



TIMSS 2019 results: The national report for Lebanon

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Executive Summary

Students' educational success depends on a spectrum of factors, including that individual at the student level and those concerning the school environment, family, etc. As these factors are unevenly distributed, differences in educational outcomes within and between countries arise.

This report aims to explore issues of enduring interest: what factors differentiate the situation of students in Lebanon in relation to students from other MENA countries and other countries, and which of them could be a potential cause of low results of Lebanese students. In addition, attention is paid to the preparation of Lebanese schools, teachers, and students to use digital devices that play a key role in education during the pandemic.

This report provides an analysis of the available evidence to inform decision-makers. The data sources used in the report are:

- the international TIMSS survey, last conducted in 2019, in which Lebanese eighth-graders participated.
- Micro-data CERD resources.

The main conclusions and recommendations are presented below.

Lebanon faces a decrease in academic results; a significant proportion of students do not attain the basic math and science knowledge

Since 2011 a significant decrease in math results has been observed among Lebanese eighth-grade students. The average math score in 2019 equal to 429, placed Lebanon in 32nd position out of 39 participating countries and 5th out of 11 considered MENA countries. In mathematics, only 64% of students reached the lowest benchmark in Lebanon, compared to 87% internationally on average. It means that more than $\frac{1}{3}$ of Lebanese eighth graders do not even have basic math knowledge. While the situation of Lebanon in comparison to other MENA countries is not the worst in the case of mathematics, compared to other countries participating in TIMSS, the significant Lebanese problem with mathematics becomes apparent. However, the variation in the results is lower compared to the international average result

For science, a dramatic drop in results has been observed since 2007. In 2019 the average result equal to 377 (lower by over 100 points than the international average) put Lebanon at 38th position and ranked it lowest among the MENA countries. Only 41% of students reached the lowest benchmark; in this case, contrary to mathematics, Lebanon fares poorly not only against the international average but also against other MENA countries.

The Lebanese education system does not struggle with gender inequalities in academic results

Although Lebanon belongs to countries where boys over-perform girls in mathematics, since 2007, this advantage has narrowed, and in 2019, boys outperformed girls by only 5.2 points, which is not a significant difference. For science, similarly, no vast discrepancies in achievement between genders were reported in Lebanon; however, since 2015, the boys' advantage was inverted, and girls outperformed boys in the last two rounds of TIMSS.

Performance gaps can be related to differences in the content covered by the Lebanese curriculum and the TIMSS assessment. School capacity needs strengthening in applying and reasoning teaching.

The differences in students' results are visible in specific content and cognitive domains. Lebanese students do worse than their colleagues from other countries, especially in data and probability and Algebra math content subdomains; their results are lower by 106 and 46 points, respectively, compared to international results. On the other hand, compared to the average of MENA countries, Lebanon achieved relatively higher results in Algebra and Number. Regarding math cognitive domains, except for *knowing*, Lebanese students achieved lower results in each category compared to international average and MENA countries. The most remarkable differences concern reasoning and applying (-28- and -16-point difference compared to MENA countries and -92 and -84 compared to international average).

In the case of science content, Lebanese students received the lowest results in Earth Science and Biology compared to the international average (difference equal to -151 points and -138 points, respectively) and the other MENA countries (-83 points and -82 points, respectively). The lowest differences concern Chemistry and Physics. As in the case of mathematics, in science, students have difficulties in *Applying* and *Reasoning*; in addition, they struggle with the *Knowing* subdomain.

Recommendations:

- Improve the education quality in Lebanon, and provide a curriculum that can strengthen the applying and reasoning skills.
- Analyze the curriculum in terms of coverage of relevant topics, whether they are expected to provide benefits in the future and whether they should be excluded from earlier stages of education.
- Weight of mathematical and science topics should be reconsidered to reflect TIMSS requirements. More emphasis should be given to „ratio, proportion, and percent” in math, and to Biology in science.
- Consider infusing high-quality additional classes within and beyond the school day and expand after-school programs to accelerate learning and reduce the opportunity gap.

A high number of instructional hours does not translate into students' higher educational results

The total instructional hours vary significantly between countries, though the share of hours devoted to mathematics is similar (ranging from 10% to 18% of the total instructional hours). Lebanon presents one of the lowest total instructional hours among MENA countries. Although the number of math classes hours does not deviate much from other countries, the low share of mathematics material is covered, which may explain why students from countries with fewer instructional hours perform better than Lebanese students. Time devoted to science teaching is the second-highest in Lebanon., Although the share of the material covered in Lebanon is comparable to schools abroad, Lebanese students performed worse than eighth-graders from other areas in the science assessment. Again, it suggests that it is not the number of instructional hours devoted to classes in building human capital but rather the quality.

Recommendations:

- Carry deep analysis of the curriculum at different levels to examine whether the problem results from the quality of teaching, curriculum content, scope and sequence, or the knowledge gaps accumulated over the years that prevent teachers from implementing the curriculum.
- Ensure high-quality early learning.

Access to home resources is at the level of other MENA countries and affects student outcomes, especially in science

The access to home resources is similar among MENA countries, but below the international level, 22% of Lebanese students have access to only a few supportive learning resources, and only 6% declared having access to many resources (7% in MENA countries and 13% internationally). Access to home resources positively influences students' performance, especially the performance of Lebanese students in science turned out to be highly sensitive to the increase in the accessibility to home resources.

The school composition indicates that Lebanon and the MENA countries have fewer affluent students than the international average (25% and 29% compared to 35%). Moreover, 44% of students were classified as more disadvantaged. As in other countries in Lebanon, higher scores in mathematics and science are obtained among "More Affluent" students, while the lower results are obtained by "More Disadvantaged" students. However, for science, the differences in achievement are more substantial than in mathematics.

Recommendations:

- Invest in high-quality educator preparation, especially for high-need communities where home educational shortages continue to be problematic.
- Implement a comprehensive system of support, organize scholarships programs aimed at addressing students experiencing financial struggles and hardship, that can provide children with educational materials.

Proficiency in the language of instruction is a precondition for learning. School capacity needs strengthening in language teaching, guaranteeing to understand of the material processed at school

For material understanding, school activities must be guided by a coherent language policy adapted to the different levels of the education system. Meanwhile, only 7% of Lebanese students speak the language of teaching at home, which is less than in MENA countries (48%) and much less than the international average (66%). Beginning to study in a foreign language in 7th grade may cause difficulties in acquiring knowledge and taking the TIMSS assessment. The differences due to the frequency of speaking in the assessment language at home are reflected in Lebanon and other countries' results. Students who never use the test language at home achieve significantly poorer results. In Lebanon and other MENA countries, a vast difference in achievement between students speaking test language at home “Almost Always” and “Always” is especially apparent.

Recommendations:

- Provide remedial language teaching courses which could be implemented throughout school program and after school.
- Policies at all levels of the education system need to ensure that the same quantity and quality of language and other targeted support are consistently offered to students and teachers responsible for language quality during classes.

The variation in the availability of school resources between schools is visible. Low access to school resources is one of the factors responsible for the lowest educational results

Students may experience different educational opportunities depending on what school they attend. In many schools, students experience resource shortages, thus their learning may be affected. In Lebanon, students are affected by mathematics resources shortage at a level similar to those experienced by students in other MENA countries (13% affected a lot and 21% not affected in Lebanon, 15% and 19% in MENA countries). Instruction affected by science resource shortages a lot concerns 13% of Lebanese students compared to 13% in MENA countries and 7% internationally.

Recommendations:

- Providing proper school equipment might reduce inequalities between schools.
- Ensure that schools have tools to take stock of students' needs. Policies at all levels of the education system need to ensure the same quantity and quality of resources.
- Ensure consistent provision of educational support and manage the opportunities and challenges that arise in particular areas or schools with large concentrations of disadvantaged students. Manage inequities by targeting discrete areas, schools, or student groups.

Integrate social and emotional learning in school life. Experiencing a high sense of school belonging relates to higher academic results. In Lebanon, moderate differences in results are found due to school belonging.

In most countries, the best performance in science and mathematics is found among students feeling the strongest connection to their school. In Lebanon, most students have experienced a positive school climate and declared either a high or a moderate sense of school belonging (46% and 42% of students, respectively). Generally, the slight differences in results due to the sense of school belonging were reported in the majority of the MENA countries. In Lebanon, a moderate range of inequalities was found for mathematics, but more significant inequalities than the MENA countries, and the international average are observed for science.

An emphasis on students' academic success also turns out to be an essential factor. High emphasis on academic success correlates positively with achievements in science and mathematics. In Lebanon, 56% of eighth-graders reported having experienced either a high or a very high emphasis on their academic success that is considerably less than in MENA countries and internationally. The positive impact of the emphasis on academic success is observable up to some point and would be the most beneficial who currently do not receive such support and spur to action.

