Developing financial competence about mortgage loans by informal learning using banks' online calculators

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Abstract

Background and aim: Financial literacy (or financial competence) has become an internationally relevant and highly regarded topic. Since people often lack sufficient financial competence, in many countries efforts have been made to foster formal financial education. Less attention, however, has been paid to whether informal learning using information available on the Internet can also support the development of financial competence. However, this seems to be an important question because the Internet has expanded the opportunities for informal learning. In addition, people need to acquire financial competence on their own because not every financial topic relevant in one's lifetime is covered in formal education syllabi. Against this background, in this study we tested whether people are able to develop financial competence by learning informally using information available on the Internet. We focused on mortgage loans, as they are comparatively complex financial products. Mortgage loans have the potential to significantly influence an individual's financial situation. In addition, society might carry the burdens of risky and uninformed decisions about mortgage loans—as the financial and real estate crisis has shown.

Method: 45 students of economics and business studies in their final undergraduate year participated. They were randomly assigned to an experimental or a control group. The experimental group explored information about mortgage loans using the loan calculator of a German bank. The control group did not explore webpages. Before the intervention, students from both groups completed knowledge tests and self-assessed their financial knowledge and behaviour. After the intervention, students had to work on a case and to decide whether a small family should take out a mortgage loan for financing a house. The decision had to be justified. In addition, students were administered an immediate and delayed knowledge test.

Results and conclusions: Students of both groups did not differ in knowledge acquisition, decision making about taking a mortgage loan and argumentation quality. However, prior knowledge can be referred to in order to explain the results. Therefore, informal learning using the Internet did not seem to be effective if people did not have sufficient prior knowledge. This result underlines, on the one hand, the necessity of financial education—be it prior to informal learning or in the course of informal learning. On the other hand, the results can be interpreted as a hint to consider how to

improve informal learning activities, e.g. by supporting self-regulation or by improving information material.

Keywords: Financial competence, Financial literacy, Informal learning, Mortgage loan, Online loan calculator

Introduction

Background and aim of the study

Recently, financial literacy (or financial competence)[1] has become considered an internationally relevant and highly regarded topic by governments, education officials, central banks, international organisations such as the Organisation for Economic Cooperation and Development (OECD) as well as scientists. Financial literacy is among the 21st century skills necessary to master the challenges and problems of our time (Trilling and Fadel 2009; Lusardi 2015) and to secure individual as well as societal financial well-being, specifically financial inclusion, and consumer protection (Atkinson and Messy 2013, p. 9). Therefore, financial literacy can be regarded as an important element of economic and financial stability, both for the individual and the economy (Lusardi 2015, p. 639).

Citizens must be competent in deciding on financial products and investments (OECD 2013, p. 140; Aprea et al. 2016), such as saving and investing money, e.g. for financial security after retirement or private (additional) financing of health and sickness payments. Moreover, financial products and consumer credit have become widely available. Since the individual is responsible for the products he or she purchases and also has to shoulder the risks associated with them, he or she needs to make informed decisions based on financial literacy. This need for financial literacy also applies if consumers take advantage of consultants' advice, which they need to understand and to consider critically (Schürz and Weber 2005; OECD 2013, p. 140; Lusardi 2015, p. 639). In order to make decisions, people often consult the Internet. Searching on the Internet can be regarded as an informal learning situation (e.g. Overwien 2016). In fact, the Internet has expanded the opportunities for informal learning, that is to say, intentional and purposeful information seeking in an everyday-life environment without guidance from a teacher and without formal recognition.

Against this background, the aim of our study is to analyse whether people are able to develop financial competence by means of online information in an informal learning setting using the Internet. In our study, we focus on mortgage loans as comparatively complex financial products and on the online information banks provide about them. Banks are important financial institutions that provide mortgage loan contracts and mortgage loans have the potential to influence individuals' financial situations for a long time. The results of our study show whether learning informally from the Internet can contribute to the development of financial competence. Based on that, it seems possible to develop recommendations on how to improve informal learning, financial education and consequently financial literacy. This might be of interest for financial literacy

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[1] The terms are not used uniformly. Financial capability, financial literacy, economic literacy, financial education and economic education are partly used synonymously, partly in superorder or suborder. For this article, financial literacy and financial competence are used as synonyms. However, we prefer a competence-oriented view of financial literacy.

educators in the field of initial and further education in VET, specifically with regard to the banking and finance sector. Furthermore, the results are assumed to be of interest for financial information providers, such as banks. The study took place in Germany.

Financial competence in the context of home buying
The concepts of financial literacy and financial competence
The OECD defines financial literacy as the "knowledge and understanding of financial concepts and risks, and the skills, motivation, and confidence to apply such knowledge and understanding to make effective decisions across a range of financial contexts" (OECD 2013, p. 144). More specifically, financial literacy consists of knowledge and abilities to plan and arrange income and expenses, savings and loans (OECD 2013, p. 148). In its latest report, the OECD (2017) defines financial literacy as "a combination of awareness, knowledge, skill, attitude and behaviour necessary to make sound financial decisions and ultimately achieve individual financial well-being" (p. 50).

Used in the sense mentioned above, the concept of literacy is comparable with the concept of competence. The concept of competence has been widely discussed in psychological and social sciences, and in VET literature (e.g. Achtenhagen and Winther 2014; Beck et al. 2016; Weber and Achtenhagen 2016; Seeber 2017) for at least two decades without a uniform definition having been obtained so far. Nevertheless, some common ground can be identified (e.g. Weinert 2001; Hartig et al. 2008; Blömeke et al. 2015, p. 3; Shavelson 2013): (1) competence comprises both dispositions and performance. The latter can be regarded as acting or making decisions, (2) competence regards both cognition and affective-motivational aspects and (3) competence is learnable and thus improvable through deliberate practice.

Authors who attempt to differentiate between literacy and competence argue that the concept of literacy in general is preferable in the context of basic education in a field (e.g. reading, mathematics, science, finance). In the field of finance, literacy refers to basic education in areas such as "money and transactions", "planning and managing finances" or "risk and reward" (OECD 2017, p. 50). Basic education aims to equip students with the knowledge and skills necessary for successfully coping with challenges in school and everyday life, to prepare students for participation in higher and further education as well as to secure financial well-being and societal participation. Other authors argue that literacy refers to knowledge only and excludes the dimension of knowledge application as well as the relevance of motivation, emotion or attitudes (Rudeloff 2019, p. 53). In contrast to literacy, competence refers to more specific and complex topics, comprises a holistic approach and aims to equip learners with knowledge and skills on an advanced level. Competence requires literacy. However, overall, the distinction between literacy and competence remains somewhat blurry.

In our context, and in line with Weinert (2001) and Wuttke and Aprea (2018), we prefer a "competence-oriented view of financial literacy, defined as the potential that enables a person to effectively plan, execute and control financial decisions. This potential is based on the availability of individual dispositions—that is, knowledge and skills, motivations and interests, attitudes, values—and contingent on situational characteristics" (Wuttke and Aprea 2018, p. 274). Therefore, we prefer to use the term financial competence. Financial competence can be regarded as specific competence concerning

financial matters. Related to mortgage loans, financial competence comprises, first and foremost, knowledge and skills about the following four core elements (Hölting et al. 2012; Keller 2013): (1) the calculation of free disposable monthly income, (2) the comparison and choice between renting and buying, (3) the calculation of the real estate's affordable purchase price and (4) the calculation of the loan regarding principal, interest, annuity, term of fixed interest and term of the loan (Fürstenau et al. 2015, 2016).

The need for financial competence in the context of home buying

The need to develop financial competence in the context of home ownership financed by mortgage loans can be justified by the fact that those kinds of loans can have potential long-term effects on individuals' financial situations, as well as the well-being of societies—as the financial and real-estate crisis in 2008 has shown. This need can also be underlined by the latest developments in the housing market. Statistics show that the trend towards home ownership has continued unchanged over the last 10 to 15 years. The homeowner share in Germany is currently about 50% (Statistisches Bundesamt)[2] Though housing prices have significantly risen from 2005 on (Deutsche Bundesbank),[3] interest payments and interest rates for housing loans to private households in Germany have fallen significantly since then (Deutsche Bundesbank).[4] Looking at the last 20 years since 1996, the average 10-year fixed interest rate was around 4.7%. In 2017, the effective 5- to 10-year fixed interest rate for mortgage loans was approximately 1.6 to 1.7% (Verband deutscher Pfandbriefbanken).[5] For this reason, it seems attractive for many people to buy a home, which is indicated by the fact that in Germany the granting of housing loans to private households by domestic banks has risen continuously since 2009.[6]

Influence factors on financial competence in the context of home buying

Recently some studies have been conducted concerning the specific focus of mortgage loans and home buying. Some results are summarised in the following: Gerardi et al. (2010, 2013), for example, analysed the relationship between financial literacy and subprime mortgage delinquency. They found "a large and statistically significant negative correlation between financial literacy and measures of mortgage delinquency and default" (Gerardi et al. 2010, p. 4) specifically due to lack of numerical ability (as one aspect of financial competence) (Gerardi et al. 2010, p. 5). Other factors such as risk aversion or general cognitive ability did not seem to be similarly relevant (Gerardi et al. 2010, pp. 3, 15). Summarising other studies, the authors report that individuals are often confused about even basic mortgage terms. Furthermore, higher cognitive abilities and financial literacy have often resulted in better bargaining outcomes and in a lower likelihood of being susceptible to questionable practices (Gerardi et al. 2013, p. 11267).

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[2] https://de.statista.com/statistik/daten/studie/155734/umfrage/wohneigentumsquoten-in-europa/.

[3] https://www.bundesbank.de/resource/blob/615214/129e5136d24f3a7a3a43e134fe998889/mL/01-preise-fuer-wohnimmoblien-in-deutschland-data.pdf.

[4] https://www.bundesbank.de/resource/blob/615312/8696b8bcc8a03dc648bfdc38c4fcb850/mL/12-zinssaetze-fuer-wohnungsbaukredite-data.pdf.

