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**Working Paper**

## Financial literacy among German students at secondary schools: Some empirical evidence from the state of Hesse

CFS Working Paper Series, No. 627

**Provided in Cooperation with:**

Center for Financial Studies (CFS), Goethe University Frankfurt

*Suggested Citation:* Brühl, Volker (2019) : Financial literacy among German students at secondary schools: Some empirical evidence from the state of Hesse, CFS Working Paper Series, No. 627, Goethe University Frankfurt, Center for Financial Studies (CFS), Frankfurt a. M., <https://nbn-resolving.de/urn:nbn:de:hebis:30:3-509980>

This Version is available at:

<https://hdl.handle.net/10419/203252>

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No. 627

Volker Brühl

FINANCIAL LITERACY AMONG GERMAN  
STUDENTS at SECONDARY SCHOOLS:  
SOME EMPIRICAL EVIDENCE FROM the  
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# **FINANCIAL LITERACY AMONG GERMAN STUDENTS at SECONDARY SCHOOLS: SOME EMPIRICAL EVIDENCE FROM the STATE of HESSE**

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## **Abstract:**

Since the financial crisis financial literacy has attracted growing interest among researchers and policy makers, as there is international empirical evidence that financial literacy is poor among both adults and students. In Germany we have almost no empirical evidence on financial literacy, especially in the case of students attending secondary schools, as financial education has not featured on German school curricula to date. Besides, Germany has not yet participated in the optional financial literacy module of PISA, which was offered for the first time in 2012. However, a lack of private pension provisioning, in spite of demographic change, and low stock ownership among German households indicate a deficit in financial knowledge and skills in this country as well.

In this paper we investigate financial literacy among students aged 14 to 16 attending a secondary school in the state of Hesse. The foundation is a test designed according to international standards. The statistical analysis of the test reveals substantial deficits in key areas of financial literacy. Particular deficits could be identified in the fields of basic knowledge of financial matters and, to an even greater degree, in more advanced concepts such as risk diversification. Applying interest calculations to financial matters turned out to be problematic for many students.

Furthermore, the paper analyses the impact of gender and type of school on the overall test score as well as test performance in specific tasks. The findings suggest that financial matters should be covered in some form at secondary schools. In light of the potentially far-reaching consequences of financial illiteracy for financial wellbeing, German participation in future PISA financial literacy tests seems highly advisable to gain a deeper understanding of the preliminary findings presented in this paper.

*Keywords: Financial Literacy, Household Finance*

*JEL Classification: D12, D14*

## **1. Introduction**

Financial literacy refers to people's ability to process economic information and make informed savings, investment and risk management decisions in order to ensure financial wellbeing throughout one's lifetime. This includes proper decisions on consumption and investments, debt levels, pension provisions and wealth accumulation, all of these being part of a financial planning process (e.g. Lusardi and Mitchell 2014). The level of financial literacy among the population has attracted a growing interest from scientists, policy makers and international organizations in recent years for various reasons.

The financial crisis has revealed that many even low-income consumers have invested in complex financial products such as investment certificates, derivative contracts or closed-end funds without having a basic understanding of their inherent risks. Legal requirements in regard to transparency and disclosure of risks were apparently not sufficient to protect retail investors from unintended consequences of investment decisions.

Financial knowledge has become even more important over recent years as complex financial products have become available to retail investors through smartphone apps. Even classic investment products targeting retail investors such as investment funds, ETFs (Exchange Traded Funds) or PRIPs (Packaged Retail Investment Products) often exhibit complex features. Financial planning tools – often made available by banks to their customers via online or mobile banking – are only useful to the extent that users are capable of both applying the technical features and grasping the financial content

and consequences of the decisions made. The same applies to credit, with products such as mortgages, consumer loans, credit cards, student loans and leasing contracts only a few clicks away on web platforms. Furthermore, demographic change in Western economies due to declining birth rates and growing life expectations leads to an increasing need for private retirement plans. The same demographic trends are putting pressure on public pension schemes, which are usually structured as pay-as-you-go-systems, especially in Western European countries. In some countries the state pillar is supported by either voluntary or mandatory elements of private pension schemes and/or pension schemes granted by companies to their employees. However, people's insight into the necessity of private pension provisions presupposes a certain level of financial literacy.

While the financial crisis revealed many deficits in financial markets and banking regulation, a reform of the respective regulatory frameworks in line with empowered financial supervisory authorities has been pursued since 2008 on a global as well as on a European and national level. In the European Union investor protection has been improved by various legal initiatives, especially by the Markets in Financial Instruments Directives (MIFID I, 2007 and MIFID II, 2018), the Alternative Investment Fund Managers Directive (AIFMD, 2011) – which provides the regulatory framework for hedge funds, private equity, real estate funds, and other “Alternative Investment Products” in the EU. In Germany corresponding legal milestones include the Investor Protection Improvement Act (Anlegerschutzverbesserungsgesetz (AnSVG), 2004), the German law to strengthen the protection of investors and improve the functionality of the capital market (Anlegerschutz- und Funktionsverbesserungsgesetz (AnsFuG), 2011) and eventually the German Capital Investment Code (KAGB, 2013) regulating open and closed-end investment funds including alternative investments. Although significant progress has been made in terms of investor protection, financial literacy has been

recognized as an important complementary factor in enabling people to make informed savings, investment and financing decisions. Empirical studies have investigated the level, structure and distribution of financial literacy in many countries, identifying determinants of differences in financial literacy as well as the potential consequences of insufficient financial education.

## **2. Empirical evidence on financial literacy**

There is broad empirical evidence that the level of financial literacy is low among adults. For instance, a global financial literacy survey applied a simple test with four questions addressing “Risk Diversification”, “Inflation”, “Numeracy” and “Compound Interest”, in which more than 150,000 people from more than 140 economies participated. A person is considered as financially literate if she or he answers at least 3 out of 4 questions correctly (Klapper, Lusardi and Outheusden 2015). Overall only one third of the entire test population passed the test.

The highest scores were achieved in Australia, Canada, Germany, the UK and Scandinavia, where at least 65% passed the test. Much lower rates have been noted in Southern Europe (e.g. Bulgaria 35%, Romania 22%). Besides, emerging economies like Brazil, Russia or India show financial literacy rates of around 28%. Large variations were found not only between countries but also within countries, as participants with lower education and lower income tend to perform worse. Gender seems to matter as well in less developed countries.