Recommendations:

- Cultivate supportive school environments filled with emotional safety and belonging. Implement a system of support taking a consistent approach promoting students' social and academic well-being.
- Include in curriculum and schools activities place, where students could develop their social competencies, collaboration skills, group work, etc.

The Lebanese students' sense of security is close to the international average but significantly lower than in the MENA countries. In addition, Lebanese students show disciplinary problems more often than their peers and more often experience bullying.

The TIMSS 2019 data shows that when the atmosphere is perceived as safer and more orderly, better results in mathematics and science are achieved on average. The level of the sense of security in Lebanon, where 47% of students feel safe at school, is close to the international level (48%) but lower than in other MENA countries (60%). Compared to MENA countries and the international average, the inequalities in mathematics performance between Lebanese students regarding safety are significantly broader, and for science, the differences in results due to school discipline and safety are even more prominent.

When it comes to school discipline, it is strongly connected with school safety, where differences in the percentages of students causing hardly any discipline problems are pretty wide between countries. In Lebanon (24%) and MENA countries (22%), slightly more students caused moderate to severe problems than on the international average (11%). Additionally, while on international average and in MENA countries, the decrease in discipline correlates with better results in mathematics and science, such a pattern is not clear in Lebanon, where the differences in results due to discipline problems are relatively small.

The problem of bullying, often stemming from disciplinary and behavioral problems, is more frequent in Lebanon than in other MENA countries and internationally. The frequency of experiencing bullying acts correlates with a lower average score in mathematics. However, the dependency between the frequency of bullying acts and the average performance in mathematics is considerably smaller in Lebanon than in the other country groups.

Recommendations:

- Consider social and emotional learning programs that have preventive effects on rates of aggression in schools.
- Develop behavior policy that is well understood by staff, parents and pupils, and is consistently applied. This should integrate social emotional learning (especially bullying) across different subjects including math (in the context of math problems).

In MENA countries including Lebanon, principals are less likely to have higher education than their colleagues in other countries. In contrast, Lebanese teachers have a university degree more often than their colleagues from other MENA countries.

Most principals have obtained at least a bachelor's degree in most countries. However, the education level of schools' principals varies strongly among participating countries. In the top achieving countries, principals possess at least a bachelor's degree. The principals who did not obtain a higher degree are overrepresented in MENA countries; in Kuwait, Lebanon, and Oman, around 1 in 10 principals did not obtain a higher education diploma, which may impact the quality of school management.

When it comes to teachers, in Lebanon, 88% of mathematics teachers have completed tertiary education, which is one of the highest shares among the MENA countries and slightly higher than the international average. In the case of science teachers, the results are similar; however, more science teachers have completed postgraduate studies compared to mathematics. Also, in Lebanon, considerably more science than mathematics teachers have obtained at least a bachelor's degree, translating to better competencies in teaching this subject. Nevertheless, this is not reflected in the higher average scores obtained by students in science. Some differences in results are visible due to the teachers' experience. While in most countries, no significant influence of the teacher's experience on students' educational performance was observed, in Lebanon, the inequalities between categories are observed (especially for mathematics). The differences in student performance may indicate that Lebanese teachers are inadequately prepared for the profession in the early years of their careers.

Recommendation:

- Invest in high-quality educator preparation, update and strengthen the teachers and principals competencies and organize additional retraining courses on the content of math and science subjects.

Lebanese teachers show relatively high interest in further training compared to other countries

The interest in training among Lebanese math teachers is relatively high compared to the other MENA countries and the international average. The most significant interest among the math teachers is in training concerning improving students' critical and analytical thinking skills, while the least is in the courses concerning the core curriculum in mathematics. Lebanese math teachers are less willing to participate in additional training on the instruction of mathematics than their colleagues from other countries.

Science teachers are less interested in developing courses than teachers from MENA countries; significant differences in the training concerning integrating technology into science and science instruc-

tion are present. Lebanese science teachers are most willing to participate in courses on science content, science curriculum, and science assessment. However, few teachers were interested in introducing technology into instruction or addressing students' individual needs in Lebanon.

Recommendations:

- Improve the training participation rate, compulsory training can be introduced to keep teachers up to date with the changes in the teaching techniques. Educator preparation programs need more effective ways of developing and sharing expertise across the profession
- Transform development opportunities to match the current needs of teachers and their students.

Lebanese teachers express a high level of job satisfaction compared to their colleagues from other countries

In Lebanon and MENA countries, many more teachers were very satisfied with their work, compared to the international average. The students whose teachers were very satisfied with their work achieved the best results; however, the relationship between teachers' job satisfaction and math educational outcomes is relatively weak. Lebanese science teachers are less often very satisfied with their job than math teachers, but they still constitute a higher share than the international average. Moreover, in the case of science, job satisfaction seems to affect student learning outcomes more intensively.

Lebanese pupils less often than the average pupils skip their classes

The problem of student absenteeism is very diverse around the world; on average, 55% of eighth-graders *never* or *almost never* missed a class. However, in Lebanon, that was declared by 62% of eighth-graders, 9% of students declared skipping classes *once a week*.

Tiredness and malnutrition insignificantly differentiate student learning outcomes in Lebanon. Students usually do not declare school fatigue, but one in three experiences hunger at school each day

Excessive tiredness can negatively affect educational outcomes. In most countries, students declare that they sometimes feel tired at school. However, when it comes to Lebanon, one of the highest shares of students who never felt tired was observed, and at the same time, a moderate share of students felt exhausted every day or almost every day. There is no clear pattern between feeling tired at school and the average score. A general conclusion is that the most tired students get the best results; this may be because they put more effort into learning.

Another problem showing a clear negative impact on students' results is experiencing hunger. More than one-third of students have experienced hunger every day in Lebanon, while one-fourth of students have never felt hungry at school. Contrary to average international results, in Lebanon, the differences in achievements due to the frequency of experiencing hunger are not significant

Recommendation:

- Address hunger in school by organizing school meals or organizing other school breakfast programs. Consider reducing the price of school meals or providing support for students in need

A positive attitude towards the subject and self-confidence go hand in hand with high scores in a given subject. Lebanese students enjoy math and science more than their colleagues from other countries

Students in Lebanon and the MENA countries enjoy learning mathematics more than the international average. At the same time, relatively fewer Lebanese students declared a low interest in learning mathematics compared to the MENA countries and the global average. Moreover, Lebanese students enjoy learning science more than the international average. In terms of confidence, Lebanese students do not differ from the average international results. Both the positive attitude and confidence are positively correlated with performance; however, we may deal with the endogeneity problem that occurs; the relation between perception and performance is mutual.

Recommendation:

- Since the extent to which students like a subject strongly correspond to their performance, reforms aimed at popularizing learning mathematics and science learning may result in higher educational achievements.

In Lebanon and generally MENA countries, students more often value math and science compared to the international average

In Lebanon and the MENA countries, almost half of the students strongly value mathematics. That is much more than observed on the international average, where only 37% of eighth-graders strongly value this subject. A similar pattern is visible in science. In addition, the correlation of the declared value of subjects on the results is evident; however, the value assigned to science more strongly correlates with average results in science compared to mathematics.

Closing the digital divide is crucial in the current world and poses a significant challenge for Lebanon, where few students have access to a computer during classes

Low access to computers during classes in Lebanon than in other countries is a severe problem when introducing distance learning. Meanwhile, almost 90% of Lebanese eighth-graders have never been introduced to digital activities during the instruction. Such patterns might be connected to the lack of proper training about digital learning among teachers as well as the lack of necessary equipment. As in the majority of countries, also in Lebanon, very few eighth-graders reported taking a computer assessment.

Recommendations:

- Students and schools should be provided with access to computer devices to stem the learning loss due to unequal access to digital devices.
- Develop standards for digital learning at schools and provide appropriate preparation for teachers with the pedagogical use of interactive technologies.

Relatively high instruction clarity declared by Lebanese students does not translate to higher academic results, as compared to other countries

In more than half of the countries, students evaluate instructional clarity in math as high; however, the students from countries where the best performances in mathematics are found declared the lowest levels of instructional clarity. In Lebanon, 61% of students claimed to have experienced high clarity of mathematics instruction. Similarly, high results concern science subjects. Although instructional clarity positively affects Lebanese students' achievement, it is still lower than in those countries, where students assess clarity lower than in Lebanon.

Access to school lab does not translate to higher academic achievement if they are ineffectively used

In the majority of the countries, most schools are equipped with professional laboratories, with only a few countries lacking these practical resources. For example, in Lebanon, almost 90% of eighth-graders have a laboratory in school; however, it does not lead to better school performance. Similarly, the high frequency of conducting experiments does not translate into better student results. It is closely related to how the teachers conduct classes and what the transfer and involvement of students in the experiments look like; often, experimenting is not followed by an understanding of the process.

