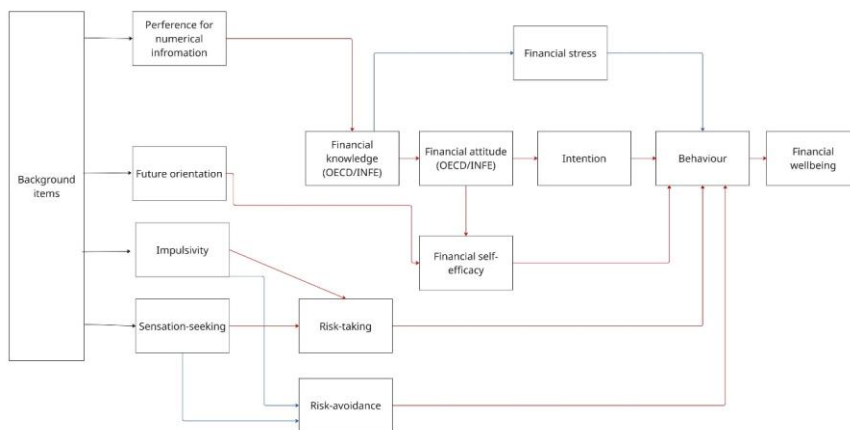


Figure 11. Expected associations between pilot survey elements.

When forming the expected relationships, different studies focusing on the determinants of financial behaviour and financial well-being were considered (Brannon & Manshad, 2022; Goyal et al., 2022; Kadyan, 2024; Lučić et al., 2024; Sekširićska et al., 2021; Strömbäck et al., 2017; van Dolder & Vandenbroucke, 2024). Only those constructs that have been shown to influence financial behaviour and impact financial decisions were included.

Before the final list of questions/items was prepared, a pre-pilot of the added constructs was carried out (the OECD INFE questions were not considered at this stage). The aim of the pre-pilot was to check the appropriateness and comprehensibility of the translation, the reliability of new components, clarify new components' internal structure and strength of associations. The initial questions, worded in English, were translated into Estonian using the TRAPD (translation, review, adjudication, pretesting and documentation) method (Harkness et al., 2010). Four researchers who had knowledge of the subject and experience with survey translation provided independent draft translations along with problematic aspects. The draft translations were compared and discussed in the group to determine the best version. This version containing 52 claims/items was used in the pre-pilot with additional 5 items added to get some indication of the socio-demographic aspects (gender, age, employment, monthly savings behaviour) of the respondents.

The pre-pilot was carried out between 7 March and 9 March 2025 in LimeSurvey environment. The anonymous responses were gathered from Master students at TalTech and EBS. In total of 184 people responded, 140 of them completed the survey. From the 140 respondents 72% were female, the average age was 28.62 years (st. dev 10.25), 51.6% considered their financial well-being above average.

In terms of employment 38.7% were specialists, 21.1% were in managing roles and 36.6% were ordinary employees.

The reliability of constructs was tested using Cronbach alpha (with 0.7 considered acceptable) and EFA (based on principal components analysis and varimax rotation) was used to check the latent factors within the constructs. For details, see Appendix 8. In the context of risk readiness component, two factors (risk avoidance and risk-taking) were present (KMO 0.697; Bartlett test of sphericity $p < 0.001$, 69.05% of variation explained by the two factors). In preference for numerical information component two factors (like to work with numbers and numbers are important) emerged (KMO 0.833; Bartlett test of sphericity $p < 0.001$, 69.51% of variation explained by the two factors). Three factors emerged from the positive financial behaviour component (KMO 0.723; Bartlett test of sphericity $p < 0.001$, 60.69% of variation explained by the three factors). During the analysis it appeared that 3 claims related to risk-avoidance and 1 claim related to positive financial behaviour needed to be reversed for analysis purposes. As a result of this analysis, a decision was made to correct the wording of the latter positive financial behaviour claim from *"I spend more than my income"* to *"I earn more than I spend"*. Also one claim related to sensation seeking (*"I can make quick decision even in unexpected situations"*) was removed from the questionnaire as it did not seem to be measuring the desired construct.

After reviewing the results and considering the importance of financial well-being for further analyses, a decision was also made to introduce additional 5 items representing (Subjective) financial wellbeing from Dare et al. (2023). This refers to a subjective satisfaction assessment of one's financial status, which characterizes a person's well-being and reflects their success in achieving financial goals (García-Mata & Zerón-Félix, 2022).

The final pilot survey

The pilot survey included in total of **121 claims**. In line with the previously stated principles the final pilot survey contained **65 claims from the existing OECD INFE instrument**, including:

- 11 background items,
- 9 knowledge items (including 1 question for subjective knowledge and 1 question for numeracy that are not included in the knowledge score) with the answers transformed into correct and incorrect,
- 3 attitude items included in the original attitude score + 7 questions/claims not included in the original score, all measured with 5-point Likert scale: Not at all (5)/ Somewhat not (4)/ Neutral (3)/ Somewhat agree (2)/Completely agree (1).
- 23 behaviour items (including three modified questions to reduce the number of questions needed for calculating the behaviour score). These questions use very different scales, some yes/no, some listed items, some 5-point Likert scales.
- 12 financial well-being items divided into subjective well-being (scale: Not at all (5)/ Somewhat not (4)/ Neutral (3)/ Somewhat agree (2)/ Completely agree (1)) and objective well-being (scale: Never (5)/ Rarely (4)/ Sometimes (3)/ Often (2)/ Always (1)).

Most of these claims included the possibility to refuse to answer.

It also included 12 new constructs containing **56 new claims** that are summarized in Table 16. All the new items were measured on 5-point Likert scales with response categories varying slightly by constructs. None of these scales included the possibility to refuse to answer.

Table 16. Summary of new constructs, scales and response categories

Construct	No if claims (items)	Response categories
Subjective financial knowledge	1	1 very low knowledge (1)/ ... 7 very high knowledge (7)
Preference for numerical information (New_numb...)	8	Strongly disagree (5)/ Somewhat disagree (4)/ Neutral (3)/
Future orientation	3	Somewhat agree (2)/ Completely agree (1)/
Impulsivity (New_imp...)	5	
Sensation seeking	2	
Risk-avoidance (New_riska...)	3	
Risk-taking (New_riskt...)	3	
Financial self-efficacy (New_sf...)	5	
(Positive) financial behaviour (New_b...)	9	Never (5)/ Rarely (4)/ Sometimes (3)/ Often (2)/ Always (1)
Intention (New_i...)	7	Definitely do not intend to (5)/ Rather do not intend to (4)/ Either way (3)/ Rather intend to (2)/ Definitely intend to (1)
Financial stress (New_ft...), current situation	5	Does not describe at all (5)/ Somewhat does not describe (4)/
(Subjective) financial wellbeing (New_fs...), future financial security	5	Neutral (3)/ Somewhat describes (2)/ Describes completely (1)/
Total new items	56	-

4.3. Step 3 – Conducting the pilot survey and analysing background indicators

The pilot survey was conducted through a survey research company Kantar Emor. The responses were gathered through web interviews from 15 to 21 May 2025. The age group 18 to 79 was targeted with the aim to obtain 350 responses. The survey was distributed only in Estonian and the aim was to maintain as much representativeness as possible. The total number of responses obtained was 539. For each final response, survey weights were calculated using the age group, gender, type of settlement, and household income as a basis.