Moreover, many users of credit products have evidently not understood the compound interest rate effect. Many participants were not familiar with the concept of risk diversification, which may have a significant impact on individuals’ investment decisions. These results have been confirmed by a number of other empirical studies (see e.g. Lusardi and Mitchell 2014, Lusardi and Mitchell 2011a, Atkinson and Messy

2012, OECD 2005a, OECD 2005b). Other important determinants of financial literacy include a person's level of education (e.g. Lusardi and Mitchell 2007, Christelis, Jappelli and Padula 2010) as well as their income level and employment status (Lusardi and Tufano 2009).

### **3. The economic relevance of financial literacy**

There is a broad consensus in economic research that financial education affects economic behavior and therefore the financial wellbeing of individual households. Many decisions of individuals or households on matters such as consumption, savings and investments can have unintended long-term consequences on their financial situation. Extensive research both on the theoretical framework and empirical evidence has been undertaken in recent years (Lusardi and Mitchell 2014).

A sound understanding of financial matters has a positive impact on people's participation in financial markets in general and their investment in stocks or related products in particular (e.g. Christelis, Jappell and Padula 2010, van Rooij, Lusardi and Alessie 2012). It has also been shown that financially literate people are more likely to prepare for their retirement (Lusardi and Mitchell 2007, 2011a).

On the other hand, a lack of financial understanding can lead to over indebtedness or even private insolvency, an income gap in the retirement phase or at least opportunity costs due to inefficient saving behaviors. Consumers who have deficits in interest rate calculations (e.g. calculation of effective interest rates, consideration of fees, impact of interest compounding) often pay higher interest rates and higher fees and tend to have a higher level of debt (e.g. Lusardi and Tufano 2009, Disney and Gathergood 2012, Stango and Zinman 2009). Contrastingly, people with higher financial literacy benefit from diversified investment decisions (Abreu and Mendes 2010) and adequate retirement savings (e.g. Behrman et al. 2012).



A further finding is that, apart from a basic knowledge of financial matters, the ability to perform calculations and the understanding of risk diversification are most important in terms of improving savings and investment decisions (van Rooij, Lusardi and Alessie 2011, Klapper and Panos 2011).

A basic knowledge of financial matters is not only pivotal for informed financial decision-making; it may also have macroeconomic consequences. For instance, financial literacy can explain significant wealth distribution effects (e.g. Lusardi, Michaud and Mitchell 2013). The economic cost of under-diversification may also be substantial (Calvet, Campbell and Sodini 2007). Gerardi, Goette and Meier (2010) show that a lack of financial skills has impacted the high default rate on subprime mortgages in the recent financial crisis.

#### **4. Financial literacy and PISA**

Financial literacy among younger people has attracted interest from researchers, especially in the US (e.g. Japelli 2010, Mandell 2008).

A breakthrough in the field of empirical financial literacy research among young people has been the integration of a financial literacy test as an optional module into the Programme for International Student Assessment (PISA), which is a worldwide test organized by the OECD. PISA evaluates educational systems every three years by measuring 15-year-old school students' performance in mathematics, science and reading. The test results provide an international perspective on how students from different countries and educational systems perform in key subjects. Hence, PISA gives policy makers and educators insights into the absolute and relative performance of their students in an international context and thereby helps to identify strengths and weaknesses of the respective educational system. An important aspect is to learn from experiences in other countries and derive measures to improve the educational concepts

in terms of test performance and inclusiveness. Around 540,000 students from 72 countries participated in the 2015 PISA test (OECD 2016a).

The 2015 PISA assessment maintains the same definition of financial literacy and the structural test design by distinguishing “content” (knowledge of financial matters such as money and transactions), “processes” (understanding, analysis and evaluation of financial information) and “context” (situations in which financial knowledge, skills and understanding are applied) (OECD 2017, OECD 2016b).

The PISA financial literacy assessment was performed in 2015 for the second time. It tests the financial knowledge and skills of 15-year-old-students. In 2015 around 48,000 students from 15 participating countries and economies took a one-hour test of financial literacy comprising 43 items. The OECD defines financial literacy as “a combination of awareness, knowledge, skill, attitude and behavior necessary to make sound financial decisions and ultimately achieve individual financial well-being” (OECD 2017, OECD/INFE 2012). The points each student achieves in each category are aggregated to an overall score. Based on this score, students are allocated into five competence levels (1 to 5) with 5 the highest.

In 2015, on average across participating countries, 22% of students scored below the baseline level of proficiency in financial literacy (Level 2) (OECD 2017). Students performing at this level understand very basic financial issues, such as spending, and can recognize the purpose of simple financial documents, such as an invoice. Yet they lack essential skills, especially in terms of numeracy, to understand more complex financial issues. Some 12% of students achieved the highest proficiency, Level 5. These students are capable of understanding, calculating and evaluating more difficult financial decisions, such as debt financing, and their future relevance.

PISA results suggest that there is a positive correlation between the level of financial literacy and the performance in mathematics and reading. However, it is important to

note that around 38% of the financial literacy score reflects factors other than the PISA reading and mathematics assessments. Possible explaining factors that are specific to financial skills include the ownership of a bank account and the socio-economic status of a student. PISA results do not give a clear picture as to whether gender is a statistically significant factor for financial literacy as the results differ from country to country (OECD 2017).

## **5. Financial Literacy in Germany**

Financial education has not featured on German school curricula to date. In addition, we lack meaningful empirical evidence on the level of financial know-how and skills both of adults and of students. For students, data availability is rather limited as Germany has not participated in the financial literacy module of PISA to date. Furthermore, the heterogeneous German school landscape makes it difficult to organize and collect test data in different federal states.

Nevertheless, we observe a few developments that may implicitly point to deficits in financial literacy in Germany as well. Due to the ongoing demographic change, it is quite clear that the current German pension model is not sustainable without a substantial increase of social security payments, massive state subsidies or significant reductions of pension claims (Börsch-Supahn and Rausch 2018, Bundesministerium für Arbeit und Soziales 2018).