Both the individual socioeconomic situation of the student and the school composition affect the academic performance; however, it is the school level that takes more account of the variation in student results

According to the TIMSS data, in Lebanon, students from more affluent backgrounds obtained higher achievements in mathematics and science than their peers from more disadvantaged households. The correlation of socioeconomic status and average achievement is positive and relatively strong on student and school levels. At the student level, the average achievements in science were much more related to socioeconomic status - 16% of the variance in the case of mathematics and 21% in the case of science was explained by individual socioeconomic status. The disproportion between students based on their status is even much more observable on the school level. Around 55.4% of the variance in the case of mathematics and 60.8% in the case of science is explained by the school's socioeconomic status. There is a substantial achievement gap between mathematics and science in more disadvantaged schools. Yet, with the increase in socioeconomic status, the gap between mathematics and science achievements diminishes.

Private school students outperform their colleagues from public schools both in mathematics and science, which is connected to a usually higher quality of educational services in the former

The average mathematics and science achievement of students attending private schools are higher (by 40 and 60 points, respectively) than public school students; simultaneously, a slightly higher heterogeneity of achievements characterizes students from private schools. This higher variation might correspond to more diversified offers and the quality of the private schools. Results show that indeed the private schools provide more effective teaching methods, as there is a substantial difference between students with the same socioeconomic status, which only depends on whether one attends private or public schools

As private schools require fees, they are mainly attended by students with a good socioeconomic situation; it makes the Lebanese education system reproduce the economic inequalities, as students from well-prospering households are attending segregated schools.

Recommendation:

- Improving the quality of education in public schools through teacher training and providing schools with the necessary educational materials

Chapter 1. Introduction. What is TIMSS? How was it implemented in Lebanon?

This chapter provides a brief overview of the TIMSS international assessment, including its history, the assessment coverage, the content of the assessment, and the topics addressed in questionnaires. It will focus mainly on its implementation in Lebanon.

1.1. What is TIMSS? History of the assessment. TIMSS in Lebanon

The acronym TIMSS stands for *Trends in Mathematics and Science Study*, and it is an international assessment in the disciplines of mathematics and science. This assessment examines the knowledge and the skills of fourth and eighth graders and additional factors related to education. The TIMSS assessment is organized by the TIMSS & PIRLS International Study Center in the Lynch School of Education at Boston College and the International Association for the Evaluation of Educational Achievement (IEA). For almost three decades, the results of the TIMSS assessment have provided valuable resources for policy-makers. Over time more countries were covered. Table 1.1. shows the number of countries participating in the assessments, respectively, in the case of fourth and eighth-graders.

Table 1.1. Number of participating countries in respectively fourth and eighth-grade assessment in years 1995-2019

Year	2019	2015	2011	2007	2003	1999	1995
Number of countries in which fourth-grade assessment was conducted	58	48	46	28	21	-	22
Number of countries in which eighth-grade assessment was conducted	39	37	35	36	37	33	35

Source: Appendix A.1: Country Participation in TIMSS 2019 and in Earlier TIMSS Assessments. Downloaded from: https://timss2019.org/reports/wp-content/themes/timssandpirls/download/center/appendices/T19_AppA_country-participation-trend.xlsx

This report will only describe and analyze the achievements of eighth-graders from Lebanon since fourth-graders have not taken part in the assessment. Lebanese eighth-graders have participated in the assessment every four years since 2003 (2003, 2007, 2011, 2015, 2019). Overall, TIMSS results show that the quality of education in Lebanon is relatively low compared to the international average.

1.2. Contents of the assessment

The TIMSS assessment consists of two dimensions, namely a 1) subject dimension which determines whether the curriculum was correctly learned and understood by the student, and 2) a cognitive dimension aimed at assessing the student's process of thinking while interacting with the discipline of study. The proportion of the subject and cognitive domains differs between fourth-graders and eighth-graders and in mathematics and science.

The content of the TIMSS **assessment in mathematics** consists of four different topics: Number, Algebra, Geometry, and Data and Probability. Table 1.2. presents the share of the assessment devoted to each of these topics.

Table 1.2. Percentage of TIMSS mathematics assessment devoted to content domains in 2019.

Content Domains	Percentages
Number (e.g. integers, fractions and decimals)	30%
Algebra (e.g. expressions, operations and equations)	30%
Geometry (e.g. geometric shapes and measurements)	20%
Data and Probability (e.g. reading and interpreting data)	20%

Source: TIMSS 2019 Assessment Frameworks. Downloaded from: <https://timss2019.org/wp-content/uploads/frameworks/TI9-Assessment-Frameworks.pdf>

However, according to the Lebanese curriculum, the TIMSS assessment framework does not reflect the content of the Lebanese Mathematics Curriculum. Table 1.3 compares the time devoted to the mathematics content fields in Lebanon to the TIMSS framework. One can observe that the 8th-grade curriculum focuses primarily on geometry in Lebanon, as more than 40% of instruction time is devoted to topics as location, plane and solid figures, and vectors transformation. Slightly less instruction time than proposed by the TIMSS framework is devoted to Numbers and Algebra. However, the most significant difference is observed in the data field, as Lebanese eighth-graders devote less than 10% of their instruction time to topics concerning handling the data. What is more, the basic probability is not covered until the 11th grade in Lebanon. As education is compulsory in Lebanon up to the 9th grade, students who decide not to continue their education might never be introduced to the probability problems, which are of great importance in daily-basis situations.

Table 1.3. Comparison of TIMSS mathematics assessment structure and Lebanese curriculum devoted to content domains in 2019.

Domains	TIMSS	Lebanon	Notes
Integers	10%	10%	
Fractions and Decimals	10%	7%	
Ratio, proportion and percent	10%	3%	
Numbers	30%	20%	
Expressions, Operations and Equations	20%	17%	
Relationships and functions	10%	10%	
Algebra:	30%	27%	
Geometric Shapes and Measurement	20%	37%	
Location	0%	7%	Not mentioned in TIMSS assessment framework
Geometry:	20%	43%	
Data	15%	7%	
Probability	5%	0%	According to CERD(1997), via Sanaa (2019), Probability is introduced in 11th grade
Data and Probability:	20%	7%	

Source: TIMSS 2019 Assessment Frameworks. Downloaded from: <https://timss2019.org/wp-content/uploads/frameworks/T19-Assessment-Frameworks.pdf>. Center for Educational Research and Development (CERD). (1997). Curriculum of Mathematics. Lebanon: Ministry of National Education, Youth and Sports.

During the assessment in mathematics, students are allowed to use calculators that can either be their own or the digital ones found in the online version of the test.

The content of the cognitive dimension in the assessment in mathematics consists of three different domains: Knowing, Applying, and Reasoning. Table 1.4. presents the share of the assessment devoted to each of the cognitive categories.

Table 1.4. Structure of TIMSS mathematics assessment devoted to cognitive domains in 2019.

Eighth Grade	
Cognitive Domains	Percentages
Knowing (e.g. recalling definitions, using appropriate units of measurements)	35%
Applying (e.g. determining efficient tools for solving problems, representing problems graphically)	40%
Reasoning (e.g. providing mathematical arguments, making generalized statements)	25%

Source: TIMSS 2019 Assessment Frameworks. Downloaded from: <https://timss2019.org/wp-content/uploads/frameworks/TI9-Assessment-Frameworks.pdf>

The structure of the **science assessment** is more complex than the one in mathematics. In particular, it consists of four different subjects usually covered independently in schools, namely Biology, Chemistry, Physics and Earth Science. Table 1.5 shows the percentages of the assessment devoted to each content category.

Table 1.5 Structure of TIMSS science assessment devoted to content domains in 2019.

Eighth Grade	
Content Domains	Percentages
Biology (e.g. cells and their functions, life cycles, ecosystems, human health)	35%
Chemistry (e.g. composition and properties of matter, chemical change)	20%
Physics (e.g. motion and forces, electricity and magnetism, energy transformation)	25%
Earth Science (e.g. Earth's structure and physical features, Earth's resources, their use and conservation)	20%

Source: TIMSS 2019 Assessment Frameworks. Downloaded from: <https://timss2019.org/wp-content/uploads/frameworks/TI9-Assessment-Frameworks.pdf>

It turns out that the science framework proposed by TIMSS also does not fully reflect the content of the Lebanese curriculum. In table 1.6 one can notice that relatively more time is devoted to chemistry and physics than it is in the TIMSS framework, whereas students spend less time on biology and earth science instruction. However, in Lebanon, Earth Science and Biology is a single subject, called “Earth and Life Sciences”; hence it is difficult to determine how much of the instruction is devoted to biology and earth science. Differently than in the case of mathematics, the curriculum document provided by CERD (1997) does not provide any information on how much time is devoted to single specific science

topics, such as motion in physics or acids in chemistry. Hence, the table below might provide biased information about the share of the instruction devoted to different subfields. Nevertheless, it can be assumed that the science content framework proposed by TIMSS does not match properly with the Lebanese science curriculum.

Table 1.6 Comparison of the structure of TIMSS science assessment and Lebanese curriculum devoted to content domains in 2019.