[5] https://www.pfandbrief.de/site/de/vdp/immobilie/finanzierung_und_markt/finanzierung_wohnimmobilien.html.

[6] https://www.bundesbank.de/Redaktion/DE/Downloads/Statistiken/Unternehmen_Und_Private_Haushalte/Indikatorensystem_Wohnimmobilienmarkt/07_entwicklung_von_wohnungsbaukrediten.pdf?__blob=publicationFile.

A number of international studies reveal factors that influence households' mortgage choice. In general, an optimal mortgage choice seems to be a very complicated problem (Campbell and Cocco 2003). Cox et al. (2015) found that Dutch households that self-report higher financial literacy and lower risk aversion are 55 to 97% more likely to opt for interest-only mortgages. In an overview, Hullgren and Söderberg (2013) report that borrower characteristics that influence choices specifically concern consumers' risk aversion, ability to handle sudden mortgage rate increases and level of financial literacy. Hullgren and Söderberg (2013) investigated characteristics that influence Swedish consumers' mortgage rate decisions, such as the choice between an adjustable rate mortgage (ARM) and a fixed rate mortgage (FRM). The results show that the following factors influenced Swedish consumers to choose FRMs: a lower level of education, lower income and lower financial literacy. Furthermore, it can be stated that age, a low level of education and risk averseness significantly affect men's mortgage choices, whereas women's mortgage choices are significantly affected by income, trouble handling interest rate increases and low financial literacy (Hullgren and Söderberg 2013, p. 221). That women tend to be more risk averse with regard to financial decisions is also reported in other studies (e.g. Dohmen et al. 2005). Furthermore, some studies found that men tend to be more overconfident in financial decision making (e.g. Barber and Odean 2001). However, the gender effect does not seem to be stable across studies.

As can be concluded from the studies, there is evidence that financial literacy, especially numerical ability, positively correlates with financial well-being. In addition, factors such as risk aversion influence decision making. This is in line with findings that indicate that those with higher financial literacy are better able to manage their money and to make informed decisions (OECD 2013, p. 141), e.g. related to—besides others—debt and debt management (Lusardi and Tufano 2009a, b; Moore 2003—cited in OECD 2013, p. 141).

In order to foster financial literacy, many countries have already made efforts to develop learning materials, to support the training of financial literacy, to integrate financial literacy into the curricula of the education system and to conceptualise and measure financial literacy. Less attention, however, has been paid so far to whether informal learning using information available on the Internet can also support the development of financial competence.

Development of financial competence in the context of home buying by means of informal learning from Internet sources

The concept of informal learning

Informal learning—in a very general sense—can be defined as "any activity involving the pursuit of understanding, knowledge or skill which occurs without the presence of externally imposed curricular criteria" (Livingstone 2001, p. 4). Informal learning is the result of activities related to work, leisure or technology use, just to name a few examples. It is not particularly organised, planned or structured in terms of objectives or time, and it is not formally recognised (Werquin 2010, p. 22). Informal learning often takes place without the assistance of an instructor to support the learning process (Damnik et al. 2013, p. 431). It occurs when it is needed (Manuti et al. 2015, p. 5), e.g. in situations in which learners solve uncommon problems or face challenges and new tasks (e.g. Marsick and

Watkins 2001). Informal learning is neither based on a syllabus nor is it discrete or linear (Cerasoli et al. 2018, p. 203). Informal learning comprises both cognitive activities, such as reflection, and observable behaviour, such as searching on the Internet (Mulder 2013).

From the perspective of the institutions involved, the European Centre for the Development of Vocational Training (Cedefop 2000) distinguishes informal learning from formal learning and from non-formal learning. Formal learning takes place in a structured environment, such as an educational setting in a classroom. Formal learning behaviour explicitly aims for the acquisition of knowledge, skills and competences (Werquin 2010, p. 21). According to Eraut (2000), formal learning is characterised by a prescribed learning framework, an organised learning event, the presence of a teacher or trainer, a qualification or credit award and the specification of outcomes (p. 114). Furthermore, from the perspective of the learner, formal learning is always intentional (Colardyn and Bjørnåvold 2004). Non-formal learning can be categorised between informal learning and formal learning. Non-formal learning is embedded in planned activities in education-like settings that do not have explicit learning objectives, time intended for learning or learning support. The learner acts intentionally (Colardyn and Bjørnåvold 2004, p. 71; Werquin 2010, p. 22).

The distinction between formal, non-formal and informal learning is often everything but easy, clear or unambiguous (Botturi et al. 2014, p. 387). This is especially true for distinguishing between non-formal learning and informal learning. Sometimes, it seems the distinction might only be helpful from a theoretical or analytical point of view (Werquin 2010, p. 17). The comparison and delineation becomes even more complicated if different forms of informal learning are considered, such as deliberate (goal-oriented and conscious learning activities), reactive (reflection on experiences, noting facts) and implicit (unconscious) informal learning (Eraut 2004, as cited in Segers et al. 2018). Marsick and Watkins (2001), however, stress that informal learning is usually intentional. However, the degree of intentionality may vary. Tannenbaum et al. (2010) suggest that the intent to learn differentiates informal learning from incidental (learning by chance) learning (p. 306). Approaches to systematise different concepts, e.g. Straka (2004), developed a structure in order to contrast formal, non-formal and informal learning (p. 12). Segers et al. (2018) suggest five continua to contrast formal and informal learning (p. 7). It should be mentioned that the latter authors do not differentiate between non-formal and informal learning. Yet, in spite of these efforts towards conceptualisation, the distinctions remain somewhat blurry.

The process of informal learning (just as learning in general) can be conceptualised as a reciprocal interaction between the individual and the environment (e.g. Tynjälä 2008; Tannenbaum et al. 2010; Ellström 2011). Both the environment and the individual contribute to that process. On the side of the environment, factors such as complexity, structure or design of tasks play a role (e.g. Dennen and Wang 2002, p. 441; Cerasoli et al. 2018, p. 204). Furthermore, learning conditions, such as time or support of others, are relevant (Cerasoli et al. 2018, p. 206; Kyndt et al. 2018, pp. 17–18.). On the side of the individual, reflection of experiences; self-directed learning ability (Marsick and Watkins 2001, pp. 25–26); predispositions, such as learning motivation or attitude; available cognitive resources in terms of cognitive load or mental effort and demographics, such as gender, age etc., play a role. First and foremost, prior knowledge and experience must be

addressed (Maier et al. 2014, p. 88; Cerasoli et al. 2018, p. 206). Furthermore, Noe et al. (2013) found significant interrelations between informal learning and the Big Five personality traits (Satow 2011), whereby extraversion, openness and agreeableness show a high positive correlation with informal learning. It is assumed that extraverted, open and agreeable individuals are more open to seeking learning opportunities.

The Internet has expanded the practice of informal learning. It has offered more and more possibilities for informal learning to take place and often made it convenient and expedient (Dennen and Wang 2002, pp. 441–442). Information tools such as webpages, search engines and databases provide learners with on-demand access to resources they may need for their informal learning requests (Dennen and Wang 2002, p. 443). However, whether informal learning will successfully support learning processes depends both on the implementation and use (Dennen and Wang 2002, p. 443). Deep learning (or meaningful learning) from the Internet requires the selection, organisation and integration of information (e.g. Mayer 2005) and higher-order thinking processes such as analysis and evaluation of information (Damnik et al. 2013, p. 431). The key processes can be affected and even distorted by different cognitive or motivational factors (Maier et al. 2014, p. 88).

Relevance of informal learning in the context of home buying

Financial competence with regard to mortgage loan decisions could be developed in formal education courses. However, in many real-life situations people (have to) learn informally. For that purpose, they often use the Internet. According to Schürkmann and Schuhen (2013) the ability to cope with media-provided objects (e.g. online calculators) can be regarded as an integral part of contemporary financial literacy (p. 81). This view can be underpinned by the fact that over the past 15 years the Internet has developed into an important marketplace in general, and for the retail banking business in particular (Stobbe and Meyer 2010). In 2010, about 60% of all new financial contracts are preceded by online research. This trend has increased since (Krotsch and Locher 2012, p. 30). Typical for the German market is the so-called ROPO effect (Research Online, Purchase Offline), which means that after the online research, in most cases, customers finalise and sign contracts offline, i.e. face to face in appointments with consultants or financial intermediaries (Stobbe and Meyer 2010). Therefore, in order to attract and retain customers, it is important that the online information meets their needs and interests. Irrelevant advertising messages and overly complicated information are presumably counterproductive (Krotsch and Locher 2012, p. 30).

Concerning mortgage loans, banks make information about all of the above-mentioned four core elements available on their webpages. Usually, banks provide information in the form of calculators that customers can manipulate. The calculators invite potential borrowers to calculate income and expenses, the affordable purchase price for a property, the annuity and costs for renting or buying. For that purpose, the calculators have blank fields to be filled in with personal data, data about the individual financial situation as well as about the desired house and financial plan. Furthermore, potential customers are, in many cases, provided with explanations of key concepts. As a result, the calculators show information about the affordable purchase price or the monthly rate to be paid, i.e. the annuity (Fig. 1). Learning from online calculators can be regarded

Fig. 1 Screenshots of the CoBa loan calculator. Remark: The design of the calculator is under constant change. Therefore, the screenshots might not totally correspond the current website anymore

as informal learning because it does not take place in an instructional setting aiming to educate, no instructor is available, it is not accredited and a new everyday-life task has to be solved. However, similar to non-formal learning, it is intentional.

Informal learning in the context of home buying—research results

Fürstenau et al. (2016) did a survey on whether banks' online calculators have the potential to support informed and responsible decision making in first-time home buyers regarding mortgage loans. The results show that banks' calculators differ considerably in type, amount and quality of information. In general, banks provide less or different information than is necessary to support knowledge acquisition and informed decision making. Thus, calculators may only be partly suitable to support the development of financial competence.