It is therefore apparent that many people can only keep their standard of living during the retirement phase if state pension entitlements are supplemented by some form of private pension provisions, including employer-funded pension programs. However, despite the increasing necessity for private retirement provisions, we do not see a significant change in saving behavior among German households, which may ultimately increase the risk of poverty in old age. A recent survey by the German

Savings and Loans Association revealed that 33% (female) or 34% (male) of the participants are not saving privately for their retirement (DSGV 2018) to prepare for a future income gap. These findings are confirmed by a longer-term research initiative SAVE (Sparen und Altersvorsorge in Deutschland), which has done extensive research on the savings behavior and old age provisioning over many years (Coppola and Lamla 2013).

In addition, even the prevailing low interest rate environment in the Eurozone has not triggered a structural change in saving portfolios in Germany. Although bank saving products or fixed income investments like government bonds carry low to negative (real) interest rates, only a slight increase of the portion of stock-related investments in private household portfolios has been recorded for the last four years. The current number of German households investing either directly in individual stocks or in stock funds represents only 12.2% of the German population. Looking at the relative importance of stock-related investments within overall monetary wealth, stock investments represent only 8.7% of the total wealth volume, compared to some 39.7% kept in bank deposits with zero or close to zero nominal interest rates (DAI 2018).

On the other hand, consumer and real estate financing have been boosted by low interest rates on mortgages or consumer loans, bringing the indebtedness of individuals and households more into focus. The share of over-indebted people in Germany is around 10.04% of the population aged 18 years or older (Statistisches Bundesamt 2019), while the share of over-indebted young adults (between 18 years and 29 years) is some 13.47%. Although there are different reasons for private insolvencies, including unemployment, illness, accidents, divorce etc., there is a clear trend that “uneconomic management of private household” as a trigger for private insolvencies has increased by some 32% over the last ten years (Statistisches Bundesamt 2019).

Therefore, a basic understanding of investment products, risk return relationships, risk diversification and the individual debt capacity of households, in conjunction with financial planning, becomes more and more important over the lifetime of individual households.

## **6. Financial education in German schools**

As Germany has so far not participated in the OECD financial literacy test, there is no nationwide evidence on the level of financial literacy for the PISA-relevant target group. Besides, it has to be taken into account that the 16 federal states in Germany have a strong influence on their respective education systems within the federal framework. Although some federal educational standards for specific subjects and examinations have been adopted, it must be kept in mind that they have no binding character, as the field of education is primarily in the responsibility of the individual states.

This applies especially to the school curricula to be covered according to the state school laws. Furthermore, the German school system differentiates four basic types of secondary schools with different levels of entry qualifications preparing students primarily for apprenticeships, academic studies or other professional qualifications. However, there are several opportunities to change the respective school track to more advanced levels both within the respective school period and after completion of the final exams. Table 1 gives an overview of the main school categories in Germany at the secondary I level as well as a translation into EQF categories and ISCED categories respectively.

*Table 1: Overview of the German secondary school system*

Type of school	Years to exam	EQF equivalent	ISCED equivalent
HS	9	Level 2	Level 2
RS	10	Level 2-3	Level 2
IGS	10-13	Level 3-4	Level 3
GYM	12-13	Level 4	Level 3

The International Standard Classification of Education (ISCED) is a conceptual framework facilitating the comparability of international education systems maintained by the United Nations Educational, Scientific and Cultural Organization (UNESCO). It distinguishes 8 qualification levels covering basic primary school up to PhD level qualifications. Similarly, the European Qualifications Framework (EQF) acts as a translation device to make national qualifications more comparable across Europe, promoting workers' and students' mobility between countries and facilitating their lifelong learning. The EQF aims to relate different countries' national qualifications systems to a common European reference framework. Qualification levels range from basic (Level 1, e.g. primary school education) to very advanced (Level 8, PhD-level qualification).

For 14- to 16-year-old students, the German school system basically offers four different types of secondary schools: The Hauptschule (HS), the Realschule (RS), the Gymnasium (GYM) and the Integrierte Gesamtschule (IGS). Hauptschulen (HS) offer students with (below) average grades in primary schools a general education (with a regular number of 9 school years) with the main objective of preparing the graduates for an apprenticeship. Realschulen (RS), with a total regular number of 10 school years, target students with medium primary school grades or slightly higher. They provide a perspective to prepare for an apprenticeship or the option to switch to a Gymnasium (GYM), which usually aim to prepare students for university studies after 12/13 school years, depending on the individual school concept. Gymnasiums (GYM) are comparable to British grammar schools or US preparatory high schools. Integrierte Gesamtschulen (IGS) are a specific type of school offering a joint education for the first

9 school years before students either leave school or decide to continue education at either RS level or GYM level.<sup>1</sup>

Independently from the type of secondary school, financial education has not been part of the German education system to date. There are certain aspects such as interest rate calculations being taught in mathematics or some general economic aspects like the definition of markets, inflation, GDP or the economic cycle covered in the subject “Politik and Wirtschaft” (“politics and economics”). But key elements of financial education, such as bank accounts, financial products, private pension schemes, insurance and risk diversification, are not part of the regular curriculum in either subject.

In light of this background, we initiated a research project that basically aims to give an overview of the general knowledge, understanding and skills in the field of financial literacy of 14- to 16-year-old students in the state of Hesse.

Furthermore, the results should shed some light on whether or not the gender of the participants and/or the type of school they attend have an impact on the overall test performance, and whether patterns could be identified suggesting that gender or type of school affect the performance on a disaggregated level, i.e. on the level of individual questions. Participation of schools was voluntary. Preliminary discussions with schools and teachers as well as strict data protection requirements led to the conclusion that barriers to participation for schools should be as low as possible. Hence, the test was designed as a multiple choice test with 15 questions to be answered in the test period of 45 minutes. It was not possible to incorporate any socio-economic factors into the test design for privacy reasons.

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<sup>1</sup> Depending on the federal state there are other more specific types of school, e.g. GYM with a technical or economic focus.

## 7. Empirical analysis

Overall, 886 students from 14 to 16 years of age participated in the test, of which 470 were male, 416 female. The distribution between types of school (HS, RS, IGS, GYM) is summarized in table 2. About 6% attend a Hauptschule, which is in line with the official school statistic in the state of Hesse. The proportion of students attending a Gymnasium in the panel is lower than in the overall student population in Hesse (above 40%) as the willingness of Gymnasiums was below that of other types of school. Tight school curricula were mentioned as the main reason for Gymnasiums not participating in this voluntary test.