Subfield	TIMSS	Lebanon
Biology	35%	17%
Chemistry	20%	33%
Physics	25%	33%
Earth Science	20%	17%

Source: TIMSS 2019 Assessment Frameworks. Downloaded from: <https://timss2019.org/wp-content/uploads/frameworks/TI9-Assessment-Frameworks.pdf>. Center for Educational Research and Development (CERD). (1997). Curriculum of Mathematics. Lebanon: Ministry of National Education, Youth and Sports.

The cognitive dimension of the assessment in science consists of the exact domains like the one in mathematics, but the shares devoted to each are different. Table 1.7 presents the share of the assessment devoted to each cognitive category.

Table 1.7 Structure of TIMSS science assessment devoted to cognitive domains in 2019.

Eighth Grade	
Cognitive Domains	Percentages
Knowing (e.g. identifying facts, describing the relationships between organisms, providing examples)	35%
Applying (e.g. using graphs to present the cycles of behaviour or phenomenon, interpreting information)	35%
Reasoning (e.g. formulating questions and hypotheses, designing investigations, drawing conclusions)	30%

Source: TIMSS 2019 Assessment Frameworks. Downloaded from: <https://timss2019.org/wp-content/uploads/frameworks/TI9-Assessment-Frameworks.pdf>

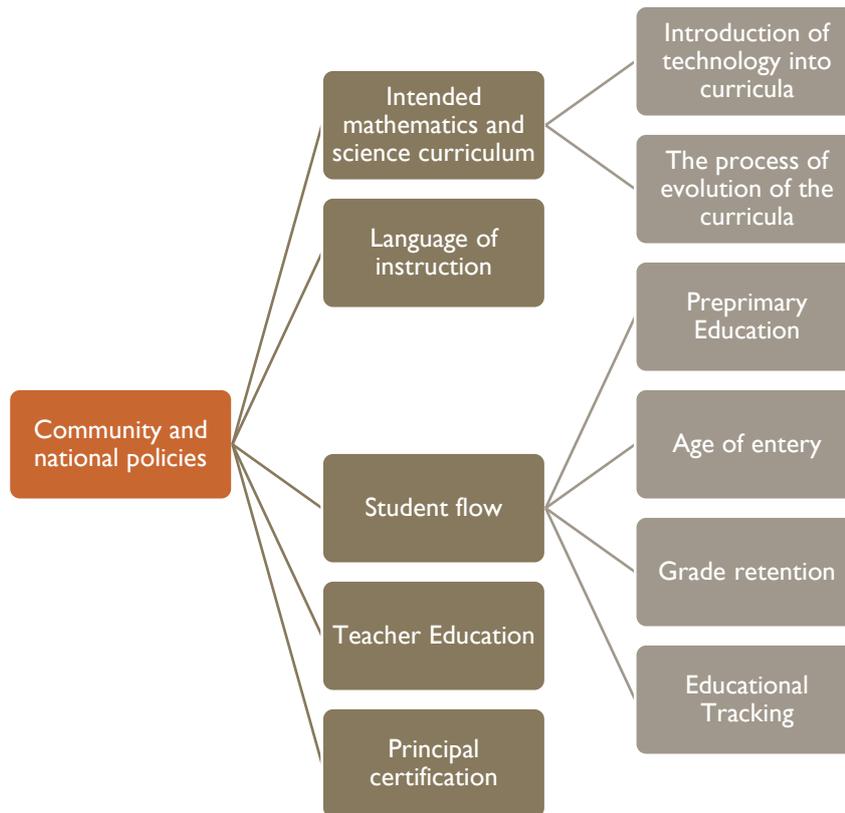
I.3. Topics addressed in additional questionnaires

On top of cognitive items, supplementary questionnaires are given to students, teachers, parents, and principals to examine their experience with learning at school and their socioeconomic situation. Since the TIMSS assessment aims to reflect the changes in the existing trends in education, the purpose of these additional questionnaires is to determine the dynamics of such changes. The subjects of the non-cognitive questionnaires can be divided into five categories:

- Community and national policies,
- Home contexts,
- School contexts,
- Classroom contexts, and
- Students' attitudes toward learning.

Community and national policies are divided into five subcategories, which separately analyze the 1) intended mathematics and science curriculum, 1) the language of instruction, 3) the student flow, 4) the teacher education, and 5) principal certification. This part aims to examine the environment in which students learn and acquire new skills. Figure 1.1 presents the topics devoted to each subcategory of the Community and national policies category.

Figure 1.1. Topics covered in additional questionnaires in TIMSS assessment – Community and national policies.

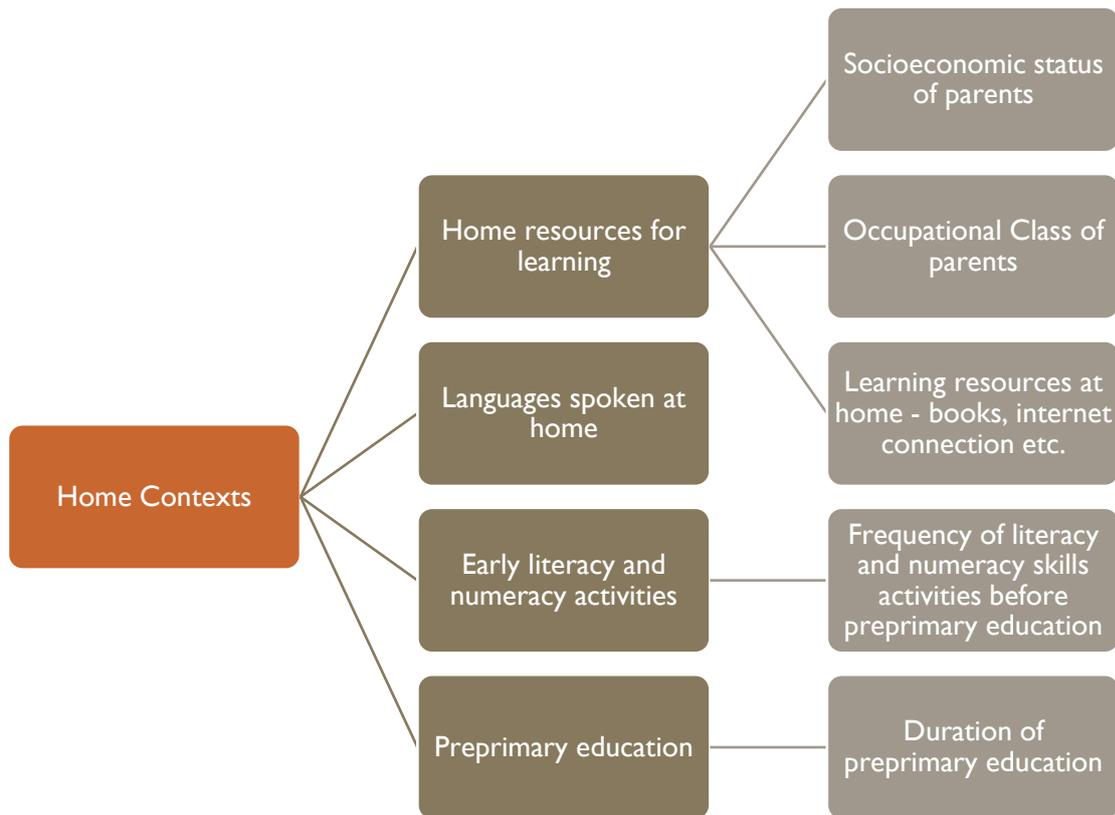


Source: TIMSS 2019 Assessment Frameworks. Downloaded from: <https://timss2019.org/wp-content/uploads/frameworks/T19-Assessment-Frameworks.pdf>

The results of the TIMSS should also be analyzed in relationship to parent's characteristics, home environment, and the early upbringing part of the lives of students since these aspects can play a crucial role in educational achievements. For this reason, the category **Home contexts** is divided into four subcategories: 1) the home resources for learning, 2) the language spoken at home, 3) early literacy and numeracy skills, and 4) preprimary activities. Figure 1.2. presents the topics devoted to each subcategory of the Home contexts category.

Providing a friendly and safe atmosphere at school is another essential factor in establishing a proper educational environment. The category **School contexts** is divided into seven subcategories: 1) the school characteristics and demographics, 2) effect of resource shortages on instruction, 3) the school emphasis on academic success, 4) the parents' perception of their child's school, whether 5) School Safety, 6) the presence of student bullying, and 7) the sense of school belonging. Figure 1.3. presents the topics devoted to each subcategory.

Figure 1.2. Topics covered in additional questionnaires during TIMSS assessment – Home Contexts.