In an explorative study, Hommel et al. (2017) investigated whether banks' online information supports the development of financial competence about mortgage loans, i.e. both knowledge acquisition and decision making. Test persons (students) were assigned to one of two experimental groups or to a control group. Students from the experimental

Fig. 1 (continued)

groups explored the loan calculator of one German bank, either Norddeutsche Landesbank (NoLB)[7] or Commerzbank (CoBa). The loan calculators differed somewhat in quality and notably in quantity of information provided. The control group did not explore any loan calculators (Hommel et al. 2017). The results show that the groups did not differ significantly in the acquisition of knowledge about mortgage loans nor in the quality of argumentation for or against taking a mortgage loan. Although the calculators were different, these differences did not affect the ability to make informed decisions and justify them. Furthermore, it became obvious that the more information was provided, the more test persons became busy with reading and selecting information instead of processing it deeply and learning meaningfully (Fürstenau and Hommel 2018). Based on this data, it cannot be assumed that loan calculators supported the test persons in the development of financial competence about mortgage loans. On the contrary, self-reported prior knowledge and prior experience can be used to explain the results (Hommel et al. 2017; Fürstenau and Hommel 2018).

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[7] Braunschweigische Landessparkasse (BLSK) is part of NordLB (as a so-called "AidA", Anstalt in der Anstalt, which means "institution in the institution of Norddeutsche Landesbank").

Schürkmann and Schuhen (2013) also examined whether online calculators as help tools and simulation tasks for online banking supported the development of financial competence. They used calculators with different levels of difficulty (p. 80). However, the difficulty level construct was not defined in detail. They determined typical errors in handling the calculators, such as inserting incorrect values into the calculators, incorrect point and comma setting and conversion errors (converting years into months). The results show that many test persons had problems working with the online calculators provided. Significant differences between the groups could be found, which can be traced back to—among other factors—the age and partly the school level and school type, whereby no clear directional statements are possible. Gender did not make a significant difference in using online calculators effectively (Schürkmann and Schuhen 2013, p. 85).

Method

Assessment of financial competence—initial remarks

With regard to assessment, both oral and written questioning, both subjective and objective measures and both qualitative and quantitative measures have been used so far (Aprea 2012, p. 3). Assessment approaches have been criticised for measuring financial competence either not reliably, or only partly. In the cases where self-reports on financial knowledge are used, results may be biased by the under- or overestimation of competence. In the case of written tests, the focus is often on financial knowledge instead of financial competence, and on lower cognitive levels instead of problem-solving or decision making. In addition, cognitive facets are taken into account whereas non-cognitive facets, e.g. motivation or emotion, are often neglected (Aprea and Wuttke 2016). Qualitative data is often not matched with quantitative data and vice versa. Frühauf and Retzmann (2016) summarise the situation for Germany as follows: "[…] it can be noted that Germany still lacks any competency-based and learning-outcome standards orientated survey of financial literacy" (p. 270). Researchers are therefore challenged to develop and implement new or complementing instruments to measure financial competence and its components comprehensively as well as validly and reliably. Some efforts have been already underway to this end, e.g. the adaptation and improvement of the Test of Financial Literacy (Förster et al. 2017) or the use of situational judgment tasks for competence measurement (Wuttke and Aprea 2018), just to name a few.

Against this background, in our study we aimed to measure financial competence in the context of home buying by using a comparatively holistic approach. We included subjective and objective measures of financial knowledge and experience in the field in question. In addition, we measured knowledge and regarded the subjective interest in the topic as a motivational factor. Moreover, we challenged the participants not only to take knowledge tests but to work on a realistic decision task about taking a mortgage loan and justifying the decision. Following a mixed methods approach, we used both quantitative and qualitative methods. Concerning qualitative methods we used a specific kind of content analysis that allowed us to compare complete lines of argumentations, not only single arguments.

Aim, research questions and hypotheses

The *aim* of our study is to analyse whether banks' webpages as informal authentic learning environments contribute to users' development of financial competence about mortgage loans. Specifically, we focus on one of the above-mentioned four core elements: loan calculation. We define financial competence about mortgage loans as knowledge and informed decision making. Knowledge refers to conceptual knowledge about mortgage loans, such as principal, interest, annuity, etc. (see above) and applicable knowledge used, for example, to interpret given information. Informed decision making is operationalised by the argumentation quality, that is to say, the quality of arguments used to decide for or against taking a mortgage loan. Furthermore, we tested which factors influence the development of financial competence. In line with the results of the studies reported above, we mainly regard prior knowledge in the sense of numerical skills, self-reported financial knowledge, self-reported financial experiences and risk aversion. In addition, we include interest in home ownership as a motivational factor, though it has not been regarded as such so far.

We raised the following research questions:

  I. Does informal learning using webpages support the development of financial competence about mortgage loans?

 II. Do certain factors, specifically prior knowledge, prior financial experience and interest in the topic influence the development of financial competence about mortgage loans? Does risk aversion influence the decision for or against taking a mortgage loan?

III. What are the similarities and differences between students' argumentations for and against taking a mortgage loan? In what respects do students' argumentations show strengths and weaknesses compared to a reference argumentation of an expert?

With regard to the first two research questions, we hypothesised the following:

1. Test persons' development of financial competence about mortgage loans is related to learning informally using webpages, as well as to prior knowledge, prior experiences with financial products and investments and to the interest in home ownership.

2. Test persons develop better financial competence about mortgage loans if they have high prior knowledge, high prior experience with investment and finances and high interest in home ownership than if they have low prior knowledge, low prior experience and low interest in home ownership.

3. The difference in the development of financial competence about mortgage loans between test persons of high and low prior knowledge, high and low prior experiences with investment and finances and high and low interest in home ownership is related to learning informally using webpages.

4. The decision for or against taking a mortgage loan is related to learning informally using webpages.

5. Test persons with low (high) risk aversion make risk-friendly (risk-averse) decisions about taking a mortgage loan.

Table 1 Participants

	N	M age	N apprenticeship	%
EG	23 (17f, 6m)	21.8	8	17.8
CG	22 (16f, 4 m, 2d)	22.5	4	8.9
Total	45 (33f, 10 m, 2d)	22.2	12	26.7

d diverse

6. The difference in the decisions regarding taking a mortgage loan between high and low risk-averse students is related to learning informally using webpages.

The third research question was answered based on the results of an in-depth qualitative analysis.
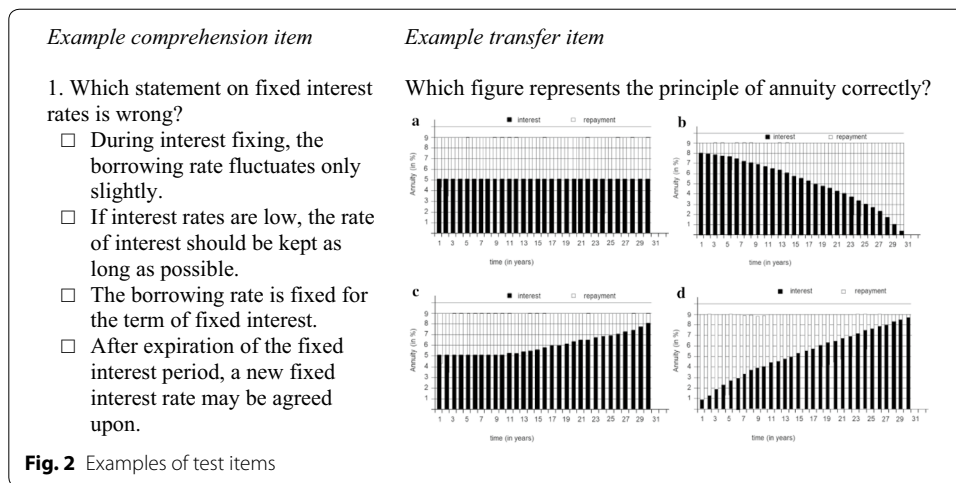
Material

In the study presented here, students explored the loan calculator of the German bank Commerzbank (CoBa) (Fig. 1). We selected the CoBa calculator because it consists of 30 concepts and includes 22 explanations and, as such, offers more information than comparable calculators of other banks. In addition, the CoBa calculator can be regarded as very structured, neither too simple nor too complicated. It is comparatively concise, though it offers and requires more information than other loan calculators, some of which is not necessary in calculating an annuity (e.g. year of birth, postcode and kind of employment). Like other loan calculators, the CoBa loan calculator is factual and does not offer additional stimulation, such as examples (Fürstenau and Hommel 2018). Furthermore, the quality of the CoBa loan calculator—in terms of differences to a reference calculator—is comparable with those of other loan calculators (Fürstenau et al. 2015, 2016).

Sample

The sample (Table 1) consists of 45 students (age $M = 22.2$) of the economics and business study programme at TU Dresden (Germany) in their final stage of undergraduate studies. The students were randomly assigned to an experimental group (EG) or a control group (CG). Participants of the EG explored the CoBa loan calculator (Fig. 1), whereas the participants of the CG just completed the tests (knowledge tests and the decision task). The average age of the students of the EG was 21.8. Students of the CG were 22.5 years on averages. 33 females, 10 males and two students of diverse gender took part in the study. Some participants completed a commercial apprenticeship prior to their study at the university. This is true for 17.6% of the EG participants and 8.9% of the CG participants. The groups did not differ significantly in that respect ($N = 45$, Mann–Whitney U-Test, $Z = -1.157$, $p = .247$).

Course of the study and data gathering

The study was conducted in June 2017. Before the intervention, the students filled in a self-assessment questionnaire on financial knowledge, previous experience with various forms of investments and financing, interest in home buying and risk disposition. We

Example comprehension item

1. Which statement on fixed interest rates is wrong?
   □ During interest fixing, the borrowing rate fluctuates only slightly.
   □ If interest rates are low, the rate of interest should be kept as long as possible.
   □ The borrowing rate is fixed for the term of fixed interest.
   □ After expiration of the fixed interest period, a new fixed interest rate may be agreed upon.

Example transfer item

Which figure represents the principle of annuity correctly?