Responses were present for all new items as no possibility to avoid the answer was provided. For the items taken from the OECD INFE 2023 instrument, there existed missing responses in sociodemographic variables for 63 (11.7%) respondents (in 61 cases only in the context of personal income) and in other items for 356 (66%) respondents. The missing responses were unevenly distributed between constructs. As seen from Table 17, attitudes and financial wellbeing seem initially more problematic with larger share of respondents with missing responses. However, the MCAR test indicates that the missing observations within these groups are missing at random, meaning that these missing observations would not create any biases in the following analysis. In the case of knowledge

and behaviour, where the proportion of respondents with missing observations is smaller, the MCAR test indicates that observations are not missing randomly. When MCAR test is run across the whole set of OECD INFE items, the Chi2 distance is 10508.35 with p at 0.012, again indicating the presence of nonrandom missing responses.

Table 17. Missing responses for OECD INFE items

No. of respondents missing response	Knowledge (total 9 items)	Attitude (total 10 items)	Behaviour (total 22 items)	Financial wellbeing (total 12 items)
1	82	145	98	120
2	19	56	6	33
3	14	26	1	8
4	9	5		4
5	2	3		2
6	1	1		
7	1			1
8				1
9				
10		1		
Total	128 (24%)	237 (44%)	105 (19%)	169 (31%)
MCAR test (Chi2 distance)	385.87***	384.85	209.01*	405.05

Notes: *** p<0.01, **p<0.05, *p<0.1

The sociodemographic indicators of the respondents for the pilot alongside with similar results for the OECD INFE 2023 Estonian survey are provided in Appendix 9. These indicate significant differences in the characteristics of the respondents. It appears that in the pilot survey the respondents were on average 6 years older, the number of adults in the household was on average 0.2 persons larger, the proportion of Estonians was 4.5 percentage points larger, the proportion of those living in Tallinn 10.5 percentage points larger and proportion of those living in rural areas 7.9 percentage points lower compared to 2023. In terms of living arrangement, somewhat greater proportion of respondents were living alone (difference 4.3 percentage points) and less respondents were living with other adult relatives (difference 9.1 percentage points). The pilot survey respondents tended to be more educated with the proportion of post-graduate education holders doubling and the share of those having only high or middle school education remaining respectively lower. It also appears that slightly greater share of respondents were in paid employment (difference 6.9 percentage points) and less respondents were students (difference 7.1 percentage points). In terms of income, the proportion of respondents with either their personal income and also household income being in the highest group was 13 percentage points greater than in 2023 while the proportion of the lowest income groups being respectively less represented.

4.4. Step 4 – Analysis of the pilot survey constructs and items

4.4.1. Constructs in the existing OECD/INFE instrument

When comparing the main knowledge, attitude, behaviour and financial wellbeing scores of the pilot survey with the Estonian OECD INFE 2023 results (see Table 18), it is possible to see significant differences in the context of knowledge, behaviour and overall financial literacy. The pilot survey respondents exhibit on average 0.21 to 0.4 greater knowledge score, 1.03 to 1.07 points greater behaviour score and 1.26 to 1.52 points greater financial literacy score. When controlling for socio-

demographic indicators, there also appears a significant difference in the objective financial well-being score with lower well-being reported in the pilot. No significant difference was observed for the attitude score.

Table 18. Missing responses for OECD INFE items

Score	Mean 2023	Mean 2025	Difference 2025 vs 2023		Difference 2025 vs 2023 with controls	
Knowledge score	5.506	5.906	0.400	***	0.210	**
Attitude score	2.530	2.582	0.052		0.018	
Behaviour score	5.470	6.538	1.068	***	1.031	***
Financial literacy score	13.506	15.026	1.520	***	1.259	***
Obj. Fin. Wellbeing score	2.103	1.980	-0.122		-0.206	**
Subj. Fin. Wellbeing score	2.965	2.910	-0.055		-0.163	

Notes: All means are corrected for weights. Column “Difference 2025 vs 2023” is calculated from simple regression (including only year dummy) with weights. Column “Difference 2025 vs 2023 with controls” is based on regressions where additional controls include all socio-demographic indicators listed in Appendix 9.

In Appendix 10 it is possible to see the means for each evaluated item. Although no changes in knowledge questions were made, 3 or 5 of the 7 knowledge items exhibited greater values in the pilot survey. This refers to greater financial knowledge of pilot respondents. Behaviour questions in the pilot were somewhat changed, however, this change affected only 2 of the 8 behaviour items (B3 and B4) while significant differences were observed in 5 of the 8 items (B1, B2, B4, B5, B6). In all cases the pilot survey provided greater scores than the 2023 survey, referring to superior financial behaviour. Rather limited number of significant differences were observed in the case of financial well-being items. This indicates that most of the differences seen in pilot survey results are not due to modifications made in some OECD/INFE questions but due to the differences in the characteristics of respondents. The fact that the inclusion of socio-demographic indicators reduces the magnitude of the difference in means, reflects that the weights capture only part of the differences in respondent characteristics.

We also analysed the reliability of existing scales, the results of which are summarised below by each construct.

Financial knowledge - the pilot survey showed that the seven OECD/INFE knowledge items (K1 to K7) exhibited very similar behaviour to what was observed in the 2023 survey round. Item K4 remained problematic with tetrachoric correlation with item K3 remaining 1.0. The 6-item knowledge score (excluding K4) provided internal consistency reliability of 0.51 which is somewhat lower than 0.64 in the 2023 survey round. The 6 knowledge items continue to form a single factor with standardized factor loadings ranging from 0.36 to 0.78.

Financial attitude - the pilot survey showed that the three OECD/INFE attitude items (A1 to A3) exhibited very similar behaviour to what was observed in the 2023 survey round. The internal consistency reliability of the 3 items was 0.55 that is somewhat lower than 0.60 in 2023 survey round. The same three items formed a strong single factor with standardized factor scores ranging from 0.44 to 0.83 (the lowest reported for item A2).

The additional 7 items did not prove very useful. EFA results indicated that, at maximum, two factors may be considered: one formed from the 3 items currently in OECD/INFE survey (A1 to A3) and one

formed from items QS1_8, QS3_5 and QS1_2. The CFA on these factors indicated SRMR 0.04, RMSEA 0.064, CFI. 0.96, TLI 0.92. Still, the AVE and composite reliability of the second factor (captured trust towards financial institutions + some risk-taking aspects) remained below desirable thresholds. This indicates that the inclusion of existing OECD/INFE questions to construct better attitude scale is not working well. The emergence of several factors also indicates that the other potential attitude items tend to measure somewhat different constructs than the main three attitude items currently employed in the calculation of OECD/INFE official attitude score.

Financial behaviour – the analysis of behaviour items relied on the sub-scores used in official OECD/INFE survey. The internal consistency reliability of items B1 to B8 was 0.45 that is very similar to 0.44 observed in 2023 survey round. The CFA, assuming a single factor, indicated that the standardized coefficients ranged from 0.11 to 0.75 with 3 items having loadings below 0.5 and 7 items below 0.7. This confirms the problematic behaviour of financial behaviour items in the survey observed also based on 2023 survey round. The alternative positive financial behaviour construct is discussed in the following section 4.4.2.

Financial well-being – wellbeing was measured with objective and subjective financial wellbeing indicators. The results indicate that the scales for both of these items function very well. In the case of 4-item objective financial well-being scale the internal consistency reliability is 0.73 and in the case of 8-item subjective financial well-being scale 0.7. These are the best results from all official OECD/INFE constructs. The alternative financial well-being constructs, used in the pilot survey, are discussed in the following section 4.4.2.

Overall, the pilot survey indicates that from the existing constructs within OECD/INFE, only financial well-being scales can be considered satisfactory from the psychometric perspective. Financial behaviour scales performs the worst, with financial attitude and financial knowledge scales performing somewhat worse than in the official 2023 survey round.

4.4.2. New constructs

New constructs were analysed using descriptive statistics, correlations and exploratory factor analysis. This was followed by structural equation modelling. Here we provide the main results and conclusions with regard to the relevance of the proposed items and constructs.