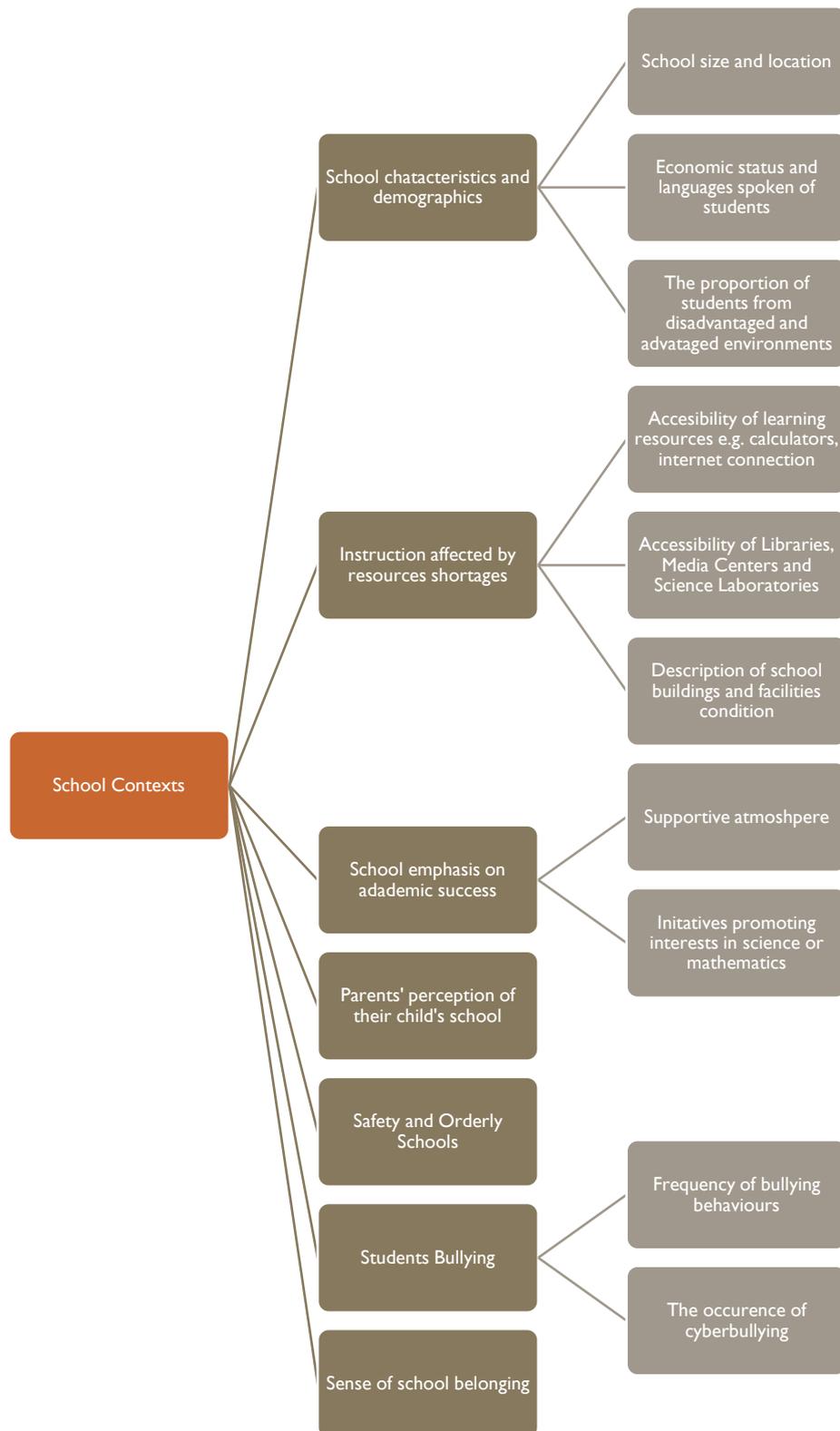


Source: TIMSS 2019 Assessment Frameworks. Downloaded from: <https://timss2019.org/wp-content/uploads/frameworks/T19-Assessment-Frameworks.pdf>

The atmosphere and climate in the classroom strongly influence students' achievements. **The Classroom context** is divided into eight different subcategories, which refer to the 1) teacher preparation and experience, 2) the TIMSS mathematics and science topics taught, 3) the instructional time, 4) the instructional practices and strategies, 5) the instructional clarity, 6) whether there is a supportive classroom climate, 7) the use of technology in instruction, and 8) challenges faced by teachers. Figure 1.4. presents the topics devoted to each subcategory of the Classroom contexts category.

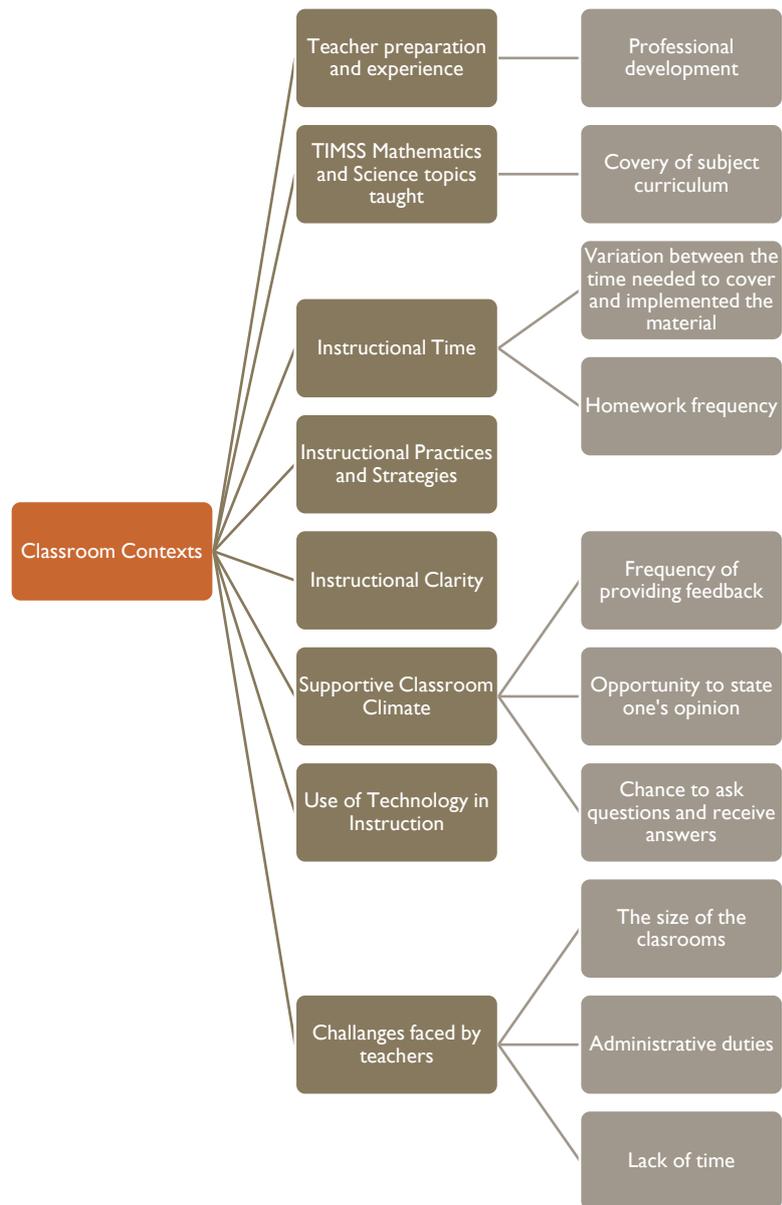
An extensive body of literature shows a strong relationship between students' attitude and their educational outcomes (see Saifi, Mehmood, 2011; Mattar, 2012; Harwell et al., 2017; Broer, Bai, Fonseca, 2019). **Students' attitude towards learning** is divided into two subcategories, which are 1) the students' attitude towards learning mathematics and science and 2) student confidence using technology. Figure 1.5. presents the topics devoted to each subcategory of the *Students' attitude toward the learning*.

Figure 1.3. Topics covered in additional questionnaires during TIMSS assessment – School Contexts.