Fig. 2 Examples of test items

have already used this questionnaire in previous studies (Hommel et al. 2017). However, in this case we added three items concerning individuals' risk disposition (need for safety as risk aversion in general, need for safety with money investments and need for safety with credits/loans) in order to control for a possible relation between decision making and risk averseness.

Before and after the intervention students were administered knowledge tests. The pre-test focused on the financial knowledge necessary to comprehend mortgage loans. It consists of four open-answer questions measuring numerical abilities and asks students to calculate a percentage, an interest payment for a specified time and an annuity. In addition, three single-choice items (one out of four alternatives) focused on basic knowledge about the interrelations between the principal and the term of the loan, interest and term of fixed interest, debts and inflation. In total, the students could achieve a maximum score of seven points. The post-test (max. score: 21) consisted of four items with an open-answer format and nine single-choice items (one out of four alternatives). The open-answer items required the test persons to name the components of an annuity and the necessary elements for an annuity calculation, to explain the influences on the amount of the annuity and to explain the concept of "term of fixed interest". The test items aimed to assess comprehension (four open-answer items and three single-choice items) and transfer (six single-choice items) (Fig. 2).

A delayed post-test, which was the same as the immediate post-test, was administered 2 weeks after the intervention. 12 CG subjects and 14 EG subjects completed the delayed post-test. The researcher team developed both the pre-test and the post-test.

Before taking the immediate knowledge post-test, the EG students explored the CoBa webpages on loan calculation (Fig. 1). To secure a comparable basis for exploration among EG students, data about a pre-selected house to be bought, such as purchase price, and data about the financial framework of a realistic potential customer, such as down payment or amount of disposable monthly income, was given. Based on that, the students got the following simple instruction: "Please explore the loan calculator thoroughly. Try to learn as much as you can about mortgage loans. Use the information given if you have to insert data in the respective fields. If necessary, specify further data." The

instruction was designed in a way to cast the participants act in the role of a potential loan taker. It therefore aimed to stimulate and simulate real life exploration behaviour. For that reason, we suggest to consider the learning environment as informal: it is characterised by voluntary participation, intentional learning, comprises cognitive activities and behaviour, is initiated when it is needed and does not take place in an educational setting (though the study took place in a university), is not highly pre-structured, is not supported by an instructor and is not formally recognised. To be able to trace the students' exploration process and to control for possible problems when using the calculator, we used screen capturing; hence, we could track the mouse movements. In addition, students filled in blank fields of a worksheet showing the calculator screenshot. This enabled us to control whether students used plausible numbers.

After the exploration, the EG and CG students worked on an authentic decision case: a young family wants to buy a single-family house. Students should decide whether they recommend that the family take a mortgage loan and should justify their decisions. The argumentation had to be made from an economic point of view, regarding whether taking a mortgage loan is justifiable in light of the financial framework given.

Data analysis

The *self-assessment* data was analysed by means of a confirmatory factor analysis (CFA, $N = 203$, uls, *CFI* 1.000, *Tucker-Lewis* 1.009, *RMSEA* 0.000). As the sample size of the current study is not large enough for this analysis, we drew on data from previous studies with 101 comparable participants who completed the same questionnaire (except the three new items about risk disposition). The previously found three-factors (Hommel et al. 2017) could be confirmed: (1) experience with investments and financing, (2) financial knowledge and (3) interest in home ownership (as a motivational factor). We subjected the data, including the three new items, to an exploratory factor analysis despite the small sample size in order to control for plausible results. As expected, the values of Cronbach's alpha and the Kaiser–Meyer–Olkin measure of sampling adequacy indicate the inappropriateness of the analysis ($n = 45$, Cronbach's $\alpha = 0.629$, $KMO = 0.601$; Varimax-Rotation). Nonetheless, the three new items are related to only one new (fourth) factor (eigenvalue 1.894; variance explained 11.1%): (4) need for *safety*/risk aversion regarding financial products. Even though we have to interpret this data very cautiously, the result seems plausible.

The *knowledge tests* were scored using a sample solution. In the case that the test subjects answered correctly (open-answer format) or ticked the correct answer (single-choice question), they received one point. If they answered incorrectly, they received zero points. We separated the total score into a comprehension score and a transfer score. A total of seven points for the pre-test and 21 points for the post-test could be achieved (15 for comprehension and six for transfer; see above). To analyse the test data beyond descriptive statistics, we controlled for normal distribution and variance homogeneity for tests and the subgroups (Rasch et al. 2014). In the case that the requirements were fulfilled, we used parametric tests. If they weren't, we used nonparametric tests. Additionally, effect sizes and the statistical power were calculated (G*Power, Version 3.1.9.3; Faul et al. 2009).

Concerning the *decisions*, we counted how many students decided in favour and how many decided against taking a mortgage loan. The *arguments* the test subjects used for justifying their decision about taking a mortgage loan were analysed using a content analysis procedure (Krippendorf 2012). The aim of the content analysis was to make the arguments of the test persons comparable amongst each other and comparable with a reference argumentation of a mortgage expert. The first step in that procedure was to identify semantically identical but differently phrased arguments and code them in the same way. For example, the arguments "the term of fixed interest is very short" and "the term of fixed interest is only 10 years" were both coded as "the term of fixed interest is very short" (Fürstenau and Hommel 2018). As a result, we obtained a lexicon of unambiguous arguments. In the second step, we recoded all individual argumentations using only the arguments of this lexicon. In the third step, we compared students' argumentations to each other, which revealed both common ground and idiosyncrasies in arguing. In addition, we compared the students' argumentations to the reference argumentation, which allowed to assess the quality of the students' argumentations. Missing arguments compared to the reference argumentation or arguments raised by the students, though not conclusive regarding a decision about taking a mortgage loan, can hint to comprehension problems or to decisions justified by reasons that were other than economic.

In order to quantify similarities and differences between students' argumentations compared to each other and between students' argumentations and the reference argumentation, we calculated a distance measure based on the Galanter metric. The Galanter metric (Oldenbürger 1986, p. 33) is a relative distance measure that allows a pairwise comparison of any two argumentations. The comparison is based on the set of arguments raised and not on the congruence of single arguments. This is because an adequate decision requires a fixed set of arguments, not a list of single arguments that don't fit together as an argumentation line. The distance measure shows how many of all the arguments that occur in two argumentations do not have a corresponding counterpart in the other argumentation. The distance measure can range between the values of zero and one, wherein a zero means total equality of two argumentations (no distance) and a one means total inequality (maximum distance). Total inequality (distance value $=1$) means that the two argumentations have nothing in common. The higher the distance value, the less the student's argumentation has in common with the reference argumentation. The lower the value, the higher the quality of an individual student's argumentation (Fürstenau and Hommel 2018).

Results

Self-assessment data

The analysis of the *self-assessment questionnaire* shows that the EG subjects assessed their financial experiences (factor 1, see above) significantly higher than the CG subjects (Mann–Whitney U-Test, $n=45$, $Z=-2.463$, $p=.014$, $d_{Cohen}=0.781$, $(1-\beta)=0.81$). This result cannot be explained by a completed commercial apprenticeship. Concerning the other three factors, financial knowledge (factor 2, Mann–Whitney U-Test, $n=45$, $Z=-1.175$, $p=.240$, $d_{Cohen}=0.466$, $(1-\beta)=0.44$), subjective interest in home ownership (factor 3, Mann–Whitney U-Test, $n=45$, $Z=-0.780$, $p=.436$, $d_{Cohen}=0.313$, $(1-\beta)=0.26$) and need for safety/risk aversion (factor 4, Mann–Whitney U-Test,

Table 2 Scores for the pre-test and post-test

	CG, n = 22				EG, n = 23			
	M	*SD*	*Min*	*Max*	*M*	*SD*	*Min*	*Max*
Pre-test	3.00	1.45	0	6	3.43	1.27	1	6
Post-test total	11.18	3.74	3	17	12.70	4.78	4	21
Post-test comprehension	8.32	2.64	2	13	8.87	3.14	3	14
Post-test transfer	2.86	1.78	0	7	3.83	1.85	1	8

Reachable max. scores: pre-test: 7; post-test: 21; post-test comprehension: 15, post-test transfer: 6

$Z = -0.517$, $p = .605$, $n = 45$, $d_{Cohen} = 0.127$, $(1 - \beta) = 0.11$), the groups did not differ significantly.

Knowledge and decision making

In the *pre-test*, students of the EG achieved a slightly higher mean score ($M = 3.43$, $SD = 1.27$) than those of the CG ($M = 3.00$, $SD = 1.45$) (Table 2). However, this difference was not significant ($n = 45$, t-Test, $t = -1.071$, $df = 43$, $p = .290$, $d_{Cohen} = 0.315$, $(1 - \beta) = 0.26$). One person in each group failed in calculating the percentage, 12 persons (52.2%) in the EG and 15 persons (68.2%) in the CG failed in calculating interest and almost all persons of both groups (except one) failed in calculating an annuity correctly. Therefore, it can be stated that students have only partial knowledge about mortgage loans and only partially fulfil the prerequisites to make an informed decision about taking a mortgage loan. The comparatively bad results related to calculating interest and annuity were not expected, since these topics were already covered in the classes of their course of studies.

In the post-test, students of the EG also achieved a slightly higher mean score ($M = 12.70$, $SD = 4.78$) than students of the CG ($M = 11.20$, $SD = 3.74$). Specifically, the EG subjects achieved slightly better results regarding comprehension ($M = 8.87$, $SD = 3.14$) and remarkably better results regarding transfer ($M = 3.83$, $SD = 1.85$) than the CG subjects (comprehension $M = 8.32$, $SD = 2.64$, transfer $M = 2.86$, $SD = 1.78$). However, the groups did not differ significantly regarding the total score as well as the comprehension and transfer scores (total score post-test: $n = 45$, t-Test, $t = -1.180$, $df = 43$, $p = .245$, $d_{Cohen} = 0.355$, $(1 - \beta) = 0.31$; comprehension score post-test: $n = 45$, t-Test, $t = -0.636$, $df = 43$, $p = .528$, $d_{Cohen} = 0.190$, $(1 - \beta) = 0.15$; transfer score post-test: $n = 45$, t-Test, $t = -1.777$, $df = 43$, $p = .083$, $d_{Cohen} = 0.535$, $(1 - \beta) = 0.51$).