Subjective financial knowledge – the polychoric correlation between the OECD/INFE original 5-point question (QK1) and the new 7-point question (New_SK) is -0.78, which refers to strong negative association. It is expected as the scales of both questions are opposite to each other (increasing with knowledge for New_SK and decreasing for QK1). As can be seen from Table 19, both variables are nearly symmetric, with slight skew to the left. QK1 is slightly peaked, with New_SK close to normal distribution.

Table 19. Descriptive statistics of subjective financial knowledge indicators

Variable	Obs	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis
QK1	522	2.893	0.749	1	5	-0.070	3.350
New_SK	522	4.161	1.181	1	7	-0.153	2.970

The frequency distribution of normalised subjective financial knowledge variables is presented in Figure 12. The QK1norm variable has also been transposed to ensure that greater value refers to greater subjective financial knowledge. It can be seen that the distributions are not very different. Still, the framing of the questions tends to indicate that the same respondents tend to select somewhat

lower level of knowledge when they are not asked to compare themselves to an average of Estonian (as is done in OECD/INFE variable QK1).

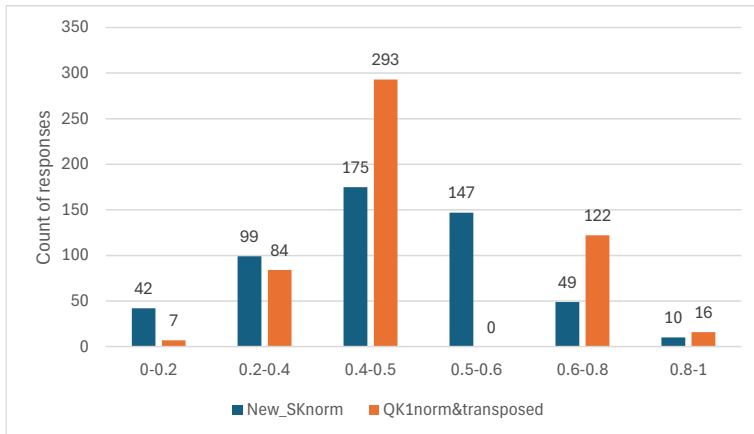


Figure 12. Distribution of normalised subjective knowledge variables.

Overall, it can be concluded that the inclusion of new subjective financial knowledge question (New_SK) does not provide enough new information compared to existing subjective financial knowledge question (QK1) to warrant its inclusion in future survey iterations.

Preference for numerical information – From the initial 8 items:

- 3 (New_num1, New_num3 and New_num3) will be reworded as these claims were not self-consistent, while the remaining statements on the scale were self-consistent.
- 2 (New_num7 and New_num8) will be removed as these responses did not enable to differentiate between respondents sufficiently.

Future orientation – from 3 items one (New_fut1) had low loading. As removing it would make the scale too short, and the low loading may be due to the current context. Therefore, the statement will be reworded to improve the performance of the statement.

Impulsivity – from 5 impulsivity items (excluding New_imp4 and New_imp8 which we consider in the same factor with risk-taking) one (New_imp6) should be removed as it clearly refers to a specific financial behaviour, while other statements do not link impulsivity to financial behaviour. This item also had the weakest loading of all impulsivity statements, 0.55 (incl. sensation seeking statements). The structural models indicated that the four remaining items perform poorly in some models exhibiting statistically insignificant path coefficients, tending also to distort some other standardised path coefficients and with their removal having no significant negative impact on model fit. Therefore, all items classified as impulsivity should be removed.

Risk-taking, risk-avoidance and sensation seeking – These items exhibited quite weak association with financial behaviour in structural models. As risk-avoidance and risk-taking are antipodes and duplicating each other, we propose the elimination of risk-aversion (New_riska1, New_riska2, New_riska3). Its exclusion slightly improved model fit. This indicates that all new risk-taking and sensation-seeking items should be added.

Financial self-efficacy – All 5 items behave well, no need for adjustments. This item has the potential to replace attitude items in more complex models.

(Positive) financial behaviour – All added 9 items should be maintained. However, the wording of 4 items should be adjusted for the following reasons:

- Item New_b1 – loading was low (0.33) and the part in brackets is unnecessary as it complicates understanding the claim.
- Item New_b2 – wording can be shortened.
- Item New_b3 – loading lower than for other items (0.52), does not differentiate respondents enough as the word “household” misleads the respondent.
- Item New_b5 – the initial claim was too long and can be shortened.

Intention – From the initial 7 items 2 (Item New_i6 and New_i7) should be removed as their loadings were lower than for other items on the scale and the claims differed in wording from the corresponding financial behaviour claims. One new item (New_i8) was added to replace the two removed claims and generate a claim similar to the behaviour item 9 wording. This step allows the new scale to be evenly distributed between 3 items focusing on the short term and 3 items focusing on the long term.

Financial stress – no changes in items. This item should be included if original OECD/INFE financial wellbeing indicator is not used. If it is used, it should be excluded due to somewhat similar focus.

(Subjective) financial wellbeing (future financial security) – no changes in items. This item should be included if original OECD/INFE financial wellbeing indicator is not used. If it is used, it should be excluded due to somewhat similar focus.

In Appendix 11 the standardised path coefficients from SEM between all new retained new items with OECD/INFE financial knowledge items and without residual correlations and demographic variables are presented. As can be seen, all constructs exhibit the expected associations between each other. All coefficients, with the exception of risk-taking+sensation-seeking are statistically significant, and refer to quite strong associations. In Appendix 12 the same results are presented by replacing the financial attitude construct with financial self-efficacy. This change improves model fit slightly, and the risk-taking + sensation seeking association with behaviour becomes statistically weakly significant while the size of the path coefficient remains very low. This indicates that this construct has rather weak association with financial behaviour. We decided not to dismiss it due to its potential in models with slightly improved wording of behaviour items.

In total of 11 items needed to be reworded. Therefore, a small-scale survey was done to test the behaviour of these items after the wording had been adjusted. We see..

4.5. Step 5 – Proposing new items to be included in future survey rounds

Our proposal depends on what the survey focuses on. We distinguish three options:

1. Original OECD/INFE survey is used together with extended set of new items. Useful if more in-depth analysis of the financial behaviour and financial well-being determinants is important.
2. Original OECD/INFE survey is used together with reduced set of new items. Allows investigation of constructs that are not currently included in the OECD/INFE survey, however, are the most relevant determinants of financial behaviour and well-being.
3. Entirely new instrument is used separately from OECD/INFE survey (e.g., during years when OECD/INFE survey is not undertaken). Contains all main elements that appear important determinants of financial behaviour and well-being, having only financial knowledge in

common with the OECD/INFE survey. Illustration in Appendix 12. This model dismisses financial attitude, as its measurement in OECD/INFE is currently a bit problematic (based on just 2 items) and there is also no agreement in the literature on the most suitable attitude questions. For example Riaz et al. (2022) show that financial self-efficacy affects financial literacy more strongly than financial attitude.