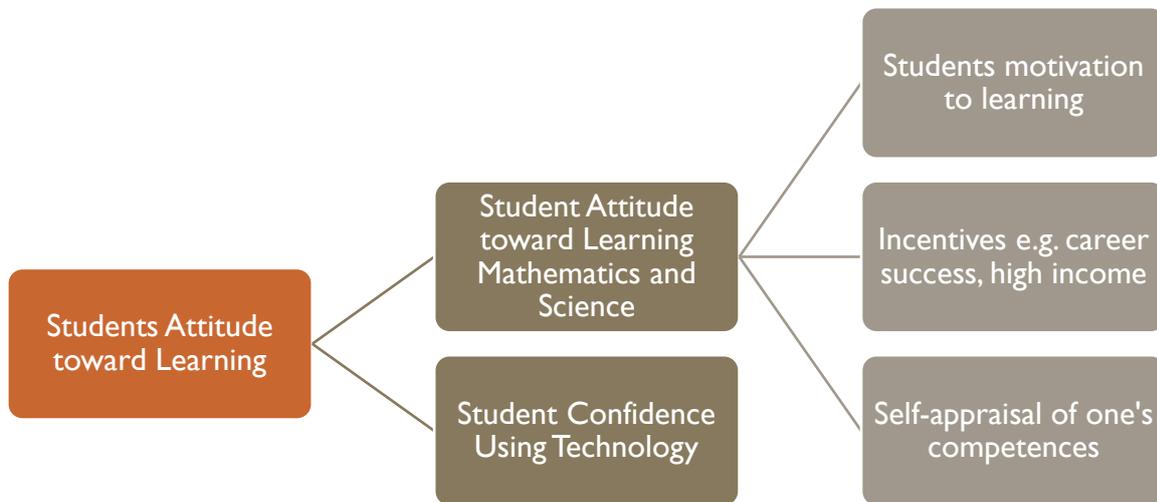
Source: TIMSS 2019 Assessment Frameworks. Downloaded from: <https://timss2019.org/wp-content/uploads/frameworks/TI9-Assessment-Frameworks.pdf>

Figure 1.4. Topics covered in additional questionnaires during TIMSS assessment – Classroom Contexts.



Source: TIMSS 2019 Assessment Frameworks. Downloaded from: <https://timss2019.org/wp-content/uploads/frameworks/T19-Assessment-Frameworks.pdf>

Figure 1.5. Topics covered in additional questionnaires during TIMSS assessment – Students attitude toward Learning



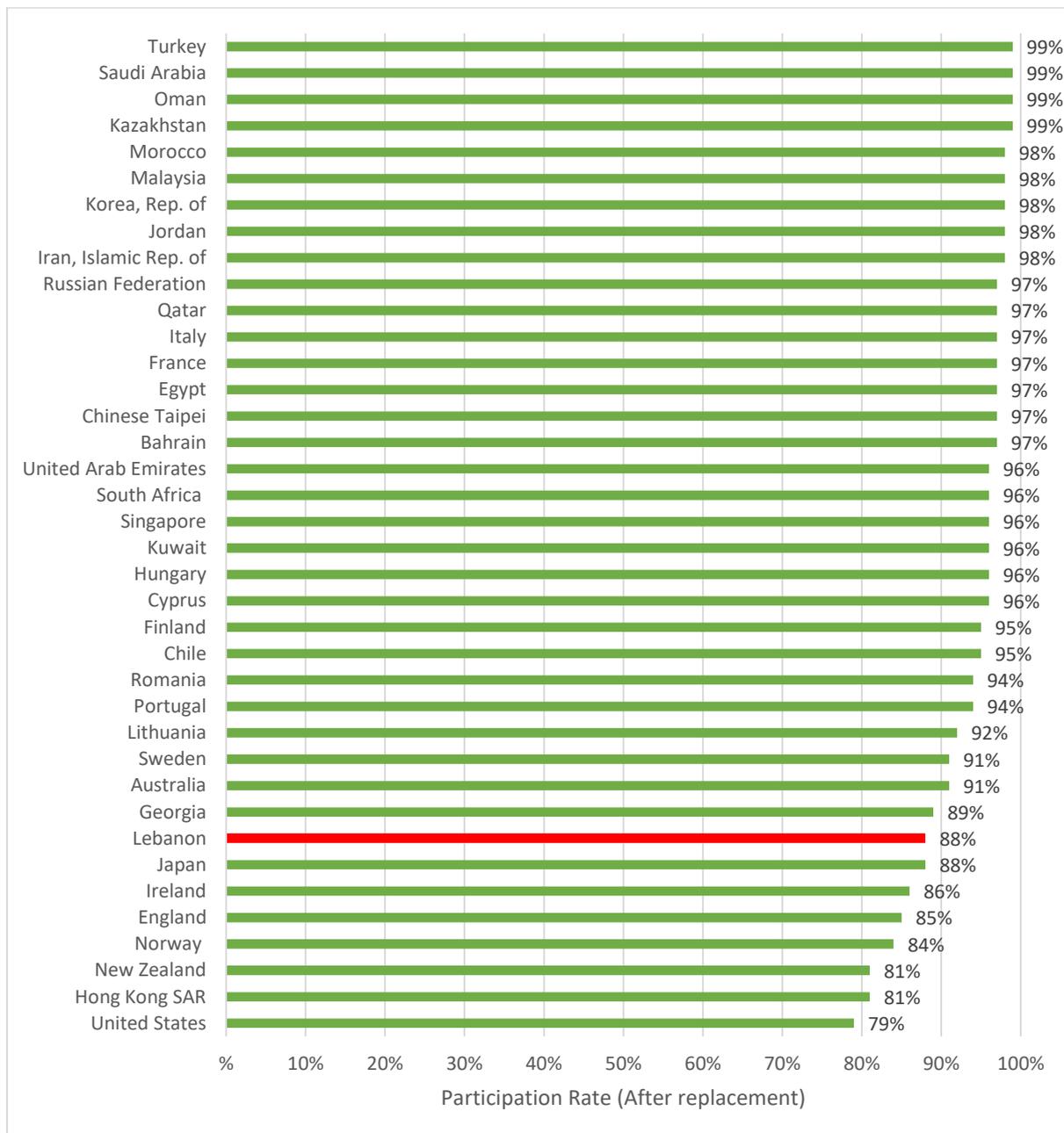
Source: TIMSS 2019 Assessment Frameworks. Downloaded from: <https://timss2019.org/wp-content/uploads/frameworks/T19-Assessment-Frameworks.pdf>

I.4. Coverage and sampling. Implementation of the assessment in Lebanon

To understand the ongoing changes in education, assessment designers have developed several rules to achieve a good level of reliability and comparability. First, to collect an adequately representative sample for each country, 150 randomly chosen schools from different geographical areas, including private and public sector schools, are expected to participate in the assessment, with approximately 4000 students involved. The minimum participation rate accepted for the school to qualify was either 85 percent of both schools and students or a combined rate (as the product of school and student participation) of 75 percent. Figure 1.6. presents the participation rate after the replacement procedure in the countries that took part in the assessment. As observed, the participation rate in Lebanon met the requirements set by TIMSS but is relatively low compared to other countries.

For the cognitive part, each student was assigned randomly to the booklet in mathematics and science. Eighth graders were given 90 minutes to complete the assessment and 30 minutes to fill the additional questionnaires. **Out of the total number of eight-graders, 68077 students (targeted population) from Lebanon, 4730 participated in the assessment.**

Figure 1.6. Overall participation rate in the 2019 TIMSS assessment.



Source: TIMSS 2019 Assessment Frameworks. Downloaded from: <https://timss2019.org/wp-content/uploads/frameworks/T19-Assessment-Frameworks-Chapter-4.pdf>

Chapter 2. Average achievement and performance trends

This chapter discusses the assessment results for eight-graders in both science and mathematics. First, it focuses on the average performance of eight-graders in Lebanon in comparison to other countries. Second, the chapter discusses gender gaps and distribution across international achievement benchmarks. The standardized outcomes of the TIMSS assessment allow one to compare its results over the years and follow the observed trends in education over time.

2.1. Average achievement in mathematics

In the 2019 TIMSS eight-graders assessment, 39 countries, including Lebanon, were covered. Figure 2.1. presents the average achievement score of Lebanon and two benchmarks: the average for MENA countries¹ and at the international level.

Figure 2.1. Average results of G8 TIMSS assessment in mathematics – Lebanon, MENA countries, international average

Lebanon	MENA Countries	International average
• 429 points	• 427 points	• 489 points