*Table 2: Database*

Number	HS		RS		IGS		GYM		$\Sigma$	
Male	30	3%	238	27%	90	10.2%	112	13%	470	53%
Female	24	3%	199	22%	75	8.5%	118	13%	416	47%
$\Sigma$	54	6%	437	49%	165	19%	230	26%	886	100%

The size of 886 participants in the test is somewhat below the average number of participants per country (1,071) in the largest global financial literacy test initiative for adults to date (Klapper, Lusardi and Outheusden 2015). Nevertheless, we think that the generated test data provide an interesting starting point for more extensive research activities on financial literacy in Germany and political discussions about the integration of financial education into the curricula of German schools.

### Test design

Several fundamental concepts of measuring financial literacy are related to saving and investment decisions (Lusardi and Mitchell 2014) such as:

- Numeracy and capacity to do calculations related to interest rates
- Understanding of inflation
- Understanding of risk diversification.



A standard set of questions covering these topics has been developed by Lusardi and Mitchell (2008, 2011b), who applied them in different surveys (Lusardi and Mitchell 2011a). Based on these insights, we designed a multiple choice test comprising 15 questions that have to be answered within 45 minutes. Each of the key topics, such as inflation, interest rate calculations or risk diversification, was addressed by more than one question to allow for double checks, cross checks and identification of inconsistencies when evaluating the individual test results. Furthermore, a few questions referred to the knowledge of basic financial products like stocks, bonds or investment funds. Use of a non-programmable pocket calculator was permitted. Table 3 gives an overview of the different tasks comprising the financial literacy test.<sup>2</sup>

*Table 3: Overview of Financial Literacy test*

Tasks	
Task 1	defining inflation rate
Task 2	understanding purchasing power
Task 3	need for private pension provisions
Task 4	compound interest calculation
Task 5	interest rate calculation
Task 6	discounting
Task 7	defining "return"
Task 8	understanding risk/return
Task 9	defining stocks
Task 10	understanding risk/return of stocks
Task 11	understanding risk diversification (1)
Task 12	understanding risk diversification (2)
Task 13	funds as long-term investment
Task 14	defining bonds
Task 15	understanding risk of bonds

### **Test score and translation into grading**

For each correct answer students received one point, so that the maximum score for 100% correct answers was 15 points. The grading of the test was done in accordance

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<sup>2</sup> See Appendix 1 for the complete test form.

with the German grading system for secondary schools, which stipulates a 15-point-system. Each grade point corresponds to a certain interval of percentage points of the maximum possible score (table 4). For instance, a student scoring between 96% and 100% of the maximum points (arithmetically translating into 14.4 and 15.0 points in our test) would get the highest grade 1+ (very good). However, as no fractional points are awarded in our test, table 4 shows how individual test results translate into grades according to the German school system:

*Table 4: Translation of test scores into grades*

<b>Max.</b>	<b>-</b>	<b>Min.</b>	<b>Max. points</b>	<b>-</b>	<b>Min. points</b>	<b>Test score</b>	<b>German grade</b>	
100.00%	-	96%	15.00	-	14.40	15.00	1+	very good
95.99%	-	91%	14.40	-	13.65	14.00	1	very good
90.99%	-	86%	13.65	-	12.90	13.00	1-	very good
85.99%	-	81%	12.90	-	12.15		2+	
80.99%	-	76%	12.15	-	11.40	12.00	2	good
75.99%	-	71%	11.40	-	10.65	11.00	2-	good
70.99%	-	66%	10.65	-	9.90	10.00	3+	satisfactory
65.99%	-	61%	9.90	-	9.15		3	
60.99%	-	56%	9.15	-	8.40	9.00	3-	satisfactory
55.99%	-	51%	8.40	-	7.65	8.00	4+	sufficient
50.99%	-	46%	7.65	-	6.90	7.00	4	sufficient
45.99%	-	41%	6.90	-	6.15		4-	fail
40.99%	-	34%	6.15	-	5.10	6.00	5+	fail
33.99%	-	27%	5.10	-	4.05	5.00	5	fail
26.99%	-	20%	4.05	-	3.00	4.00	5-	fail
19.99%	-	0%	3.00	-	0.00	0-3	6	fail

Any student with a score of 6 points or below fails the financial literacy test. Students with a score between 7 and 10 points achieve an average result (equivalent to the German school grade “satisfactory” or “sufficient”), while all students who score 11 points or higher are considered good/very good performers.

As Germany has not participated in the financial literacy module of the PISA test to date, it is of interest to find out whether or not the level and distribution of our simplified financial literacy test shows similar patterns to the international empirical findings.

## **Data analysis**

The data analysis is performed in two steps. In the first instance the test results should provide a statistical overview of the average level, variability and distribution of financial literacy skills in the respective target group. Furthermore, it is of interest whether or not the overall test scores differ according to gender or type of school the students attend. Other potential factors, such as socio-economic factors or prior experience with financial matters, e.g. having one's own bank account, were not covered due to the privacy reasons mentioned above.

In a next step the data set is disaggregated in order to conduct a task-by-task analysis. For each question it is investigated whether or not statistically significant differences in performance levels can be observed by gender or type of school the students attend. Irrespective of the relevance of these factors for the overall test score, findings might be different on the individual task level. Hence the data analysis could reveal statistically significant differences in specific areas of financial knowledge or skills between genders and/or school type. Such findings could provide valuable hints for political decision makers in terms of adapting educational programs as well as teachers looking to improve educational practice.

## **Statistical analysis of the overall test results**

The test results in table 5 show that 19.4% of all students failed the test, i.e. their total score was between 0 and 6 points. 64.9% had a sufficient or satisfactory score (7-10 pts) and 15.7% showed a good or very good performance (> 11 pts). The performance of female students was a little lower than their male counterparts, with a slightly higher failure rate (20.9% versus 18.1%) and a slightly lower rate of good/very good scores (13.9% versus 17.2%). Students attending a HS showed a much higher failure rate (27.8%) than students from a GYM (10.9%). Overall performance, with an

average score of 55.2% of achievable points, i.e. correct answers, underpins that there are substantial deficits in financial literacy. Even students attending a GYM scored on average only some 61.5% of the maximum score.