In terms of item sets, it means the following:

Option 1 - OECD/INFE + extended (44 new items + required OECD/INFE set)	Option 2 - OECD/INFE + reduced form (34 new items + required OECD/INFE set)	Option 3 – entirely new instrument (44 new items + 19 existing OECD/INFE)
6 Preference for numerical information	6 Preference for numerical information	6 Preference for numerical information
3 Future orientation	3 Future orientation	3 Future orientation
3 risk-taking (New_riskt...) 3 + 2 sensation seeking (New_imp4, New_imp8)	3 risk-taking (New_riskt...) 3 + 2 sensation seeking (New_imp4, New_imp8)	3 risk-taking (New_riskt...) 3 + 2 sensation seeking (New_imp4, New_imp8)
5 Financial self-efficacy (New_sf...)	5 Financial self-efficacy (New_sf...)	5 Financial self-efficacy (New_sf...)
9 (Positive) financial behaviour (New_b...)	9 (Positive) financial behaviour (New_b...)	9 (Positive) financial behaviour (New_b...)
6 Intention (New_i...)	6 Intention (New_i...)	6 Intention (New_i...)
5 Financial stress (New_ft...)		5 Financial stress (New_ft...)
5 (Subjective) financial wellbeing (New_fs...)		5 (Subjective) financial wellbeing (New_fs...)
		8 OECD/INFE knowledge items (K1 to K7 + QK1)
		11 OECD/INFE background items

Detailed list of questions is provided in a **separate Excel file**.

These options do not cover the possible changes in the original OECD/INFE methodology that may require additional analysis to determine the usefulness of the proposed new items. It is also important to bear in mind that our analysis did not cover more detailed analysis of financial well-being aspects that researchers at University of Tartu are currently working on. The outcomes of that research may influence our suggestions concerning financial stress and financial wellbeing item sets.

Kommenteeritud [LL4]: [Piloteeritav küsimustik lõplik 2025_03_24 & modif 2025_08&09.xlsx](#)

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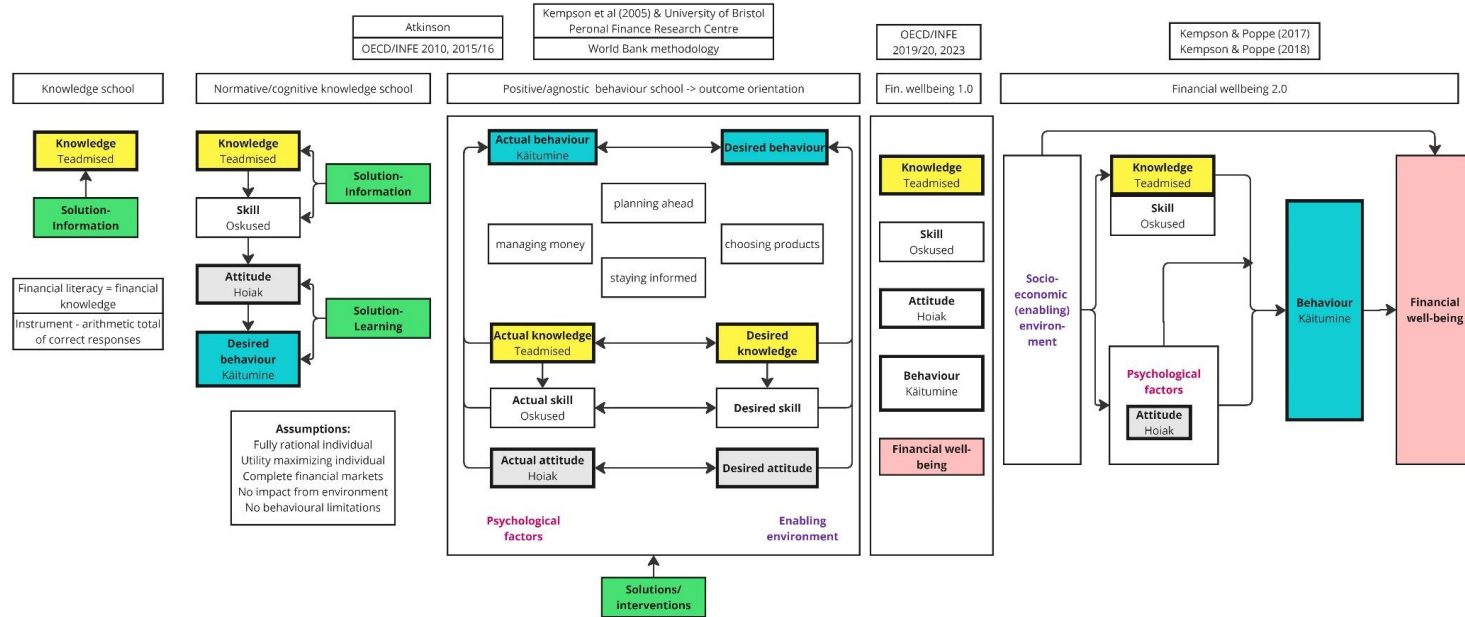
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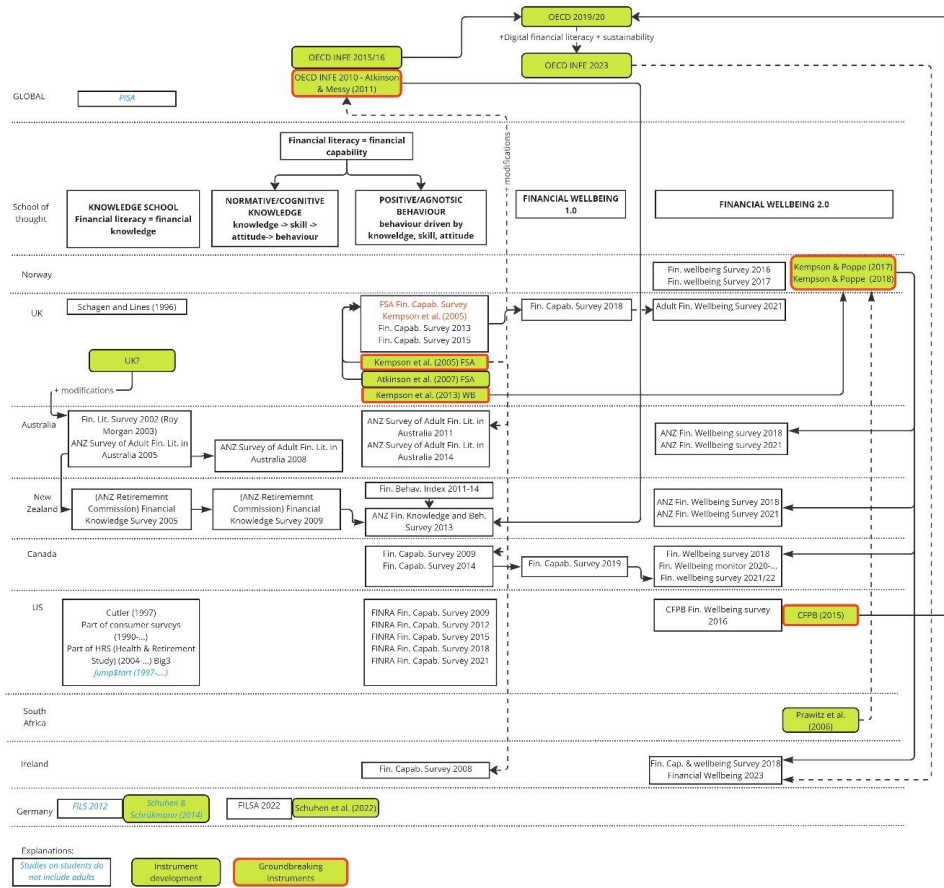
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Appendix 1. Overview of financial literacy schools of thought