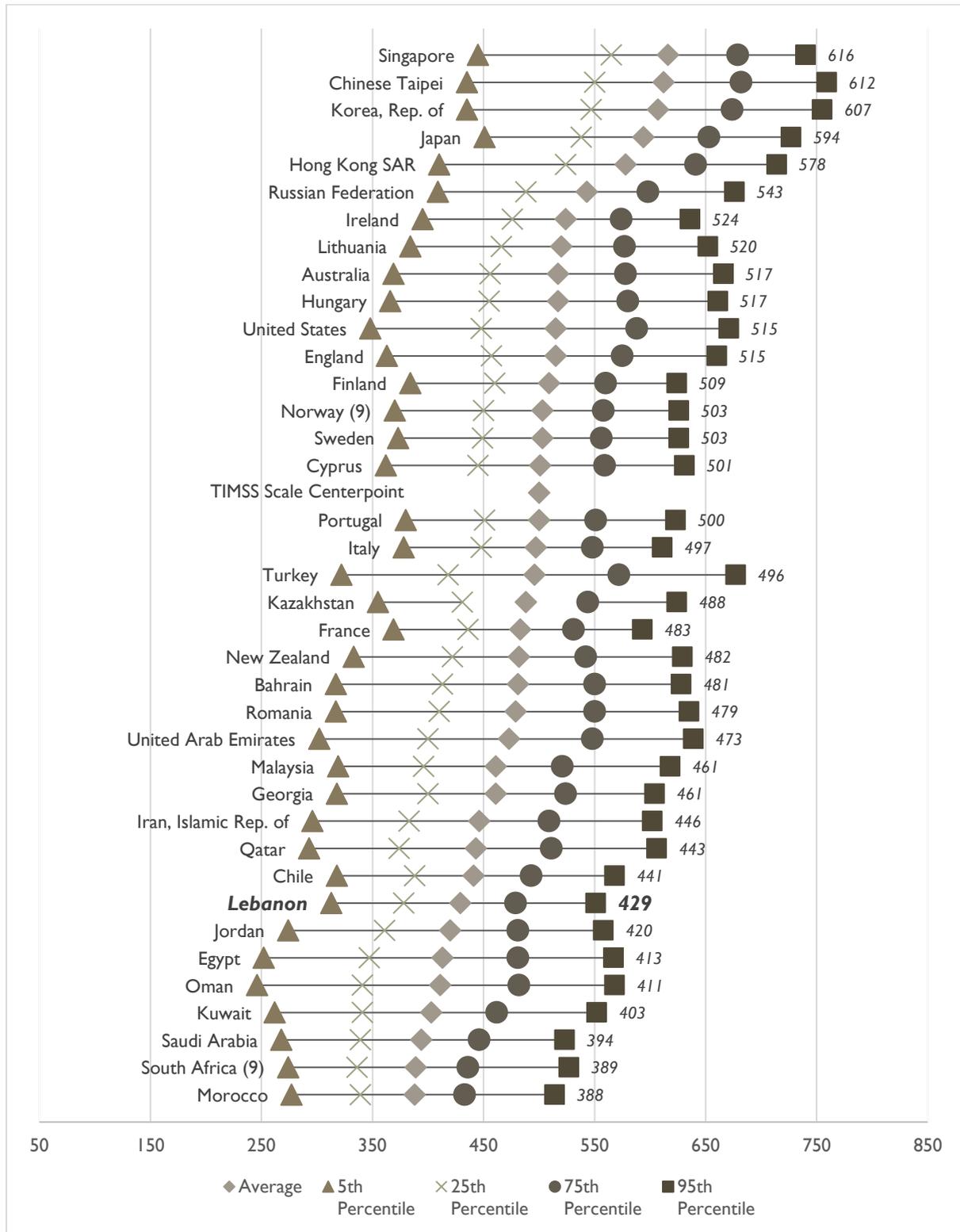
Source: Exhibit 3.1: Average Mathematics Achievement and Scale Score Distributions. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Lebanon scored 429 points, compared to 427 for MENA countries and 489 internationally. Thus, Lebanese students achieved comparable results in mathematics to students in other MENA countries – the difference is not statistically significant. At the same time, the mean result of all participating countries was significantly higher.

Way more insightful than the country means are the distributions of the TIMSS results in participating countries. The differences between the 5% of low-achieving students and the 5% of high-achieving ones capture educational inequalities. Figure 2.2. presents the distribution of results in mathematics in the TIMSS assessment.

¹ According to UNICEF: Algeria, Bahrain, Djibouti, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Sudan, Saudi Arabia, Syria, Tunisia, United Arab Emirates, Yemen.

Figure 2.2. Distribution of average results of G8 TIMSS assessment in mathematics. The numbers on the right side stand for the average results.



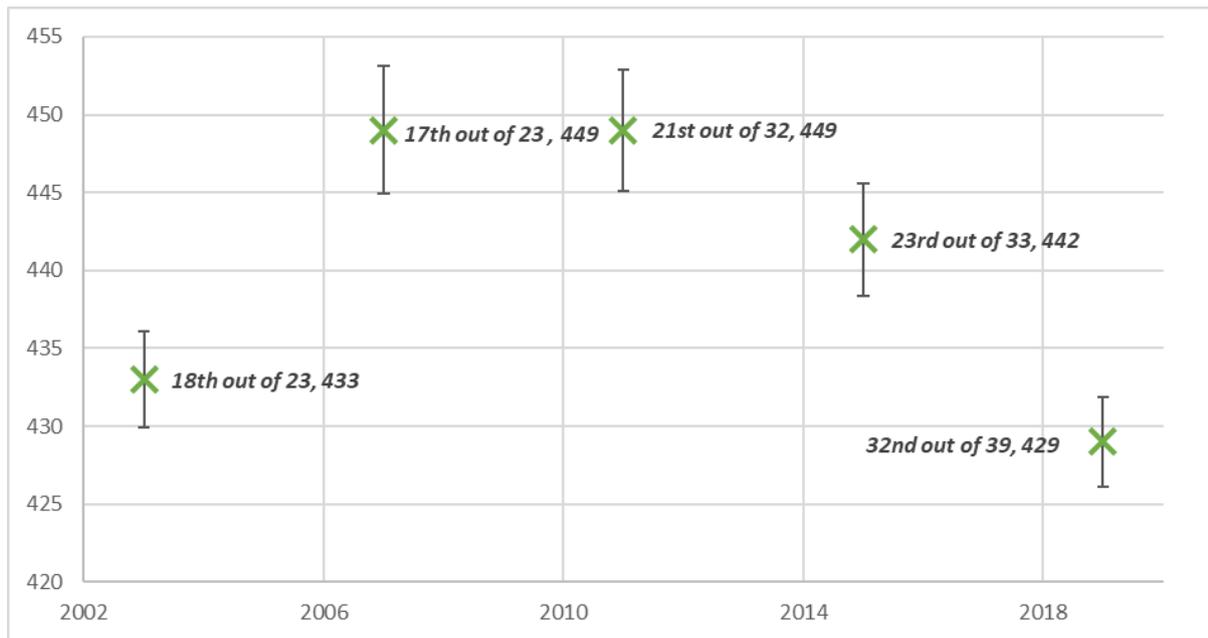
Source: Exhibit 3.1: Average Mathematics Achievement and Scale Score Distributions. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Lebanese eighth-graders were classified in 32nd position out of 39 participating countries and 5th out of 11 considering the MENA countries. The difference between the highest achieving students (95th percentile) and the lowest-achieving students (5th percentile) is lower than at the international average. It is also the fourth lowest difference among the countries that took part in the assessment. If the countries were sorted by the results obtained by the 5% of lowest-achieving students, Lebanon would take 29th position in the ranking of participating countries.

2.2. Trends in mathematics achievements

The plot of the change of results scored by Lebanese eighth-graders in TIMSS over the years allows for trend analysis. Figure 2.3. presents the average results scored in mathematics in Lebanon since 2003 with the corresponding confidence interval.

Figure 2.3. Average results G8 Mathematics Lebanon 2003-2018



Source: Exhibit 3.3: Trend Plots of Average Mathematics Achievement Across Assessment Years. TIMSS 2019

International Results in Mathematics and Science. Downloaded from:

<https://timssandpirils.bc.edu/timss2019/international-results/>

As it can be observed that only between 2003 and 2007 did Lebanese students achieve a significant increase in their performance in mathematics. Even though there was no increase in absolute score, Lebanon was classified in a relatively higher position in the ranking in 2011 than it was observed in the previous assessments. Nevertheless, since 2011 there has been a significant decrease in both the position in the ranking and the nominal score in mathematics. Finally, **Lebanon has reached the lowest results in the last assessment in 2019.**

2.3. International benchmarks in mathematics achievements

The TIMSS framework proposes international benchmarks that aim to determine the percentage of students who achieved specific competencies in mathematics in each country. The definition of each international benchmark proposed by the TIMSS framework is listed in table 2.1.

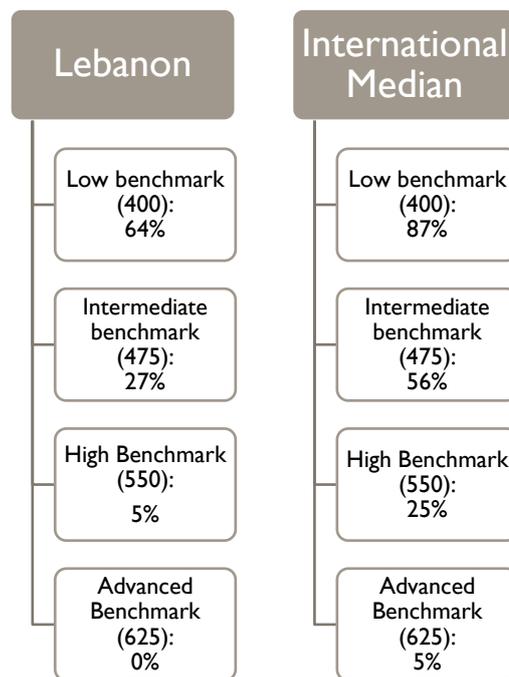
Table 2.1. International benchmarks in mathematics definitions, TIMSS 2019