*Table 5: Distribution of test scores (overall, per gender, per type of school)*

total score (pts)	all students (%)	male (%)	female ( %)	HS (%)	RS (%)	IGS (%)	GYM (%)
0	0	0	0	0.0%	0.0%	0.0%	0.0%
1	0	0	0	0.0%	0.0%	0.0%	0.0%
2	0.3%	0.4%	0.2%	0.0%	0.2%	1.2%	0.0%
3	1.0%	0.6%	1.4%	1.9%	1.6%	0.0%	0.4%
4	3.5%	3.0%	4.1%	5.6%	4.8%	2.4%	1.3%
5	5.2%	5.3%	5.0%	3.7%	6.9%	4.8%	2.6%
6	9.4%	8.7%	10.1%	16.7%	10.5%	7.9%	6.5%
7	15.6%	13.6%	17.8%	22.2%	18.1%	17.0%	8.3%
8	19.4%	20.6%	18.0%	22.2%	18.3%	25.5%	16.5%
9	18.1%	18.5%	17.5%	14.8%	17.6%	18.8%	19.1%
10	11.9%	11.9%	11.8%	7.4%	10.5%	12.1%	15.2%
11	8.5%	8.5%	8.4%	3.7%	6.4%	5.5%	15.7%
12	5.0%	6.2%	3.6%	1.9%	3.9%	3.0%	9.1%
13	1.8%	2.3%	1.2%	0.0%	0.9%	1.8%	3.9%
14	0.5%	0.2%	0.7%	0.0%	0.2%	0.0%	1.3%
15	0	0	0	0.0%	0.0%	0.0%	0.0%
total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
average score (% of max. pts)	55.2%	56.1%	54.2%	50.0%	52.7%	54.4%	61.5%
0-6 pts*	19.4%	18.1%	20.9%	27.8%	24.0%	16.4%	10.9%
7-10 pts**	64.9%	64.7%	65.1%	66.7%	64.5%	73.3%	59.1%
>11 pts***	15.7%	17.2%	13.9%	5.6%	11.4%	10.3%	30.0%

Number of students: 886

\* failed

\*\* satisfactory/sufficient

\*\*\* very good/good

In the following, the Mann-Whitney U test is applied as a non-parametric test method for ordinary scaled variables to check whether or not these gender-specific differences in the overall test scores are statistically significant. The summary of the test statistic (figure 1) shows that the difference in overall test performance between male and female students is statistically not significant at a significance level ( $\alpha$ ) of 5%. This is consistent with empirical findings in the PISA financial literacy test 2015, where in 9 out of 15 participating countries (e.g. USA, Russia, Netherlands) no statistically

significant differences between genders were identified. In one country (Italy) boys performed better than girls, while in the remaining 4 countries (e.g. Australia, Spain) girls scored better than boys. Hence the impact of gender on financial literacy among students depends very much on the country. This contrasts with the empirical findings for adults, where women usually perform worse than men, even when education and income are on a comparable level (Klapper, Lusardi and Oudheusden 2015, Lusardi and Mitchell 2014).

*Figure 1: Results of Mann-Whitney U test*

gender	n	average rank	rank sum
female	416	426.25	177319.0
male	470	458.77	215622.0
total	886		
Mann-Whitney U	90583,0		
Z score	-1.907		
asymptotic significance (2- sided)	0.056		
$\alpha$	0.050		

Table 5 displays different performance levels per type of school applicable to the average score as well as failure rates. In order to find out whether these differences are statistically significant, we perform a Kruskal-Wallis test, the results of which are summarized in figure 2.

It appears that the type of school has a statistically significant impact on the test scores of the students. A post hoc analysis performing pairwise comparisons between the students of different school types allows for additional insights. Adjusted significance levels (i.e. p-values) in figure 2 indicate that only the differences between the scores of students attending a GYM and any other type of school are statistically significant, whereas the different scores between the HS, RS and IGS among each other are not significantly different. Hence, it can be concluded that students attending a GYM perform significantly better than those at all other types of schools. We need to

take into account that either all types of school cover the respective topic (e.g. interest calculations) in their curriculum or none of the school types do (e.g. risk diversification).

*Figure 2: Kruskal-Wallis test “type of school”*

total	886				
test statistic	64.993				
df	3				
asymptotic significance (two sided)	0.000				
$\alpha$	0.050				
pairwise comparison "type of school"					
pairs	test statistics	std error	standard test statistics	significance	adjusted significance Sig.*
1-2	-54.221	36.536	-1.484	0.138	0.827
1-3	-83.085	39.710	-2.092	0.036	0.218
1-4	-207.934	38.301	-5.429	0.000	0.000
2-3	-28.865	23.144	-1.247	0.212	1.000
2-4	-153.713	20.634	-7.450	0.000	0.000
3-4	-124.848	25.841	-4.831	0.000	0.000
*Bonferroni correction applied					

1 = Hauptschule (HS)

2 = Realschule (RS)

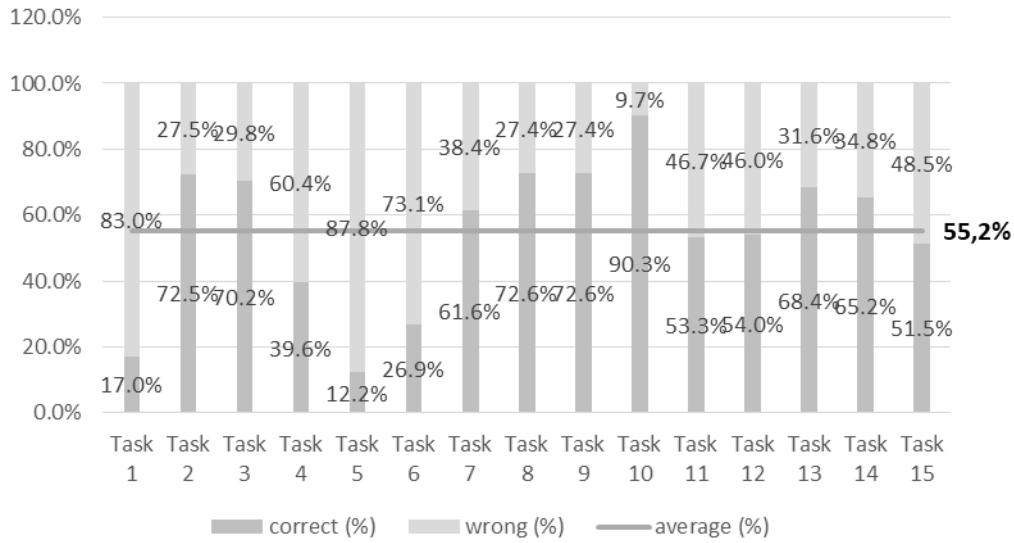
3 = Integrierte Gesamtschule (IGS)