Looking at the subsample of test persons (CG 2 m, 10f; EG 4 m, 10f) who completed all tests (the pre-test, immediate post-test and delayed post-test), the same tendencies that were true for the whole sample could be observed (Table 3). EG and CG students achieved almost the same mean score in the pre-test ($M_{CG} = 3.42$, $SD = 1.38$ vs. $M_{EG} = 3.43$, $SD = 1.45$). In the immediate post-test, EG students scored better with regard to the total score ($M_{CG} = 11.67$, $SD = 3.52$ vs. $M_{EG} = 13.00$, $SD = 5.62$), slightly better with regard to comprehension ($M_{CG} = 8.75$, $SD = 2.60$ vs. $M_{EG} = 9.07$, $SD = 3.41$) and remarkably better with regard to transfer ($M_{CG} = 2.92$, $SD = 1.38$ vs. $M_{EG} = 3.93$, $SD = 2.09$) than CG students. The same is true for the delayed post-test (Table 3). Interestingly, subjects of both the CG and the EG scored slightly better

Table 3 Scores for the pre-test, immediate post-test and delayed post-test

	CG, n = 12				EG, n = 14			
	M	SD	Min	Max	M	SD	Min	Max
Pre-test	3.42	1.38	1	6	3.43	1.45	1	6
Immediate post-test total	11.67	3.52	6	17	13.00	5.26	4	21
Immediate post-test comprehension	8.75	2.60	5	13	9.07	3.41	3	14
Immediate post-test transfer	2.92	1.38	0	4	3.93	2.09	1	8
Delayed post-test total	12.67	3.06	8	19	13.79	3.47	9	19
Delayed post-test comprehension	9.92	2.23	6	13	9.93	1.82	7	12
Delayed post-test transfer	2.75	1.60	1	6	3.86	1.96	2	8

Reachable max. scores: pre-test: 7; post-test: 21; post-test comprehension: 15, post-test transfer: 6

concerning comprehension in the delayed post-test compared to the immediate post-test (Table 3). The results remained stable over time, and did not decrease—as is more often the case when delayed post-tests are administered. The knowledge of test persons did not seem to decay over time.

In order to control for group differences, we ran t-tests ($\alpha = 0.05$). Though data was not normally distributed, homogeneity of variances for the subgroups could be secured, which in turn enabled us to choose for parametric testing. The t-test results show that the groups neither differed significantly in pre-test scores (total score of the pre-test n = 26, t-test, $t = -0.021$; $df = 24$, $p = .983$, $d_{Cohen} = 0.007$, $(1 - \beta) = 0.05$) nor in the immediate post-test scores (total score of the immediate post-test: n = 26, t-test, $t = -0.745$, $df = 24$, $p = .463$, $d_{Cohen} = 0.293$, $(1 - \beta) = 0.18$; comprehension score of the immediate post-test: n = 26, t-test, $t = -0.267$, $df = 24$, $p = .792$, $d_{Cohen} = 0.104$, $(1 - \beta) = 0.08$; transfer score of the immediate post-test: n = 26, t-test, $t = -1.428$, $df = 24$, $p = .166$, $d_{Cohen} = 0.561$, $(1 - \beta) = 0.40$) and in delayed post-test scores (total score of the delayed post-test: n = 26, t-test, $t = -0.866$, $df = 24$, $p = .395$, $d_{Cohen} = 0.341$, $(1 - \beta) = 0.21$; comprehension score of the delayed post-test: n = 26, t-test, $t = -0.015$, $df = 24$, $p = .988$, $d_{Cohen} = 0.005$, $(1 - \beta) = 0.05$; transfer score of the delayed post-test: n = 26, t-test, $t = -1.409$, $df = 24$, $p = .171$, $d_{Cohen} = 0.615$, $(1 - \beta) = 0.45$).

Furthermore, a repeated measures ANOVA does not show significant interaction effects, which means that the groups did not differ in the development of scores (total score: $F(1,24) = 0.036$, $p = .851$, $\eta^2 = 0.001$, $(1 - \beta) = 0.06$; comprehension score: $F(1,24) = 0.136$, $p = .716$, $\eta^2 = 0.006$, $(1 - \beta) = 0.12$ transfer score: $F(1,24) = 0.019$, $p = .892$, $\eta^2 = 0.000$, $(1 - \beta) = 0.05$) from the immediate post-test to the delayed post-test. For further analyses we focus exclusively on the immediate post-test, data which are available for the whole sample.

Decision making

Regarding the decision, in both groups a higher proportion of students voted against (CG: 63.6%; EG: 82.6%) than in favour of taking a mortgage loan (Table 4).

The subjects of the CG raised 4.1 arguments ($SD = 2.00$, $Min = 1.00$, $Max = 8.00$) on average; those of the EG raised 6.50 ($SD = 2.80$, $Min = 3.00$, $Max = 15$) (Table 5).

Table 4 Decision

	Decision			
	0		1	
	N	%	N	%
CG	14	63.6	8	36.4
EG	19	82.6	4	17.4

0 = against taking a mortgage loan

1 = for taking a mortgage loan

Table 5 Number of arguments

N arguments	Argumentation of groups					
	CG			EG		
	$n=14$	$n=8$	$n=22$	$n=19$	$n=4$	$n=23$
	Dec. = 0	Dec. = 1	Σ Dec.	Dec. = 0	Dec. = 1	Σ Dec.
M	3.90	4.30	4.10	6.20	7.80	6.50
SD	2.10	1.90	2.00	2.30	4.90	2.80
Min	1	2	1	3	4	3
Max	8	7	8	12	15	15

Dec. = decision

0 = against taking a mortgage loan

1 = for taking a mortgage loan

No. of arguments in reference argumentation: decision 0: 7; decision 1: 5

The groups significantly differ regarding the number of arguments ($n=45$, Mann–Whitney U-Test, $Z=-3.069$, $p=.002$, $d_{Cohen}=0.983$, $(1-\beta)=0.94$). Concerning the decision against taking a mortgage loan, subjects of the CG raised 3.9 ($SD=2.10$) arguments and subjects of the EG raised 6.20 arguments on average ($SD=2.30$). Subjects of the EG raised significantly more arguments against taking a mortgage loan than subjects of the CG ($n=33$, Mann–Whitney U-Test, $Z=-2.503$, $p=.012$, $d_{Cohen}=1.037$, $(1-\beta)=0.88$). With regard to the decision for taking a mortgage loan, again students of the EG ($M=7.80$, $SD=4.90$) raised more arguments than students of the CG ($M=4.30$, $SD=1.90$). The groups did not differ significantly in that respect (n = 12, Mann–Whitney U-Test, $Z=-1.462$, $p=.144$, $d_{Cohen}=1.122$, $(1-\beta)=0.51$). However, it has to be acknowledged that test power did not reach the desirable 80% value.

The number of arguments raised by the EG subjects against taking a mortgage loan is closer to the number of arguments in the reference argumentation. Concerning the decision for taking a mortgage loan, the number of arguments raised by the CG students is closer to the number of arguments in the reference argumentation (Table 5).

Independent of the number of arguments, the content of the students' argumentation is somewhat different from the reference argumentation. This is indicated by the high average distance values of the students' argumentations. Concerning both the decisions against and in favour of taking a mortgage loan, the distance values are higher than 0.9. The EG group reached slightly better, i.e. lower values than the CG group (Table 6).

Table 6 Distance from reference argumentation

Distance	CG			EG		
	$n = 14$	$n = 8$	$n = 22$	$n = 19$	$n = 4$	$n = 23$
	Dec. = 0	Dec. = 1	Σ Dec.	Dec. = 0	Dec. = 1	Σ Dec.
M	0.97	0.94	0.96	0.94	0.91	0.93
SD	0.06	0.07	0.06	0.07	0.08	0.07
Min	0.82	0.86	0.82	0.77	0.80	0.77
Max	1	1	1	1	1	1

Dec. = decision

0 = against taking a mortgage loan

1 = for taking a mortgage loan

A Mann–Whitney U-Test confirms that the groups did not differ in quality of argumentation ($n = 45$, $Z = -1.246$, $p = .213$, $d_{Cohen} = 0.475$, $(1 - \beta) = 0.17$).

Testing of hypotheses

Hypothesis 1 First, we tested whether the development of competence about mortgage loans is related to learning informally using webpages, and if it is related to prior knowledge, prior experiences and interest in home ownership. Competence is operationalised by our dependent variable knowledge (indicated by the immediate post-test total score and its components, comprehension and transfer score), and argumentation quality in terms of distance from the reference argumentation.

We ran ANCOVAs with the immediate post-test scores and decision quality as dependent variables, with the pre-test score, self-assessed financial knowledge, self-assessed financial experience, self-assessed interest in home ownership as covariates and the EG and CG as group variable. The *total score of the immediate post-test* is significantly influenced only by prior knowledge ($F(1,39) = 5.907$, $p = .02$, $\eta^2 = .132$, $(1 - \beta) = 0.72$), not by other variables. The same is true for the *comprehension sub-score* ($F(1,39) = 5.502$, $p = .024$, $\eta^2 = 0.124$, $(1 - \beta) = 0.69$) and the *transfer sub-score* ($F(1,39) = 9.334$, $p = .004$, $\eta^2 = 0.193$, $(1 - \beta) = 0.89$). *Argumentation quality* is significantly influenced by interest in home ownership ($F(1,39) = 4.576$, $p = .039$, $\eta^2 = 0.105$, $(1 - \beta) = 0.61$), and only almost significantly influenced by prior knowledge ($F(1,39) = 3.531$, $p = .068$, $\eta^2 = 0.083$, $(1 - \beta) = 0.51$).

Based on the results, we have to state that informal learning by using webpages does not support the development of competence better than a control condition. The t-tests have already shown that the groups did not differ in the immediate post-test scores and in the sub-scores for comprehension and transfer. Furthermore, the result of the Mann–Whitney U-Test revealed that the groups did not differ in argumentation quality (see above).