Appendix 2. Overview of national reports



Appendix 3. National reports with links and details

Instrument title	Report name	Reference	Link	Country	Period (data collection)	Interval	Target group comment	Sample
Fin. Well-being	Financial Well-being Survey	Kempson and Poppe (2017)	link	Norway	2016	?	18+	2058
Fin. Well-being	Financial Well-being Survey	Kempson and Poppe (2018b)	link	Norway	2017	?	18 to 80	2043
Mix	SUM Financial Capability/Well-being		-	UK	2005-....	lately 3 years		NA
Fin. Well-being	Adult financial well-being Survey	<i>Adult Financial Wellbeing Survey 2021 Technical Report (2021)</i>	link	UK	2021	3 years	18+	10306
Fin. Capability	Financial Capability Survey	<i>Financial Capability Survey, 2018: Technical Report (2018)</i>	link	UK	2018	3 years	18+	5974
Fin. Capability	Financial Capability Survey	<i>Financial Capability in the UK 2015 - Initial results from the 2015 UK Financial Capability Survey (2015)</i>	link	UK	2015	?	18+	5603
Fin. Capability	Financial Capability Survey	Allegedly done, cannot be located	***	UK	2014	?	?	?
Fin. Capability	Financial Capability Survey	The Money Advice Service (2013)	link	UK	2013	?	18+	4872
Fin. Capability	FSA Fin-. Capability Survey	Kempson et al. (2005)	link	UK	2005	?	18+	5328
Mix	SUM ANZ survey		-	Australia	2003-...	3 years	18+	NA
Fin. Well-being	ANZ survey of financial well-being Australia	ANZ (2021a)	link	Australia	2021	3 years	18+	3552
Fin. Well-being	ANZ survey of financial well-being Australia	ANZ (2018a)	link	Australia	2018	3 years	18+	3578
Fin. Lit	ANZ survey of adult financial literacy in Australia	ANZ (2015)	link	Australia	2014	3 years	18+	3400
Fin. Lit	ANZ Survey of Adult Financial Literacy in Australia	ANZ (2011)	link	Australia	2011	3 years	18+	3502
Fin. Lit	ANZ Survey of Adult Financial Literacy in Australia	ANZ (2008)	link	Australia	2008	3 years	18+	3500
Fin. Lit	ANZ Survey of Adult Financial Literacy in Australia	ANZ (2005)	link	Australia	2005	3 years	18+	3513
Fin. Lit	ANZ Survey of Adult Financial Literacy in Australia	Roy Morgan Research (2003)	link	Australia	2002	3 years	18+	3548
Fin. Well-being	SUM ANZ financial Well-being New Zealand		-	New Zealand	2018-....	3 years	18+	NA
Fin. Well-being	ANZ survey of financial well-being New Zeland	ANZ (2021b)	link	New Zealand	2021	?	18+	1505
Fin. Well-being	ANZ survey of financial well-being New Zeland	ANZ (2018a)	link	New Zealand	2018	?	18+	?
Mix	SUM ANZ Financial Knowledge and Behaviour Survey		-	New Zealand	2005-2013	4 years		NA
Mix	Financial Knowledge and Behaviour Survey	<i>Financial Knowledge and Behaviour Survey 2013 (2013)</i>	link	New Zealand	2013	4 years	18+	852
Fin. Knowl	(ANZ-Retirememnt Commission) Financial Knowledge Survey	ANZ-Retirement Commission (2009)	link	New Zealand	2009	4 years	18+	850

Instrument title	Report name	Reference	Link	Country	Period (data collection)	Interval	Target group comment	Sample
Fin. Knowl	(ANZ-Retirement Commission) Financial Knowledge Survey	ANZ-Retirement Commission (2005)	link	New Zealand	2005	4 years	18+	856
Fin. Capability	SUM Canadian Financial Capability Survey (CFCS)		-	Canada	2009-2019			NA
Fin. Capability	Canadian Financial Capability Survey (CFCS)	<i>Canadians and their money: Findings from the 2019 Canadian Financial Capability Survey (2019)</i>	link	Canada	2019	5 years	18+	7169 core + 3026 follow-up
Fin. Capability	Canadian Financial Capability Survey (CFCS)	<i>Managing Money and Planning for the Future: Key Findings from the 2014 Canadian Financial Capability Survey (2014)</i>	link	Canada	2014	5 years	18+	?
Fin. Capability	Canadian Financial Capability Survey (CFCS)	<i>Initial Findings from the 2009 Canadian Financial Capability Survey (2010)</i>	link	Canada	2009	5 years	18+	15519
Fin. Well-being	Financial Well-being Survey	NA see link	link	Canada	2021-22	?	18+	5526
Fin. Well-being	Financial Well-being Monitor	NA see link	link	Canada	2020-...	Monthly		~1000
Fin. Well-being	Financial Well-being Survey	<i>Financial well-being in Canada - Survey results (2019)</i>	link	Canada	2018	once?	18+	1935
Fin. Well-being	CFPB Financial Well-being Survey	CFPB (2015)	link	US	2015	?	18+	6394
Fin. Capability	SUM FINRA		-	US	2009-....	3 years		NA
Fin. Capability	FINRA Financial Capability Study	FINRA (2022)	link	US	2021	3 years	18+	27118
Fin. Capability	FINRA Financial Capability Study	FINRA (2019)	link	US	2018	3 years	18+	27091
Fin. Capability	FINRA Financial Capability Study	FINRA (2016)	link	US	2015	3 years	18+	27564
Fin. Capability	FINRA Financial Capability Study	FINRA (2013)	link	US	2012	3 years	18+	25509
Fin. Capability	FINRA Financial Capability Study	FINRA (2009)	link	US	2009	3 years	18+	1488
Fin. Well-being	Financial Well-being Report	Indecon (2023)	link	Ireland	2023	?	?	?
Mix	Financial Capability & Well-being	<i>Financial Capability and Well-being in Ireland in 2018 (2018)</i>	link	Ireland	2018	?	18 to 80	1401
Fin Capability	Financial Capability Survey	O'Donnell and Keeney (2009)	link	Ireland	2008	?	18+	1529

Notes: The year numbers in the reference and in the period column may differ if the data was gathered a year earlier.

Appendix 4. Detailed overview of combined instruments

Reference	Survey instrument availability	Age group	Total Q	Obj. knowledge Q	Subj. Knowl. Q	Attitude Q	Beh. Q	Financial wellbeing Q	Aggregation		Aggregation methods used	
									1 single score	Components from dimensions	Knowledge	Other dimensions
Fernandes et al. (2014)	full	Adults	58	3 basic + 10 advanced + 19 numeracy	1	13 (46 claims)	12 (19 claims)	1	No	Several	Unclear	Unclear
van Rooij et al. (2011b)	full	Adults	10	5 basic + 1 advanced	1	3 (3 claims)	0	0	No	Several	Factor analysis	Attitude thresholds
Rieger (2020)	full	Young	15	2 basic + 4 advanced	1	5 (15 claims)	3 (4 claims)	0	No	1 for knowledge	Unclear	No aggregation
Ramos-Hernández et al. (2020)	full	Young	9	3 basic + 4 advanced	0	0	2 (8 claims)	0	No	1 for knowledge	% correct, sum, threshold	No aggregation
Garber and Koyama (2016)	full	Adults	OECD + 16	?	?	?	?	1	No	Several	PCA	Factor analysis
Shanmugam et al. (2022)	full	Adults	12	0	1	5 (15 claims)	5 (16 claims)	1	No	Several	No aggregation	Factor analysis
Nițoi et al. (2022)	full	Adults	20	4 basic + 3 advanced + 1 numeracy	0	5 (26 claims)	4 (23 claims)	3	No	1 for financial wellbeing	No aggregation	IRT
Klapper et al. (2013)	partial	Adults	19	6 basic + 2 advanced	1	3 (33 claims)	7 (54 claims)	0	No	1 for knowledge	sum, threshold	No aggregation
Xiao, Ahn, et al. (2014)	partial	Young	33	8	1	0	24	0	No	Several	sum	Factor analysis
Potrich et al. (2016)	full	Young	19	3 basic + 5 advanced	0	8 (14 claims)	3 (9 claims)	1	No	1 for knowledge	sum	No aggregation
Abdallah et al. (2024)	full	Adults	17	2	0	4 (4 claims)	11 (14 claims)	0	No	Several	mean	mean
Lusardi and Mitchell (2011)	full	Elderly	6	3 basic	0	0	3 (3 claims)	0	No	None	% correct	No aggregation
Lusardi and Mitchell (2008)	full	Adults - women	6	3 basic	0	0	3 (3 claims)	0	No	None	% correct	No aggregation
Hilgert et al. (2003)	partial	Adults	25 (?)	5 advanced	0	0	20 (?)	0	No	Several	% correct	Index?
Chen and Volpe (1998)	full	Young	36	31	0	1 (4 claims)	4 (18 claims)	0	No	None	% correct, threshold	No aggregation
Bianchi (2018)	full	Adults	11	6 + 1 numeracy	1	3 (3 claims)	0	0	No	1 for knowledge	sum	No aggregation
Anderson et al. (2017)	full	Adults	10	4 basic + 1 advanced	0	1 (6 claims)	4 (7 claims)	0	No	1 for knowledge	% correct, sum, mean	No aggregation
Gathergood (2012)	full	Adults	8	1 basic + 2 advanced	1	2 (2 claims)	0	2	No	None	sum, threshold	No aggregation