4 = Gymnasium (GYM)

### *Statistical analysis of the individual test questions*

In a next step the test results are disaggregated to find out whether or not there are statistically significant differences on a task-by-task level. Figure 3 gives an overview of the distribution of correct/incorrect answers per task for all students. On average, the ratio of correct answers is around 55.2% showing large differences per task. The below average rates of correct answers refer to “defining inflation” (task 1), “interest calculation, compound interest and discounting” (tasks 4, 5, 6), “the understanding of risk diversification” (tasks 11, 12) and finally “understanding the risks of bonds” (task 15). Particularly low rates of correct answers can be observed for tasks 1 (17%), 5 (12.2%) and 6 (26.9%).

Figure 3: Distribution of correct/incorrect answers per task (all students in %)



High score rates were achieved for “understanding purchasing power” (task 2, 72.5%), “need for private pension provision” (task 3, 70.2%), “defining and understanding risk/return of stocks” (tasks 8 and 9, 72.6%, task 10, 90.3%).

Table 6: Chi-Square tests per task and gender

Tasks		right (total, %)		wrong (total)	right (male, %)		wrong (male)	right (female, %)		wrong (female)	$\chi^2$	$\chi^2_{(0.95;1)}$	p-value	$\alpha$	H <sub>0</sub>
Task 1	defining inflation rate	151	17%	735	98	21%	372	53	13%	363	10.27	3.84	0.001	0.05	-
Task 2	understanding purchasing power	642	72%	244	308	66%	162	334	80%	82	24.08	3.84	0.000	0.05	-
Task 3	need for private pension provisions	622	70%	264	335	71%	135	287	69%	129	0.55	3.84	0.458	0.05	✓
Task 4	compound interest calculation	351	40%	535	196	42%	274	155	37%	261	1.82	3.84	0.177	0.05	✓
Task 5	interest calculation	108	12%	778	51	11%	419	57	14%	359	1.68	3.84	0.196	0.05	✓
Task 6	discounting	238	27%	648	145	31%	325	93	22%	323	8.11	3.84	0.004	0.05	-
Task 7	defining "return"	546	62%	340	291	62%	179	255	61%	161	0.04	3.84	0.851	0.05	✓
Task 8	understanding risk/return	643	73%	243	348	74%	122	295	71%	121	1.09	3.84	0.297	0.05	✓
Task 9	defining stocks	643	73%	243	366	78%	104	277	67%	139	14.12	3.84	0.000	0.05	-
Task 10	understanding risk/return of stocks	800	90%	86	425	90%	45	375	90%	41	0.02	3.84	0.888	0.05	✓
Task 11	understanding risk diversification (1)	472	53%	414	268	57%	202	204	49%	212	5.65	3.84	0.017	0.05	-
Task 12	understanding risk diversification (2)	478	54%	408	256	54%	214	222	53%	194	0.11	3.84	0.742	0.05	✓
Task 13	funds as long term investment	606	68%	280	317	67%	153	289	69%	127	0.42	3.84	0.518	0.05	✓
Task 14	defining bonds	578	65%	308	315	67%	155	263	63%	153	1.41	3.84	0.236	0.05	✓
Task 15	understanding risk of bonds	456	51%	430	233	50%	237	223	54%	193	1.44	3.84	0.231	0.05	✓

“✓” = H<sub>0</sub> accepted; “-” = H<sub>0</sub> rejected

It is worth mentioning that the scores of “defining inflation” (task 1, 17% correct answers) and understanding the impact of increasing price levels on purchasing power (task 2, 72.5% correct answers) differ widely although they refer to the same area of financial knowledge.

Although we ascertained that the overall test performance does not suggest a gender-specific difference, this might be different on a task level. In order to review this, Chi-Square independence tests are performed for each individual task on a significance level of 5%. The results are summarized in table 6.

It is interesting to note that a statistically significant difference between male and female students can only be observed for tasks 1, 2, 6, 9 and 11. Except for in task 2, the male test students score higher than the female participants. Looking into the content of the respective questions, it can be noted that in the topics “defining inflation” (task 1), “discounting” (task 6), “defining stocks” (task 9) and “understanding risk diversification” (task 11) male students scored higher, whereas regarding the impact of “purchasing power” (task 2) the female students scored higher.

Performing a comparable analysis for the impact of “type of school” on the task-specific test performance, a two-step approach was pursued: Firstly, Chi-Square tests were performed for each task to identify those tasks where statistically significant deviations of performance among the students attending different types of schools could be observed. For those tasks indicating such differences, a post hoc analysis was carried out to find out more about those types of school that exceed or fall below their expected score.

The task-specific Chi-Square tests (table 7) show that only the tasks 3 (“need for private pension provision”), 5 (“compound interest calculations”), 6 (“discounting”) and 15 (“understanding risks of bonds”) show no statistically significant difference in performance per type of school. For all other tasks a post hoc analysis was conducted (figure 4) to find out more about the reasons for rejecting the hypothesis that the type of school is irrelevant for the task-specific test performance.