Hypotheses 2 and 3 The *second* hypothesis aimed to test whether students develop better financial competence about mortgage loans if they have high prior knowledge (measured by both the pre-test and the self-assessment), high prior experience with

investment and finances and high interest in home ownership than if they have low prior knowledge, low prior experience and low interest in home ownership. The *third* hypothesis aimed to test whether the difference in the development of financial competence about mortgage loans between students with high and low values of the respective variables interacts with the experimental design (that is to say, belonging to the experimental group that learned informally using webpages or to the control group). We tested the second hypothesis in conjunction with the third hypothesis. For that purpose, we ran ANOVAs for the dependent variables of knowledge and argumentation quality. As independent variables, we used the group (EG, CG) and each of the following variables: prior knowledge, self-assessed financial knowledge, self-assessed financial experiences with investments and financing and self-assessed interest in home ownership. In order to differentiate between high- and low-value students, we used the median split for each variable.

Concerning *prior knowledge*, the first ANOVA shows that high and low prior knowledge students significantly differed in the *immediate post-test total score* ($F(1,41) = 13.23$, $p = .001$, $\eta^2 = 0.244$, $(1 - \beta) = 0.96$). Neither the main factor group (EG vs. CG) nor the interaction factor (group*prior knowledge) explains the result. Therefore, it made no difference whether students were in the EG or the CG. The same result was observed for the *comprehension sub-score* ($F(1,41) = 5.366$, $p = .026$, $\eta^2 = 0.116$, $(1 - \beta) = 0.66$) and the *transfer sub-score* ($F(1,41) = 9.299$, $p = .004$, $\eta^2 = 0.185$, $(1 - \beta) = 0.88$). The *argumentation quality* can neither be explained by the main factors nor by the interaction factor.

With regard to *self-assessed financial knowledge*, the *immediate post-test total score* significantly differed dependent on whether students reported high or low financial knowledge ($F(1,41) = 5.340$, $p = .026$, $\eta^2 = 0.115$, $(1 - \beta) = 0.66$). The score did not differ dependent on group (EG or CG) participation ($F(1,41) = 1.142$, $p = .292$, $\eta^2 = 0.027$, $(1 - \beta) = 0.19$). Moreover, the difference in scores between high and low financial knowledge students did not differ between the EG and the CG. Other than is true for the total score, students with high and low financial knowledge did not differ in the *comprehension sub-score* ($F(1,41) = 1.510$, $p = .226$, $\eta^2 = 0.036$, $(1 - \beta) = 0.24$) or the *transfer sub-score* ($F(1,41) = 2.99$, $p = .091$, $\eta^2 = 0.068$, $(1 - \beta) = 0.43$) of the immediate post-test. In addition, the post-test *comprehension sub-score* ($F(1,41) = 2.357$, $p = .132$, $\eta^2 = 0.054$, $(1 - \beta) = 0.35$) and *transfer sub-score* ($F(1,41) = 2.99$, $p = .091$, $\eta^2 = 0.068$, $(1 - \beta) = 0.43$) did not differ depending on students' participation in the EG or the CG. Furthermore, the difference in the post-test comprehension sub-score ($F(1,41) = 0.940$, $p = .338$, $\eta^2 = 0.022$, $(1 - \beta) = 0.17$) and transfer sub-score ($F(1,41) = 1.934$, $p = .172$, $\eta^2 = 0.045$, $(1 - \beta) = 0.30$) between high and low financial knowledge students did not differ between the EG and the CG. Finally, the *argumentation quality* can neither be explained by the main factors nor by the interaction factor.

Regarding *experiences with investments and finances*, results of an ANOVA show that the *total score of the immediate post-test* differed significantly between students with high and low experiences ($F(1,41) = 9.122$, $p = .004$, $\eta^2 = 0.182$, $(1 - \beta) = 0.87$). The score did not differ depending on participation of students in the EG or the CG ($F(1,41) = 0.000$, $p = .996$, $\eta^2 = 0.000$, $(1 - \beta) = 0.05$). The differences in the score between students with

low and high experience did not differ between the groups ($F(1,41)=.004$, $p=.953$, $\eta^2=0.000$, $(1-\beta)=0.05$). The *post-test comprehension score* can neither be explained by high or low financial knowledge ($F(1,41)=1.576$, $p=.216$, $\eta^2=0.037$, $(1-\beta)=0.25$), nor by belonging to the EG or the CG ($F(1,41)=2.941$, $p=.094$, $\eta^2=0.067$, $(1-\beta)=0.42$). However, using a reduced model (via elimination of the interaction factor group*high/low experience), the main factor group significantly influenced the result, meaning that the comprehension score significantly differed between the groups ($F(1,41)=4.378$, $p=.042$, $\eta^2=0.094$, $(1-\beta)=0.56$). In addition, the difference in the comprehension score between high and low experience students did not differ between the high/low experience groups ($F(1,41)=2.376$, $p=.131$, $\eta^2=0.055$, $(1-\beta)=0.35$). Similar to the total score, the immediate *post-test transfer score* significantly differed depending on students' high or low experience with financial investments and finances ($F(1,41)=12.176$, $p=.001$, $\eta^2=0.229$, $(1-\beta)=0.95$). The participation in the EG or the CG, and therefore the intervention (informal learning), did not matter in that respect ($F(1,41)=0.113$, $p=.739$, $\eta^2=0.003$, $(1-\beta)=0.06$). In addition, the difference in the transfer score between high and low experience students did not differ between the high/low experiences groups ($F(1,41)=0.425$, $p=.518$, $\eta^2=0.010$, $(1-\beta)=0.10$). The *argumentation quality* can neither be explained by the main factors nor by the interaction factor.

Finally, concerning *interest in home ownership* (as a motivational factor), the *total score of the immediate post-test* significantly differed between students who reported high and low interest ($F(1,41)=6.657$, $p=.014$, $\eta^2=0.140$, $(1-\beta)=0.75$). The score did not differ depending on the participation of students in the EG or the CG ($F(1,41)=2.111$, $p=.154$, $\eta^2=0.049$, $(1-\beta)=0.31$). Furthermore, score differences between students who reported high and low interest in home ownership did not significantly differ between the EG and the CG ($F(1,41)=1.493$, $p=.229$, $\eta^2=0.035$, $(1-\beta)=0.24$). Concerning the *comprehension score* of the immediate post-test, the same can be stated: The score differed depending on high and low interest in home ownership ($F(1,42)=7.87$, $p=.008$, $\eta^2=0.161$, $(1-\beta)=0.82$). The EG and CG did not differ significantly in the immediate post-test comprehension score ($F(1,41)=2.492$, $p=.122$, $\eta^2=0.057$, $(1-\beta)=0.36$). The difference in the score between students who reported high and low interest did not differ between the EG and the CG ($F(1,41)=0.482$, $p=.491$, $\eta^2=0.012$, $(1-\beta)=0.11$). The *transfer score*—unlike the comprehension score—did not differ depending on high or low interest in home ownership ($F(1,41)=1.191$, $p=.281$, $\eta^2=0.028$, $(1-\beta)=0.20$), however it did differ depending on participation in the EG or the CG ($F(1,41)=4.261$, $p=.045$, $\eta^2=0.045$, $(1-\beta)=0.30$). The difference in the score between students who reported high and low significance did not differ between the EG and the CG ($F(1,41)=2.004$, $p=.164$, $\eta^2=0.047$, $(1-\beta)=0.06$). Finally, *argumentation quality* differed significantly depending on whether students reported high or low interest in home ownership ($F(1,41)=4.408$, $p=.042$, $\eta^2=0.095$, $(1-\beta)=0.57$). Students who reported low interest in home ownership scored higher than students who reported high interest in home ownership. Argumentation quality did not differ depending on whether students participated in the EG or the CG ($F(1,41)=2.307$, $p=.136$, $\eta^2=0.052$, $(1-\beta)=0.34$). The difference in argumentation quality between students who reported high and low interest in home ownership did not differ between the groups.

Hypotheses 4, 5 and 6 The fourth hypothesis aimed to test whether the decision about taking a mortgage loan is related to learning informally using webpages. Based on a Mann–Whitney U-Test, we can state that the groups did not differ in the percentage of students who decided for or against taking a mortgage loan ($Z = -1.423$, $p = .155$, $n = 45$, $d_{Cohen} = 2.361$, $(1 - \beta) = 0.51$).

The fifth hypothesis aimed to test whether the decision for or against taking a mortgage loan can be explained by high or low risk-averseness. In order to differ between risk-averse and risk-friendly students we used the median split of the factor need for safety/risk aversion, which shows that the decision for or against taking a mortgage loan is not dependent on whether people are risk averse or not ($Z = -0.224$, $p = .823$, $n = 45$, $d_{Cohen} = 3.255$, $(1 - \beta) = 1.00$).

The sixth hypothesis aimed to test whether the difference in the decision about taking a mortgage loan between high and low risk-averse students is related to learning informally using webpages. As Mann–Whitney U-Tests show, in both groups, high and low risk-averse students did not differ in deciding for or against taking a mortgage loan (EG: $Z = -0.094$, $p = .925$, n = 23, $d_{Cohen} = 3.203$, $(1 - \beta) = 1.00$; CG: $Z = -0.082$, $p = .935$, n = 22, $d_{Cohen} = 2.824$, $(1 - \beta) = 0.99$).

In-depth analyses of students' argumentations

To answer the third research question, we analysed the arguments students used in the process of justifying their decisions. Students' arguments revealed common ground as well as idiosyncrasies, and first and foremost provided insight regarding differences from the expert's reference argumentation.