Reference	Survey instrument availability	Age group	Total Q	Obj. knowledge Q	Subj. Knowl. Q	Attitude Q	Beh. Q	Financial wellbeing Q	Aggregation		Aggregation methods used	
									1 single score	Components from dimensions	Knowledge	Other dimensions
Sivaramakrishnan et al. (2017)	partial	Adults - retail investors	21	5 basic + 1 advanced	1	1 (2 claims)	9	4	No	Several	Factor analysis	Factor analysis
Lusardi (2011)	partial	Adults	39 (?)	5 basic	1	0	33 (?)	0	No	None	% correct, mean	No aggregation
Xiao, Chen, et al. (2014)	partial	Adults	31	5 basic	1	0	24	1	No	1 for knowledge	sum	No aggregation
Shockey (2002)	full	Adults - low wealth	48	15 advanced	1	1 (8 claims)	30 (30 claims)	1	No	Unclear	sum	Unclear
Moore (2003)	partial	Adults	42	3 basic + 9 advanced	0	1 (1 claim)	29	0	No	1 for knowledge	mean	No aggregation
Méndez-Prado et al. (2023)	full	Adults	20	10	2	4 (4 claims)	4 (4 claims)	0	Yes (mean, SEM)	Several	sum	sum, factor analysis
Lone and Bhat (2024)	full	Adults	12	0	2	1 (5 claims)	6 (6 claims)	3	No	Several	Factor analysis	Factor analysis
Xue et al. (2020)	full	Elderly	5	3 advanced	0	0	1 (1 claim)	1	No	1 for knowledge	IRT	No aggregation
Xue et al. (2019)	full	Elderly	4	3 advanced	0	0	1 (1 claim)	0	No	1 for knowledge	IRT	No aggregation
Almeida et al. (2024)	partial	Adults	3+(?)	3 basic	0	0	?	0	No	Several	% correct	Factor analysis
Schagen and Lines (1996)	full	Adults	13	3 basic + 5 advanced	1	2 (6 claims)	2 (2 claims)	0	No	None	No aggregation	No aggregation
Stella et al. (2020)	full	Adults	16	5 basic + 4 advanced	1	1 (1 claim)	4 (10 claims)	1	No	Several	Factor analysis	Factor analysis
Nicolini et al. (2013)	partial	Adults	16+ (?)	16	0	0	?	0	No	1 for knowledge	sum	No aggregation
Netemeyer et al. (2018)	partial	Adults	2+ (?)	?	0	0	0	2	No	1 for knowledge	Unclear	Unclear

Notes: Q refers to questions. Aggregation methods: % correct – proportion of correct responses, sum – total of correct responses, threshold – the initial result is transformed into grouping variable (e.g., high/low literacy), IRT – aggregation through item response theory, PCA - principal component analysis, SEM – structural equation modelling.

Appendix 5. Spearman's rank correlations- knowledge items and scores

	K1	K2	K3	K4	K5	K6	K7	K8
K1	1.000							
K2	0.272	1.000						
K3	0.289	0.341	1.000					
K4	0.208	0.210	0.534	1.000				
K5	0.123	0.186	0.231	0.185	1.000			
K6	0.149	0.120	0.193	0.126	0.240	1.000		
K7	0.149	0.228	0.220	0.231	0.259	0.110	1.000	
K8	0.122	0.164	0.155	0.105	0.301	0.290	0.216	1.000
K9	0.134	0.214	0.212	0.167	0.200	0.123	0.383	0.177
K_score7	0.401	0.429	0.672	0.788	0.464	0.307	0.579	0.247
K_score9	0.378	0.415	0.640	0.738	0.461	0.299	0.594	0.375
K1o	0.525	0.212	0.280	0.251	0.174	0.092	0.215	0.078
K2o	0.199	0.527	0.306	0.262	0.225	0.095	0.251	0.125
K3o	0.229	0.274	0.743	0.475	0.238	0.129	0.233	0.123
K4o	0.149	0.168	0.430	0.881	0.141	0.090	0.181	0.063
K5o	0.124	0.196	0.263	0.241	0.633	0.168	0.276	0.213
K6o	0.123	0.141	0.229	0.222	0.228	0.443	0.187	0.148
K7o	0.144	0.205	0.224	0.250	0.255	0.072	0.787	0.174
K8o	0.103	0.164	0.216	0.196	0.268	0.158	0.244	0.547
K9o	0.123	0.189	0.249	0.236	0.219	0.089	0.333	0.124
K_score7o	0.371	0.409	0.630	0.682	0.443	0.272	0.526	0.227
K_score9o	0.338	0.391	0.587	0.599	0.440	0.261	0.527	0.323
	K7_9	K_score7	K_score9	K1o	K2o	K3o	K4o	K5o
K7_9	1.000							
K_score7	0.302	1.000						
K_score9	0.458	0.963	1.000					
K1o	0.158	0.398	0.387	1.000				
K2o	0.202	0.412	0.407	0.796	1.000			
K3o	0.213	0.589	0.569	0.663	0.698	1.000		
K4o	0.138	0.676	0.632	0.224	0.248	0.497	1.000	
K5o	0.207	0.445	0.448	0.703	0.759	0.631	0.229	1.000
K6o	0.155	0.352	0.347	0.779	0.781	0.631	0.195	0.767
K7o	0.317	0.534	0.546	0.564	0.594	0.500	0.253	0.600
K8	0.176	0.320	0.394	0.705	0.749	0.592	0.164	0.766
K9	0.642	0.351	0.443	0.690	0.726	0.603	0.229	0.693
K_score7o	0.300	0.886	0.859	0.682	0.704	0.800	0.651	0.707
K_score9o	0.415	0.815	0.839	0.718	0.749	0.810	0.569	0.759
	K6o	K7o	K8	K9	K_score7o	K_score9o		
K6o	1.000							
K7o	0.540	1.000						
K8o	0.779	0.575	1.000					
K9o	0.708	0.635	0.679	1.000				
K_score7o	0.645	0.698	0.597	0.607	1.000			

K_score9o	0.697	0.732	0.708	0.731	0.965	1.000
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Appendix 6. IRT results with 1-PL models