Table 7: Chi-Square tests per task and type of school

Tasks		right (HS, %)	wrong (HS)	right (RS, %)	wrong (RS)	right (IGS, %)	wrong (IGS)	right (GYM, %)	wrong (GYM)	$\chi^2$	$\chi^2_{(0.95;3)}$	p-value	$\alpha$	H <sub>0</sub>				
Task 1	defining inflation rate	13	24%	41	57	13%	380	30	18%	135	51	22%	179	11.27	7.81	0.010	0.05	-
Task 2	understanding purchasing power	30	56%	24	301	69%	136	124	75%	41	187	81%	43	17.51	7.81	0.001	0.05	-
Task 3	need for private pension provisions	38	70%	16	297	68%	140	124	75%	41	163	71%	67	3.03	7.81	0.387	0.05	✓
Task 4	compound interest calculation	14	26%	40	166	38%	271	51	31%	114	120	52%	110	25.11	7.81	0.000	0.05	-
Task 5	interest calculation	9	17%	45	50	11%	387	18	11%	147	31	13%	199	1.85	7.81	0.604	0.05	✓
Task 6	discounting	15	28%	39	111	25%	326	45	27%	120	67	29%	163	1.11	7.81	0.774	0.05	✓
Task 7	defining "return"	28	52%	26	256	59%	181	103	62%	62	159	69%	71	9.42	7.81	0.024	0.05	-
Task 8	understanding risk/return	34	63%	20	317	73%	120	110	67%	55	182	79%	48	10.37	7.81	0.016	0.05	-
Task 9	defining stocks	28	52%	26	311	71%	126	119	72%	46	185	80%	45	19.24	7.81	0.000	0.05	-
Task 10	understanding risk/return of stocks	49	91%	5	378	86%	59	154	93%	11	219	95%	11	15.29	7.81	0.002	0.05	-
Task 11	understanding risk diversification (1)	28	52%	26	204	47%	233	92	56%	73	148	64%	82	19.41	7.81	0.000	0.05	-
Task 12	understanding risk diversification (2)	25	46%	29	205	47%	232	91	55%	74	157	68%	73	29.05	7.81	0.000	0.05	-
Task 13	funds as long term investment	39	72%	15	281	64%	156	112	68%	53	174	76%	56	9.38	7.81	0.025	0.05	-
Task 14	defining bonds	31	57%	23	283	65%	154	98	59%	67	166	72%	64	8.87	7.81	0.031	0.05	-
Task 15	understanding risk of bonds	24	44%	30	240	55%	197	76	46%	89	116	50%	114	5.18	7.81	0.159	0.05	✓

“✓” =  $H_0$  accepted; “-” =  $H_0$  rejected

HS = Hauptschule

RS = Realschule

IGS = Integrierte Gesamtschule

GYM = Gymnasium

With respect to the ability to define “inflation” (task 1, 17% correct answers) and to understand the impact of increasing price levels on purchasing power (task 2, 72.5% correct answers), an interesting discrepancy can be noted. Students from a GYM perform better than expected, whereas students from a RS (task 1) or HS (task 2) perform worse than expected. The ability to apply interest rate calculations is tested by tasks 4, 5 and 6. With a rate of correct answers of 39.6% (task 4), 12.2 % (task 2) and 26.9% (task 6), the overall performance is surprisingly low, given that these topics are covered in the subject mathematics.

The post hoc analysis illustrates that the wide range of correct answers to task 4, ranging from 26% (HS) to 52% (GYM), is statistically significant. The worst test results were recorded for task 5, suggesting that the concepts of loans might be particularly problematic, as financial planning and hence the use of credit is not part of German school education at all. It is striking that tasks 5 (“interest calculations”) and 6 (“discounting”) show no statistically significant difference in performance across types of school.

Figure 4: Post hoc analysis for impact of type of school on task-specific test score

Task	Score		Type of school			
			HS	RS	IGS	GYM
Task 1	wrong	number	41	380	135	179
		expected number	44.8	362.5	136.9	190.8
		adjusted residuals	-1.4	3.1	-0.4	-2.4
		number	13	57	30	51
	right	expected number	9.2	74.5	28.1	39.2
		adjusted residuals	1.4	-3.1	0.4	2.4
		$\chi^2$	2.0	9.8	0.2	5.8
	test statistic	p-value	0.1562	0.0018	0.6662	0.0162
Task 2	wrong	number	24	136	41	43
		expected number	14.9	120.3	45.4	63.3
		adjusted residuals	2.9	2.4	-0.9	-3.5
		number	30	301	124	187
	right	expected number	39.1	316.7	119.6	166.7
		adjusted residuals	-2.9	-2.4	0.9	3.5
		$\chi^2$	8.2	5.5	0.7	12.2
	test statistic	p-value	0.0041	0.0185	0.3910	0.0005
Task 4	wrong	number	40	271	114	110
		expected number	32.6	263.9	99.6	138.9
		adjusted residuals	2.1	1.0	2.5	-4.5
		number	14	166	51	120
	right	expected number	21.4	173.1	65.4	91.1
		adjusted residuals	-2.1	-1.0	-2.5	4.5
		$\chi^2$	4.5	1.0	6.4	20.5
	test statistic	p-value	0.0338	0.3278	0.0112	0.0000
Task 7	wrong	number	26	181	62	71
		expected number	20.7	167.7	63.3	88.3
		adjusted residuals	1.5	1.8	-0.2	-2.7
		number	28	256	103	159
	right	expected number	33.3	269.3	101.7	141.7
		adjusted residuals	-1.5	-1.8	0.2	2.7
		$\chi^2$	2.3	3.4	0.1	7.4
	test statistic	p-value	0.1275	0.0660	0.8150	0.0065
Task 8	wrong	number	20	120	55	48
		expected number	14.8	119.9	45.3	63.1
		adjusted residuals	1.6	0.0	1.9	-2.6
		number	34	317	110	182
	right	expected number	39.2	317.1	119.7	166.9
		adjusted residuals	-1.6	0.0	-1.9	2.6
		$\chi^2$	2.7	0.0	3.6	6.7
	test statistic	p-value	0.1024	0.9825	0.0594	0.0096
Task 9	wrong	number	26	126	46	45
		expected number	14.8	119.9	45.3	63.1
		adjusted residuals	3.5	0.9	0.1	-3.1
		number	28	311	119	185
	right	expected number	39.2	317.1	119.7	166.9
		adjusted residuals	-3.5	-0.9	-0.1	3.1
		$\chi^2$	12.4	0.9	0.0	9.6
	test statistic	p-value	0.0004	0.3546	0.8853	0.0019
Task 10	wrong	number	5	59	11	11
		expected number	5.2	42.4	16.0	22.3
		adjusted residuals	-0.1	3.8	-1.5	-2.9
		number	49	378	154	219
	right	expected number	48.8	394.6	149.0	207.7
		adjusted residuals	0.1	-3.8	1.5	2.9
		$\chi^2$	0.0	14.2	2.1	8.6
	test statistic	p-value	0.9088	0.0002	0.1437	0.0034
Task 11	wrong	number	26	233	73	82
		expected number	25.2	204.2	77.1	107.5
		adjusted residuals	0.2	3.9	-0.7	-3.9
		number	28	204	92	148
	right	expected number	28.8	232.8	87.9	122.5
		adjusted residuals	-0.2	-3.9	0.7	3.9
		$\chi^2$	0.0	15.0	0.5	15.3
	test statistic	p-value	0.8290	0.0001	0.4783	0.0001
Task 12	wrong	number	29	232	74	73
		expected number	24.9	201.2	76.0	105.9
		adjusted residuals	1.2	4.1	-0.3	-5.1
		number	25	205	91	157
	right	expected number	29.1	235.8	89.0	124.1
		adjusted residuals	-1.2	-4.1	0.3	5.1
		$\chi^2$	1.4	17.2	0.1	25.6
	test statistic	p-value	0.2442	0.0000	0.7315	0.0000
Task 13	wrong	number	15	156	53	56
		expected number	17.1	138.1	52.1	72.7
		adjusted residuals	-0.6	2.6	0.2	-2.8
		number	39	281	112	174
	right	expected number	36.9	298.9	112.9	157.3
		adjusted residuals	0.6	-2.6	-0.2	2.8
		$\chi^2$	0.4	6.7	0.0	7.6
	test statistic	p-value	0.5327	0.0097	0.8738	0.0060
Task 14	wrong	number	23	154	67	64
		expected number	18.8	151.9	57.4	80.0
		adjusted residuals	1.2	0.3	1.7	-2.6
		number	31	283	98	166
	right	expected number	35.2	285.1	107.6	150.0
		adjusted residuals	-1.2	-0.3	-1.7	2.6
		$\chi^2$	1.6	0.1	3.1	6.6
	test statistic	p-value	0.2125	0.7685	0.0806	0.0102