Starting with the analysis of the decision against taking a mortgage loan (Table 7), students of both groups only partly brought up arguments of the reference argumentation. Many more students of the EG (more than 50%) than of the CG (9%) realised that the term of the loan is very long under the conditions given. Other arguments of the reference argumentation were either not taken into account (e.g. that the total amount to be repaid is very high, the initial repayment rate is very low or that it is uncertain how the interest rate develops after the term of fixed interest) or only a very small number of students considered the arguments (e.g. the maintenance costs have to be taken into account). Other than what was suggested by the reference argumentation, students of both groups shared a common ground in that they mentioned that after the expiration of the term of fixed interest, a residual debt remains and that the free disposable monthly income is very low. A considerable percentage of students of the EG (almost 25%) shared the opinion that the rate is smaller than the free disposable monthly income, that the rate as well as the interest can increase after the term of fixed interest and that the due date of the purchase price is very early. Students of the EG more often referred to information given on the webpages (e.g. the purchase price is due at short notice). In general, the argumentations of the students were very heterogeneous. This is true for both the CG, as indicated by the distance between the students' argumentations (*M* distance value: 0.97, $Min = 0.67$, $Max = 1$), and the EG (*M* distance value: 0.93, $Min = 0.5$, $Max = 1$). Argumentations of the EG students were slightly more homogeneous than those of the CG students, as can be seen by the smaller distance value (Table 6).

Table 7 Arguments against taking a mortgage loan (decision = 0)

Reference arguments	Concept mentioned [on webpage (w), in case (c)]	Ref.	N (%) of students	
			CG	EG
Term of fixed interest is very short	w/c	X		1 (4.3)
Term of the loan is very long/high	w/c	X	2 (9.1)	12 (52.2)
Percentage of repayment is very low	w	X		
Total repayment is very high	w	X		
Maintenance costs have to be considered	w	X	2 (9.1)	2 (8.7)
Development of interest rate after the term of fixed interest is uncertain	w	X		

Common arguments brought up by students beyond reference arguments (N > 1)	Concept mentioned [on webpage (w), in case (c)]	N (%) of students	
		CG	EG
Debt remains after expiration of term of fixed interest	w	6 (27.3)	6 (26.1)
Free disposable monthly income is not enough/very low	w/c	4 (18.2)	3 (13)
Expenses for children have to be considered	w	2 (9.1)	2 (8.7)
Term of fixed interest is 10 years	m	2 (9.1)	
Annual instalment is less than free disposable monthly income	w		6 (26.1)
Instalment can increase after expiration of term of fixed interest	w		5 (21.7)
Interest rate can increase after expiration of term of fixed interest	w		5 (21.7)
Due date of the purchase price is very early	w		5 (21.7)
Repayment of the loan lasts until retirement age is reached	w		4 (17.4)
There are no comparable offers	w		3 (13)
Unscheduled repayment is very low	w		2 (8.7)
Payment in advance/arrear	w		2 (8.7)
Expenses for contingencies must be taken into account	w		2 (8.7)
The calculator is confusing	w		2 (8.7)
More information is needed			2 (8.7)

Ref. reference arguments, *X* part of the reference argumentation

Concerning the argumentation in favour of taking a mortgage loan, a considerable percentage of the EG students mentioned three out of five reference arguments, whereas this is true for only one out of five arguments for the CG group (Table 8). Students of both groups mentioned that the monthly rate is smaller than the free disposable monthly income. Students of the EG further mentioned, in accordance with the reference argumentation, that the repayment lasts until retirement age will be reached and that expense buffers have to be considered. Furthermore, students of both groups agreed that the income will be safe and that a house is a good investment. The other arguments of the CG students referred mainly to information given in the case or to subjective opinions (e.g. "a house is your own property") whereas the EG students' arguments also referred to webpage information (e.g. "an unscheduled repayment is possible").

As is true for the argumentations against taking a mortgage loan, the argumentations of students in favour of taking a mortgage loan were also very heterogeneous. Again, this is true for both the CG (*M* distance value: 0.92, *Min*: 0.33, *Max*: 1) and the EG (*M* distance value: 0.84, *Min*: 0.67, *Max*: 1), and is indicated by the distance values (Table 6).

Table 8 Arguments for taking a mortgage loan (decision = 1)

Reference arguments	Concept mentioned [on webpage (w), in case (c)]	Ref.	N (%) of students	
			CG	EG
The duration of the term of the loan is appropriate	w	X		
Repayment of the loan lasts until retirement age is reached	w	X		3 (75)
Rate is less than disposable monthly income	w/c	X	4 (50)	2 (50)
Level of interest rate is low		X		
Expenses for contingencies must be taken into account	w	X		2 (50)
Common arguments named by students beside reference arguments (N > 1)	**Concept mentioned [on webpage (w), in case (c)]**		**N (%) of students**	
			CG	EG
Income seems to be safe	c		3 (37.5)	2 (50)
The term of fixed interest is sufficient	w/c		2 (25)	
No rent payments	c		2 (25)	
Real estate as an investment			2 (25)	2 (50)
A house is your own property	c		2 (25)	
Free disposable income after term of fixed interest is adequate	w/c			3 (75)
Repayment of the loan lasts until retirement age is reached	w			3 (75)
Unscheduled repayment is possible	w			2 (50)
A house is a retirement provision				2 (50)

Ref. reference arguments, *X* part of the reference argumentation

Argumentations of the EG students are slightly more homogeneous, and are more homogeneous than the argumentations against taking a mortgage loan.

Summary of results and discussion

Summary of results

In order to summarise the results, we first refer to data about self-assessment, knowledge, decision making and argumentation quality. The groups did not differ in *self-assessments* of the factors "financial knowledge", "interest in home ownership" and "need for safety/ risk aversion". However, students of the EG assessed their "experience with investments and financing" significantly higher than students of the CG. Concerning *knowledge*, we can state that the EG students achieved slightly better results both in the pre-test and the immediate post-test. Furthermore, students of the EG scored a little higher than students of the CG in the delayed post-test. The differences between the groups are more obvious for transfer than for comprehension. The results remained stable over time from the immediate to the delayed post-test. With regard to *decision making*, in both groups more students decided against than for taking a mortgage loan. Therefore, they opted for risk-averse behaviour, though the case was constructed in a way that the mortgage loan would have been financeable. Students of the EG raised considerably more arguments than students of the CG. The quality of argumentation was deficient in both groups in terms of distance from the reference argumentation. This is indicated by the high distance values, independent of arguing for or against taking a mortgage loan. The students' argumentations were very heterogeneous, which is indicated by the high average

distance values concerning comparison among students. Our in-depth analysis shows that students' argumentations for and against taking a mortgage loan were fairly different from the reference argumentation. Students of both groups only partly considered important arguments suggested by the reference argumentation. Arguments raised often repeated information given in the case material or on the webpage.

Concerning our hypotheses, an overview of the results is shown in Table 9. First of all, we tested whether informal learning by using webpages is advantageous to the control condition, that is to say, students who only completed the tests. In line with the descriptive data, the groups did not differ in knowledge (total score, comprehension and transfer) and argumentation quality. In addition, decisions did not differ dependent on students' participation in the EG or the CG. Consequently, the assumption that financial competence development and decision making is related to informal learning via using webpages finds no support in the data. Instead, prior knowledge is the crucial variable that can be used to explain the knowledge test scores. Specifically, students with high prior knowledge achieved significantly better results than students with low prior knowledge with regard to the total score and to the comprehension and transfer sub-scores. In addition, the total test scores significantly differed between students who self-reported high versus low financial knowledge. The transfer score of students who reported having high experience with investments and finances differed significantly from those who reported low experience with investments and finances. While knowledge and experience partly explain test scores, the interest in home ownership as a motivational variable can be used to explain differences in argumentation quality. Students who rated interest in home ownership as high reached significantly lower argumentation quality than students who rated the interest in home ownership as low. The factor *need for safety/risk aversion* did not explain the decision for or against taking a mortgage loan. Students with high risk aversion opted mainly against taking a mortgage loan, and only a small percentage of students opted for taking a mortgage loan. The same is true for students who showed low risk aversion. The results did not differ depending on whether students participated in the EG or the CG.

To sum up and answer the research questions, we can say the following: The main result of our study is that informal learning via using webpages (or, in particular, the webpages of Commerzbank concerning loan calculation) is not superior to a control condition (research question I). In the study presented here, prior knowledge is the most important factor explaining the results. In addition, prior experience with investment and financing, as well as motivation, can be referred to in order to explain the results. Concerning the motivational factor *interest in home ownership*, it can be stated that high motivation goes along with high test scores as well as, interestingly, low argumentation quality concerning the decision for or against taking a mortgage loan. Finally, risk averseness is not related to the decision against or in favour of taking a mortgage loan (research question II). Students' argumentations for or against taking a loan are comparatively heterogeneous. Argumentations of students in the EG are a little more homogeneous than those of the students in the CG. Argumentation quality as measured by distance from a reference argumentation is comparatively low for both groups (research question III).