	Original knowledge scores			Original knowledge scores wo K4			Original knowledge scores wo K4 + Numeracy			Original + 2 additional			Original wo K4 + 2 additional + Numeracy		
	Value	St. error	Sign.	Value	St. error	Sign.	Value	St. error	Sign.	Value	St. error	Sign.	Value	St. error	Sign.
Discrimination	1.739	(0.077)	***	1.649	(0.084)	***	1.590	(0.077)	***	1.658	(0.067)	***	1.593	(0.070)	***
Difficulty by															
K6	-2.132	(0.105)	***	-2.192	(0.113)	***	-2.233	(0.115)	***	-2.186	(0.107)	***	-2.230	(0.112)	***
K2	-1.835	(0.091)	***	-1.884	(0.098)	***	-1.920	(0.099)	***	-1.878	(0.093)	***	-1.915	(0.097)	***
K1	-1.812	(0.090)	***	-1.861	(0.097)	***	-1.896	(0.098)	***	-1.855	(0.092)	***	-1.891	(0.096)	***
Num							-1.896	(0.098)	***				-1.891	(0.096)	***
K8										-1.759	(0.088)	***	-1.793	(0.092)	***
K5	-1.409	(0.075)	***	-1.444	(0.079)	***	-1.471	(0.081)	***	-1.438	(0.076)	***	-1.467	(0.079)	***
K9							-1.406	(0.075)	***	-1.406	(0.075)	***	-1.434	(0.078)	***
K3	-1.015	(0.064)	***	-1.039	(0.067)	***	-1.059	(0.068)	***	-1.034	(0.065)	***	-1.055	(0.067)	***
K7	-0.815	(0.059)	***	-0.834	(0.062)	***	-0.850	(0.063)	***	-0.830	(0.061)	***	-0.847	(0.062)	***
K4	0.035	(0.052)								0.038	(0.054)				
No of obs.	1119			1119			1119			1119			1119		
Log likelihood	-3150.7			-2514.2			-2844.6			-3910.6			-3591.9		

Appendix 7. IRT results with 2-PL models

	Original knowledge scores			Original knowledge scores wo K4			Original knowledge scores wo K4 + Numeracy			Original + 2 additional			Original wo K4 + 2 additional + Numeracy		
	Value	St. error	Sign.	Value	St. error	Sign.	Value	St. error	Sign.	Value	St. error	Sign.	Value	St. error	Sign.
Discrimination by															
K6	1.087	(0.151)***		1.359	(0.199)***		1.306	(0.191)***		1.238	(0.166)***		1.371	(0.188)***	
Num							1.325	(0.172)***					1.166	(0.156)***	
K8										1.078	(0.139)***		1.477	(0.177)***	
K1	1.381	(0.152)***		1.764	(0.223)***		1.785	(0.220)***		1.480	(0.167)***		1.544	(0.188)***	
K5	1.001	(0.114)***		1.442	(0.175)***		1.389	(0.165)***		1.241	(0.139)***		1.652	(0.184)***	
K2	1.558	(0.165)***		2.234	(0.297)***		2.287	(0.296)***		1.776	(0.197)***		2.024	(0.246)***	
K9										1.153	(0.133)***		1.608	(0.181)***	
K7	0.817	(0.093)***		1.226	(0.146)***		1.120	(0.132)***		1.124	(0.124)***		1.580	(0.172)***	
K3	5.141	(0.966)***		2.303	(0.326)***		2.666	(0.403)***		4.719	(1.004)***		1.948	(0.221)***	
K4	1119.398NA									3.349	(0.599)				
Difficulty by															
K6	-2.787	(0.308)***		-2.447	(0.248)***		-2.507	(0.260)***		-2.610	(0.259)***		-2.435	(0.234)***	
Num							-2.104	(0.195)***					-2.288	(0.232)***	
K8										-2.295	(0.235)***		-1.870	(0.154)***	
K1	-1.980	(0.162)***		-1.797	(0.137)***		-1.784	(0.133)***		-1.977	(0.156)***		-1.923	(0.156)***	
K5	-1.916	(0.188)***		-1.552	(0.131)***		-1.584	(0.135)***		-1.700	(0.149)***		-1.438	(0.108)***	
K2	-1.875	(0.140)***		-1.643	(0.110)***		-1.624	(0.106)***		-1.817	(0.128)***		-1.704	(0.117)***	
K9										-1.743	(0.161)***		-1.426	(0.110)***	
K7	-1.284	(0.148)***		-0.985	(0.101)***		-1.043	(0.110)***		-1.041	(0.108)***		-0.849	(0.076)***	
K3	-0.697	(0.041)***		-0.901	(0.070)***		-0.858	(0.063)***		-0.751	(0.048)***		-0.958	(0.073)***	
K4	0.152	(0.003)***								0.026	(0.042)				
No of obs.	1119			1119			1119			1119			1119		
Log likelihood	-3053.0			-2505.3			-2826.2			-3877.9			-3583.4		
LR test chi2	195.5	***		17.7	**		36.7	***		65.4	***		17.1	*	

Appendix 8. Results of pre-pilot constructs' analysis

	No. of claims	Standardized Cronbach α	Expected no. of factors	No. of factors based on EFA
Risk readiness**	6	0.693	1	2
<i>Incl. risk avoidance</i>	3	0.714		1
<i>Incl. risk-taking</i>	3	0.808		1
Impulsivity	8	0.807	1	2
<i>Incl. impulsivity</i>	5	0.841		1
<i>Incl. sensation seeking</i>	3	0.648		1
Preference for numerical information	8	0.872	1	2
<i>Incl. like to work with numbers</i>	5	0.881		1
<i>Incl. numbers are important</i>	3	0.77		1
Future orientation	3	0.705	1	1
Financial self-efficacy	5	0.866	1	1
(Positive) financial behaviour**	10	0.78	1	3
<i>Incl. responsible financial behaviour</i>	4	0,71		1
<i>Incl. securing future</i>	3	0.743		1
<i>Incl. prudent financial behaviour</i>	3	0.483		1
Financial stress	5	0.82	1	1
Intention	7	0.714	1	

Notes: ** during analysis 3 claims in risk readiness were turned positive ("I prefer situations that have foreseeable outcomes", "Before I make a decision, I like to be absolutely sure how things will turn out", "I avoid situations that have uncertain outcomes") and in positive financial behaviour 1 claim ("I spend more than my income") was reversed.

Appendix 9. Sociodemographic indicators of respondents

	OECD INFE	Pilot		
	2023 mean	2025 mean	Difference 2025 vs 2023	
Age (in years)	47.415	53.380	5.965	***
Household count (adults only)	1.986	2.202	0.217	***
Children count	1.729	1.667	-0.062	
	2023 proportion	2025 proportion	Difference 2025 vs 2023	
Gender				
Female	52.9%	54.3%	1.4%	
Nationality				***
Estonian	94.9%	99.4%	4.5%	***
Russian	3.2%	0.2%	-3.0%	***
Other	1.9%	0.4%	-1.5%	**
Region				***
Tallinn	25.1%	35.6%	10.5%	***
Tartu (urban settlement)	12.5%	10.6%	-1.9%	
Tartu (rural area)	3.5%	4.6%	1.1%	
Pärnu (urban settlement)	3.2%	4.5%	1.3%	
Pärnu (rural area)	2.0%	1.7%	-0.4%	
Narva		0.2%	0.2%	
Kohtla-Järve	0.5%	0.2%	-0.3%	
Other town	21.3%	18.7%	-2.6%	
Rural area	31.8%	23.9%	-7.9%	***
Living alone	22.6%	26.9%	4.3%	**
Living with a partner/spouse	57.4%	59.2%	1.7%	
Living with children under the age of 18	23.9%	21.2%	-2.7%	
Living with children aged 18 or over	8.8%	10.4%	1.6%	
Living with other adult relatives	14.5%	5.4%	-9.1%	***
Living with friends, colleagues or students	1.1%	0.4%	-0.8%	*
Living with other adults; not related	0.6%	0.4%	-0.3%	
Education level				***
Post-graduate education or equivalent	16.5%	34.4%	17.8%	***
University-level education	16.4%	18.2%	1.8%	
Upper secondary school or high school	57.3%	44.8%	-12.5%	***
Lower secondary school or middle school	9.5%	2.4%	-7.1%	***
Primary school	0.1%	0.2%	0.1%	
No formal education	0.1%			
Work situation				***
Self-employed (work for yourself)	8.0%	8.2%	0.2%	
In paid employment (work for someone else)	56.0%	62.9%	6.9%	**
Apprentice	0.3%	0.2%	-0.1%	
Looking for work	2.2%	1.3%	-0.9%	
Looking after the home (unemployed)	1.5%	1.3%	-0.2%	
Retired	19.0%	19.7%	0.7%	