$\alpha = 0.05$

HS = Hauptschule

IGS = Integrierte Gesamtschule

RS = Realschule

GYM = Gymnasium

Task 4, testing the ability to apply compound interest calculations to savings, reveals again that students from a GYM deliver the best results, with students from HS again performing below expectations.

The tasks 7 (“return”), 8 (“understanding risk/return”), 9 (“defining stock”) and 10 (“understanding risk/return of stocks”) form a block of tasks aiming to find out, from slightly different perspectives, whether and to what extent students know about the basic characteristics of stocks as participation rights in corporates, the concept of a return on an investment and the relationship between risk and return. Overall the average scores achieved by the whole panel were above average at 61.6% (task 7), 72.6% (tasks 8 and 9) and 90.3% (task 10) correct answers.

With regard to questions 7 (“return”) and 8 (“risk/return”) – two concepts closely interrelated and important to understand portfolio diversification effects – students attending a GYM show clearly the best performance (69% and 79% correct answers) compared to students from HS (52% correct answers) and RS (59% correct answers).

Tasks 9 (“stocks”) and 10 (“risk/return of stocks”) cover a related area of financial knowledge focusing specifically on stocks. Both tasks are solved especially well by students from a GYM, while students from HS show a below average level of knowledge about stocks in general (52% correct answers) and students from a RS underperform when it comes to the risk/return concept of stocks.

Tasks 11 and 12 test the students’ knowledge of diversification effects. The overall ratios of correct answers are 53.3% (task 11) and 54.0% (task 12). This means that more than 46% of the panel do not understand the concept of risk diversification properly. Again students from a GYM perform above expectations, while in this case RS students show a particular deficit in this field. Task 13 is related to tasks 11 and 12 as it refers to the suitability of investment funds as financial instruments for retirement. The findings are similar to those of tasks 11 and 12.

Finally, the understanding of bonds (task 14) shows quite a reasonable performance, with 65.2% correct answers, but again students from a GYM perform above expectations.

## **7. Conclusions**

The Financial Literacy test for students at the age of 14 to 16 years attending different types of school in the state of Hesse shows that around 19.4% of all students failed the test and that only 15.7% achieved a good/very good performance. The average score of about 55.2% of achievable points indicates that the level of financial literacy is somewhat low. Particular deficits were detected in the areas of financial calculations and the understanding of risk diversification effects. Regarding the overall test result, no statistically significant gender-specific differences can be observed. These findings are consistent with international empirical studies, e.g. those performed within the optional financial literacy module of PISA.

However, a task-specific analysis allows for a more differentiated view. It turns out that in the topics “defining inflation” (task 1), “discounting” (task 6), “defining stocks” (task 9) and “understanding risk diversification” (task 11) male students scored higher, whereas female students scored higher when it came to the impact of “purchasing power” (task 2). The understanding of possible drivers behind these findings may also be an interesting field of future research.

Looking at the second dimension of the test – the type of school the students attend – there is a clear indication that the type of school matters for the financial literacy test score. Students attending a GYM perform better than students attending other types of schools in almost all tested fields. Students attending a HS perform below all other school types in many tasks. These findings are consistent with findings in the US, where researchers have also found substantial differences in financial knowledge by education:

specifically, those without a college education are much less likely to understand advanced financial concepts such as risk diversification (Lusardi and Mitchell 2011b). Moreover, numeracy is especially lacking among those with low educational attainment (Christelis, Jappelli and Padula 2010).

In light of the potential impact of insufficient financial literacy on the future financial well-being of individuals, e.g. through inefficient portfolio choices, high indebtedness or insufficient private pension provisioning, it is worth considering the inclusion of some basic financial concepts in the school curricula, for instance within the subjects “Politik und Wirtschaft” and/or mathematics.

As Germany has so far not participated in the financial literacy module of PISA, it seems reasonable to change this in the next PISA rounds. Furthermore, a broadening of the test results presented in this paper by conducting similar test surveys in other states, or even on a federal level, would allow for more robust test results. This would also make it possible to analyze the impact of state-specific educational particularities on the test performance.

As none of these topics are covered under the school curricula, a possible reason might be that students attending advanced secondary schools might benefit from a knowledge transfer from their parents or more broadly speaking from their socio-economic environment. Corresponding empirical results have been found in the PISA financial literacy tests. On the other hand, topics requiring numeracy revealed surprisingly poor test results across all types of school.

Such deficits may also be discussed in a broader context when looking at the PISA results for Germany. This could be tight to the reason that many students are lacking the ability to apply certain numeracy skills in financial decision-making. A final point is worth mentioning: In PISA 2015 around 10 out of 15 participating countries/economies developed a national strategy to improve financial education for younger people, which

in most cases led to better results compared to PISA 2012 (OECD/INFE 2015). Therefore, it is worth discussing whether a similar undertaking could make sense for the German educational system.

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