Table 9 Results of hypotheses testing

Hypothesis	Result	
	Dependent variable	**Decision**
1. Students' development of financial competence about mortgage loans is related to		
Learning informally using webpages	Knowledge	
	Total score	Reject
	Comprehension score	Reject
	Transfer score	Reject
	Argumentation quality	Reject
Prior knowledge	Knowledge	
	Total score	Accept
	Comprehension score	Accept
	Transfer score	Accept
	Argumentation quality	Reject (by trend)
Self-assessed knowledge.	Knowledge	
	Total score	Reject
	Comprehension score	Reject
	Transfer score	Reject
	Argumentation quality	Reject
Experience with investments and financing	Knowledge	
	Total score	Reject
	Comprehension score	Reject (by trend if a reduced model is calculated)
	Transfer score	Reject
	Argumentation quality	Reject
Interest in home ownership	Knowledge	
	Total score	Reject
	Comprehension score	Reject
	Transfer score	Reject
	Argumentation quality	Accept
2. Students develop better financial competence about mortgage loans if they have		
High prior knowledge rather than low prior knowledge	Knowledge	
	Total score	Accept
	Comprehension score	Accept
	Transfer score	Accept
	Argumentation quality	Reject
High self-assessed knowledge rather than low self-assessed knowledge	Knowledge	
	Total score	Accept
	Comprehension score	Reject
	Transfer score	Reject
	Argumentation quality	Reject
High prior experience with investment and finances rather than low prior experiences	Knowledge	
	Total score	Accept
	Comprehension score	Reject
	Transfer score	Accept
	Argumentation quality	Reject

Table 9 (continued)

Hypothesis	Result	
	Dependent variable	**Decision**
High interest in home ownership rather than low significance	Knowledge	
	Total score	Accept
	Comprehension score	Accept
	Transfer score	Reject
	Argumentation quality	Reject (significant difference between groups in the opposite direction)
3. The difference in the development of financial competence about mortgage loans between high and low … students is related to learning informally using webpages		
… Prior knowledge	Knowledge	
	Total score	Reject
	Comprehension score	Reject
	Transfer score	Reject
	Argumentation quality	Reject
…Self-assessed knowledge	Knowledge	
	Total score	Reject
	Comprehension score	Reject
	Transfer score	Reject
	Argumentation quality	Reject
…Experience with investments and finances	Knowledge	
	Total score	Reject
	Comprehension score	Reject
	Transfer score	Reject
	Argumentation quality	Reject
…Interest in home ownership	Knowledge	
	Total score	Reject
	Comprehension score	Reject
	Transfer score	Reject
	Argumentation quality	Reject
4. The decision for or against taking a mortgage loan is related to learning informally using webpages	Decision for/against loan	Reject
5. Students with low (high) risk aversion make a risk-friendly (risk-averse) decision about taking a mortgage loan	Decision for/against loan	Reject
6. The difference in the decision about taking a mortgage loan between high and low risk-averse students is related to learning informally using webpages	Decision for/against loan	Reject

Discussion

The result that prior knowledge as well as prior experience and motivation explain knowledge gain supports the assumption that financial literacy is prerequisite for financial well-being and that insufficient knowledge and skill might have negative consequences for financial well-being (e.g. Lusardi and Tufano 2009a, b; OECD 2013; Lusardi and Mitchell 2014). In addition, literature in the field of learning has always pointed out the importance of prior knowledge as well as motivation for learning and

thus knowledge acquisition (e.g. Mayer 2008; Hattie 2009). However, interestingly, high motivation was negatively associated with argumentation quality. It is possible that high motivation to own a home induces people not to think through a decision thoroughly, even though they are able to do so based on their knowledge. The same could be said for the other way around: If people are not (too) interested in owning a home, they are more open to consider the arguments. However, these assumptions have to be tested in further research studies.

The main question is why studying online information in an informal setting did not support the test persons in developing financial competence about mortgage loans. Factors relating both to the subjects and to the learning environment (webpage calculator) may be considered, since informal learning can be regarded as an interactional process between the individual and the environment (e.g. Segers et al. 2018). Both factors are intertwined. Concerning the individual, a variety of factors that are known for influencing informal learning can be considered. First and foremost, prior knowledge and experience can be mentioned (e.g. Maier et al. 2014, see above). We assume that many test persons did not have enough prior knowledge and experience to cope with the information given on the webpage. Therefore, the learning potential of the webpage could only be exploited to a very limited amount, and did not help test persons in knowledge acquisition and informed decision making. Furthermore, the lack of knowledge might explain why the majority of test persons decided against taking a mortgage loan. If persons perceive their own lack of knowledge or are insecure about having substantial knowledge, a decision against taking a loan means sticking to familiar behaviour. Because participants might feel overstrained by arguing in favour of taking a mortgage loan, they leave everything as it was before the decision situation. This was true for both risk-averse and risk-friendly students. Arguments used for justification of decisions often resulted from basic comparisons of data, as opposed to deeply processing and integrating information with prior knowledge. Concerning risk aversion it might be the case that it probably only comes into play when it comes to deciding on a certain type of mortgage loan, e.g. adjustable rate mortgage or fixed rate mortgage (Hullgren and Söderberg 2013), not when it comes to taking out a loan at all. It might also be the case that behaviour (reading information and inserting data) is predominant in the course of exploring the loan calculator at the expense of cognitive activities such as reflection (e.g. Mulder 2013). This means that test persons process information on a surface level instead of on a deep level. In a preceding study to the one presented here, we gathered think-aloud protocols of students that support the assumption regarding surface-level cognitive activities (Fürstenau and Hommel 2018). We can assume that self-regulated learning ability (Marsick and Watkins 2001) or personality traits, such as openness and agreeableness, also play a role (e.g. Noe et al. 2013); however, that cannot be stated conclusively here. Last, but not least, we can rule out the possibility that the test persons did not use the calculators correctly. The analysis of worksheets which documented the data the students filled in the calculator show plausible information.

On the side of the calculator, i.e. the learning environment we can state that according to the dimensions of text comprehensibility (Groeben 1982; Langer et al. 1999), the CoBa calculator is very structured. However, it is comparatively complicated and uses unfamiliar words, such as heritage right, and offers a comparatively large amount of information

(30 concepts and 22 explanations). Furthermore, the calculator is concise, however comprises information, some of which is not necessary in calculating an annuity (e.g. year of birth of the potential customer). The calculator is factual and offers no stimulation (Fürstenau and Hommel 2018). Therefore, comprehensibility can be improved with respect to simplicity (in the direction of increased simplicity for users without prior knowledge) and stimulation (stimulating addenda such as examples or illustrations). Concerning the quality of information provided, the calculator on the webpage only partly meets the requirements of experts (Fürstenau et al. 2015, 2016). Beside the arguments just mentioned and taking learning with media or multimedia into account, it can be assumed that basic principles, such as the multimedia principle, are not sufficiently regarded in the design of the webpage. Therefore, the calculator might cause extraneous load, preventing the students from generative processing of information and deep learning (e.g. Mayer 2014). Regarding the learning environment and its influence on informal learning, it could have helped students to spend more time on exploring the calculator or interacting with others, discussing difficulty and receiving feedback or social support (Kyndt et al. 2018). Basically, it seems that informal learning, in the case presented here, did not support meaningful learning sufficiently. Selection, organisation and integration of information with prior knowledge as well as higher-order thinking processes were not sufficiently stimulated (e.g. Mayer 2005; Damnik et al. 2013).

Also, we would like to mention that from the perspective of the bank it might not be the aim to provide sufficient information for a potential customer, but instead—in times of digitalisation—automatise decision processes and customer services. For this reason, effective automation and not the learning support for customers may have been guiding action for the design of the calculator. Furthermore, not learning support but attracting potential customers to schedule a consultancy appointment might be of prior interest from the perspective of the bank. Nevertheless, information should be provided in a way that it can be comprehended. This would be consistent with newer approaches to relationship marketing aimed to foster customer education. Customer education is understood as a learning activity initiated systematically by a company in order to enable customers to consume products, whereby the customer relationship is to be sustainably improved and strengthened (Stolz-Römmermann et al. 2019).

Conclusions

To conclude, the kind of everyday-life environment we used in this study did not sufficiently enable potential customers' development of financial competence. Therefore, this study could be interpreted as effort and plea for systematically supporting informal learning, or for better complementing informal and formal learning in the field of financial competence development. Informal learning could be fostered by implementing support on the webpage for selecting, organising and integrating information with prior knowledge. Hints could be found in multimedia learning literature and the related multimedia principles, e.g. the pre-training principle or the multimedia principle. The pre-training principle suggests to provide learners with names and characteristics of key concepts before they learn something. The multimedia principle means that people learn better from text and pictures than from text alone. Therefore text information and suitable pictures should be provided (e.g. Mayer 2014). In

addition, students could be supported in self-regulated learning, e.g. by using appropriate learning strategies (e.g. Baars et al. 2018). Furthermore, the comprehensibility (Groeben 1982) of webpages can be improved by adding stimulations and by simplifying information given. These ideas might be relevant for information providers. Last, but not least, learners might be supported by more time on task, opportunities for social support or feedback from peers (Kyndt et al. 2018).

In order to complement informal learning by formal learning, formal learning or instruction could aim to teach the necessary prior knowledge, or necessary literacy, for the development of financial competence regarding mortgage loans. Specifically, we would suggest providing students with necessary numerical abilities (Gerardi et al. 2010). It also has to be considered whether just-in-time learning (Fernandes et al. 2014) can support learning so that necessary concepts are not taught in advance but in close temporal relation to the learning process. This could be implemented online by providing explanations and examples and could be interpreted as specific version of the application of the pre-training principle (see above).

One contribution of our study can be seen in that we measured competence as a complex construct by regarding both knowledge and performance measures. In addition, we used a mixed methods approach that reveals insights into learning processes, and by that clues for interpreting quantitative results and at the same time starting points for informal learning processes. The argumentation analyses, in particular, revealed the wrong foci of argumentation that could be considered in formal learning processes.

Limitations of the study can be seen in following aspects: first of all, the small sample size is notable. Therefore, replication studies are necessary in order to confirm the results. Associated with this, the subgroups are partially too small for detecting actual existing small and medium effect sizes. In these cases, the sample and hence the test power are not sufficient (Rasch et al. 2014). Second, it would be of interest to see if people who are closer to setting the plan of buying their own home into action are better able to develop competence due to expected perceivable consequences, high motivations and already higher prior knowledge. In this study we were only able to control for possible future motivation by measuring the factor "interest in home ownership". As it turned out, higher motivation resulted in higher knowledge test scores, but not in better argumentation. Closely connected with the argument just mentioned, one critique could be that the test persons—the university students—might not be interested in the topic because it is not yet relevant to their private lives. Therefore, their motivation to learn deeply might be low, which in turn might negatively influence test results. This seems, on the one hand, plausible. On the other hand, we controlled for motivation and the EG and CG did not differ in that respect. Furthermore, the main aim of the study was to investigate the potential of informal learning using webpages. To follow this aim, it primarily had to be secured that conditions in the EG and the CG are comparable. A third limitation could be a lack of data regarding the learning process; data such as think-aloud protocols, for example, could help to interpret the results. In addition, cognitive load measures or data about motivation or attitudes could complement our measurement of financial competence in the field of mortgage loans. Fourthly, data about personality traits could help to comprehend and explain our results.

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