Unable to work due to sickness or ill-health	2.0%	1.3%	-0.7%	
Not working and not looking for work	0.5%	1.1%	0.6%	
Student	8.7%	1.7%	-7.1%	**
Other	1.8%	2.2%	0.5%	
Personal monthly net income				***
Up to 750€ a month	24.6%	12.1%	-12.5%	***
between 751€ and 1100€ a month	21.2%	21.1%	-0.1%	
between 1101€ and 1600€ a month	24.8%	24.3%	-0.5%	
1601€ or more a month	29.4%	42.5%	13.1%	***
Household income				***
Up to 750€ a month	11.1%	3.2%	-7.9%	***
between 751€ and 1050€ a month	11.1%	5.6%	-5.6%	***
between 1051€ and 1450€ a month	15.9%	9.1%	-6.8%	***
between 1451€ and 1750€ a month	11.0%	9.7%	-1.3%	
between 1751€ and 2100€ a month	12.2%	12.9%	0.7%	
between 2101€ and 2500€ a month	11.1%	12.6%	1.5%	
2501€ or more a month	27.5%	46.9%	19.4%	***

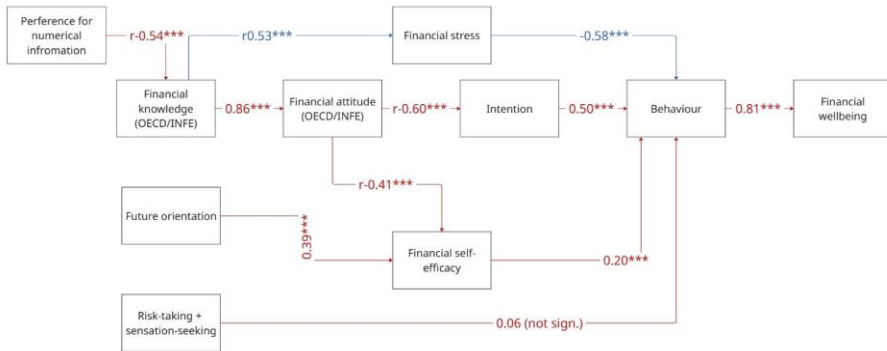
Notes: differences calculated based on simple regression for continuous variables and using Chi2 test for proportions.

Appendix 10. Descriptive statistics of OECD/INFE items – pilot vs 2023 round

Category	Item	Mean 2023	Mean 2025	Difference 2025 vs 2023		Difference 2025 vs 2023 with controls	
Knowledge	K1	0.901	0.936	0.035	*	0.025	
Knowledge	K2	0.906	0.990	0.084	***	0.065	***
Knowledge	K3	0.734	0.823	0.089	***	0.052	*
Knowledge	K4	0.445	0.516	0.070	**	0.014	
Knowledge	K5	0.806	0.930	0.124	***	0.110	***
Knowledge	K6	0.921	0.930	0.009		0.001	
Knowledge	K7	0.793	0.782	-0.011		-0.058	**
Attitude	A1	2.446	2.477	0.031		-0.048	
Attitude	A2	2.614	2.687	0.073		0.084	
Attitude	A3	2.070	1.978	-0.093		-0.106	
Behaviour	B1	0.682	0.806	0.124	***	0.093	***
Behaviour	B2	0.728	0.824	0.096	***	0.096	***
Behaviour	B3	0.893	0.893	-0.001		-0.011	
Behaviour	B4	0.579	1.217	0.638	***	0.628	***
Behaviour	B5	0.679	0.756	0.077	**	0.080	**
Behaviour	B6	0.316	0.454	0.137	***	0.132	***
Behaviour	B7	0.629	0.628	0.000		0.022	
Behaviour	B8	0.964	0.960	-0.003		-0.009	
Obj. fin. wellbeing	OW1	0.583	0.556	-0.027		-0.045	
Obj. fin. wellbeing	OW2	0.584	0.566	-0.018		-0.025	
Obj. fin. wellbeing	OW3	0.489	0.451	-0.038		-0.058	*
Obj. fin. wellbeing	OW4	0.447	0.407	-0.040		-0.078	**
Subj. fin. wellbeing	SW1	0.255	0.305	0.050	*	0.039	
Subj. fin. wellbeing	SW2	0.222	0.170	-0.052	*	-0.074	***
Subj. fin. wellbeing	SW3	0.787	0.806	0.019		-0.020	
Subj. fin. wellbeing	SW4	0.406	0.424	0.018		-0.006	
Subj. fin. wellbeing	SW5	0.463	0.441	-0.023		-0.026	
Subj. fin. wellbeing	SW6	0.344	0.301	-0.043		-0.061	*
Subj. fin. wellbeing	SW7	0.265	0.253	-0.012		-0.012	
Subj. fin. wellbeing	SW8	0.222	0.209	-0.013		-0.003	

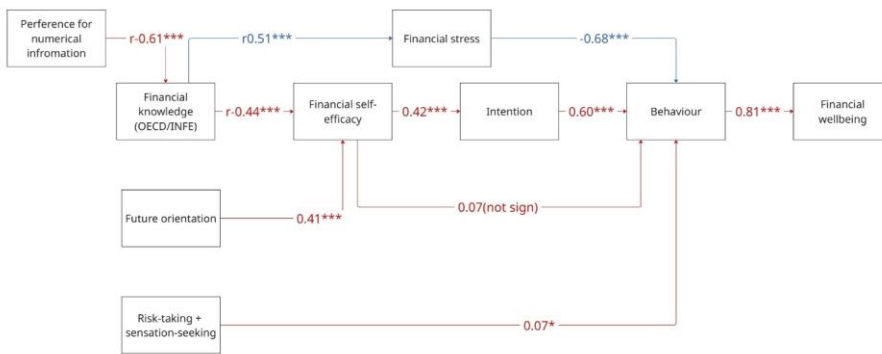
Notes: All means are corrected for weights. Column “Difference 2025 vs 2023” is calculated from simple regression (including only year dummy) with weights. Column “Difference 2025 vs 2023 with controls” is based on regressions where additional controls include all socio-demographic indicators listed in Appendix 9.

Appendix 11. SEM results with the initial model presented in Figure 11



Notes: Blue lines – expected negative association; red lines -expected positive association. Standardised path coefficients in blue negative value, in red positive value, if preceded by r the scale is reversed in OECD/INFE for this construct (opposite sign to expected should be observed). Test statistics – CFI 0.951, TLI 0.949, RMSEA 0.101, SRMR 0.107. No background items included in the model. Not sign – path coefficient is not statistically significant. Statistical significance * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Appendix 12. SEM results with the model replacing attitude with financial self-efficacy



Notes: Blue lines – expected negative association; red lines -expected positive association. Standardised path coefficients in blue negative value, in red positive value, if preceded by r the scale is reversed in OECD/INFE for this construct (opposite sign to expected should be observed). Test statistics – CFI 0.954, TLI 0.951, RMSEA 0.101, SRMR 0.105. No background items included in the model. Not sign – path coefficient is not statistically significant. Statistical significance * p<0.1, ** p<0.05, *** p<0.01.