Benchmark	Score	Description
Advanced Benchmark	625	Students can apply and reason in a variety of problem situations, solve linear equations, and make generalizations. They can solve a variety of fraction, proportion, and percent problems and justify their conclusions. They can understand linear functions and algebraic expressions. Students can use their knowledge of geometric figures to solve a wide range of problems involving angles, area, and surface area. They can calculate means and medians, and understand how changing data points can impact the mean. Students can interpret a wide variety of data displays to draw and justify conclusions, and solve multistep problems. They can solve problems involving expected values.
High Benchmark	550	Students can apply their understanding and knowledge in a variety of relatively complex situations. They can solve problems with fractions, decimals, ratios, and proportions. Students at this level show basic procedural knowledge related to algebraic expressions and equations. They can solve a variety of problems with angles, including problems involving triangles, parallel lines, rectangles, and congruent and similar figures. Students can interpret data in a variety of graphs and solve simple problems involving outcomes and probabilities.
Intermediate Benchmark	475	Students can apply basic mathematical knowledge in a variety of situations. They can solve problems involving whole numbers, negative numbers, fractions, decimals, and ratios. Students have some basic knowledge about properties of two-dimensional shapes. They can read and interpret data in graphs and have some rudimentary knowledge of probability.
Low Benchmark	400	Students have some knowledge of whole numbers and basic graphs

Source: IEA's Trends in International Mathematics and Science Study - TIMSS 2019. Downloaded from <http://timss2019.org/download>

The following Figure 2.4. presents the percentage of students classified in each of the international benchmarks in Lebanon and a comparison with the international results.

Figure 2.4. International benchmarks in Lebanon, compared to International Median

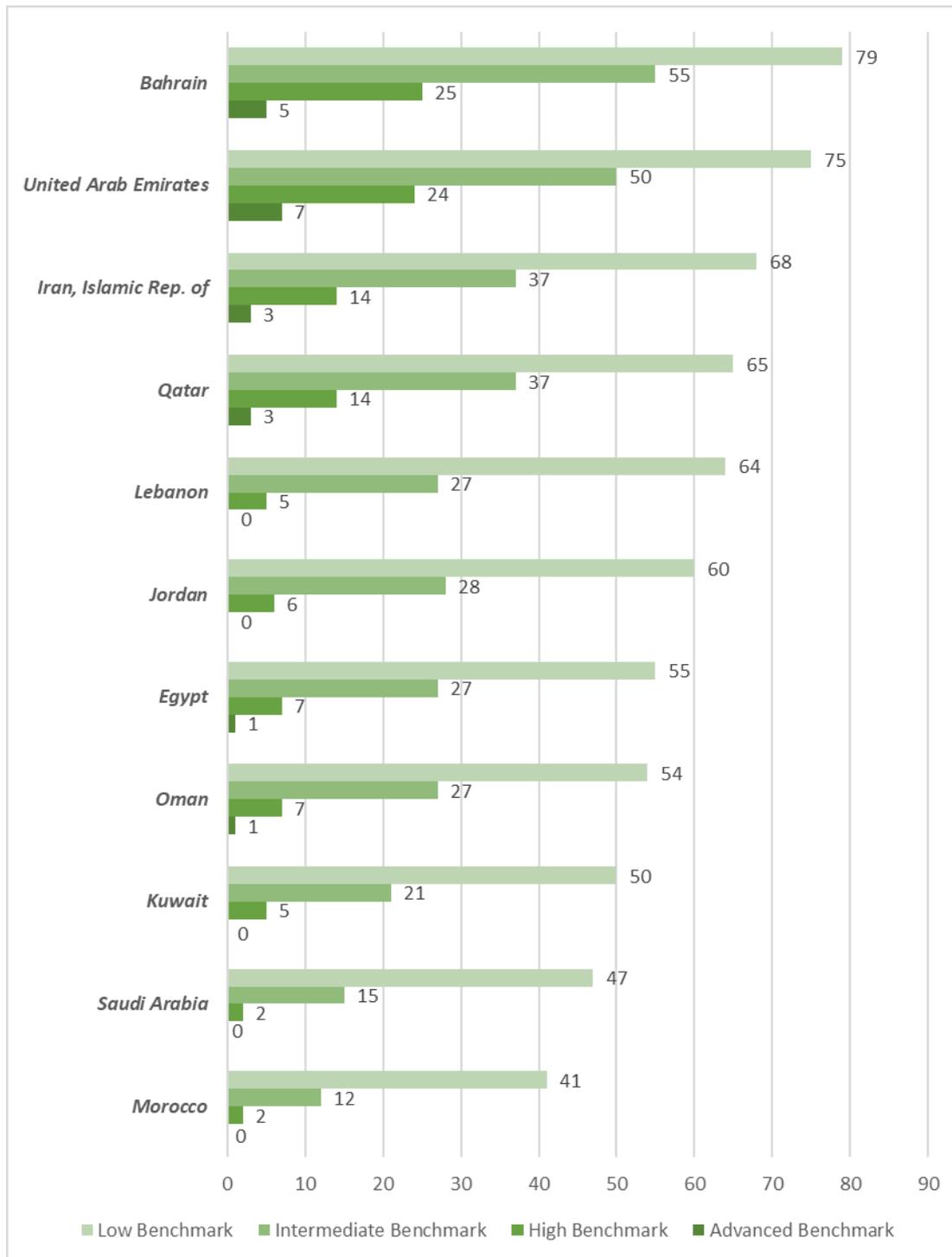


Source: Exhibit 3.8: Percentages of Students Reaching International Benchmarks of Mathematics Achievement. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirils.bc.edu/timss2019/international-results/>

Only 64% of students reached the lowest benchmark in Lebanon, compared to 87% internationally on average. This result means that more than $\frac{1}{3}$ of Lebanese eighth graders do not even have basic numbers and graphs knowledge. Moreover, significantly fewer students reached the higher benchmarks in Lebanon than the international average.

While the comparison between Lebanon and the international average shows that Lebanese students have a significant problem with math learning underperformance, the comparison of Lebanon to the other MENA countries brings a different perspective. Figure 2.5. presents the percentage of students reaching each international benchmark in mathematics in the MENA countries. Compared to other MENA countries, Lebanon's situation seems not as bad.

Figure 2.5. G8 International benchmarks in mathematics in Lebanon and other Mena Countries



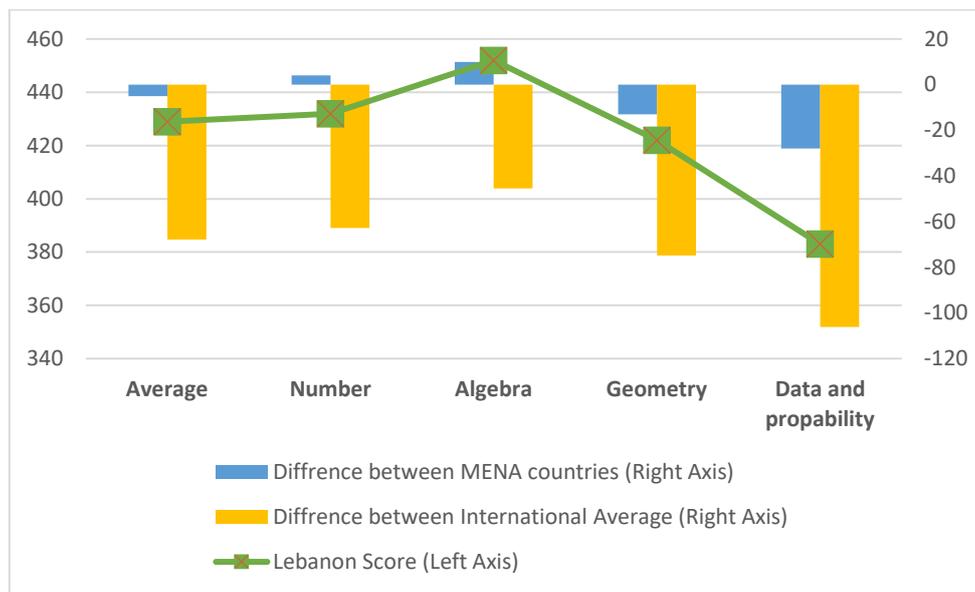
Source: Exhibit 3.8: Percentages of Students Reaching International Benchmarks of Mathematics Achievement. TIMSS 2019 International Results in Mathematics and Science. Downloaded from:

<https://timssandpirls.bc.edu/timss2019/international-results/>

2.4. Mathematics Content domains average results

The topics covered in mathematics assessment are Numbers, Algebra, Geometry, and Data and Probability. To illustrate the drawbacks of Lebanese students in the different topics of mathematics, an indicator showing the difference between the score of students in Lebanon and MENA countries and the international average was developed. Figure 2.6. presents the difference between Lebanon, the MENA countries, and the international average.

Figure 2.6. Difference between scores obtained in mathematics content domains – Lebanon, MENA countries and International average².



Source: Exhibit 3.14: Average Achievement in Mathematics Content Domains. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

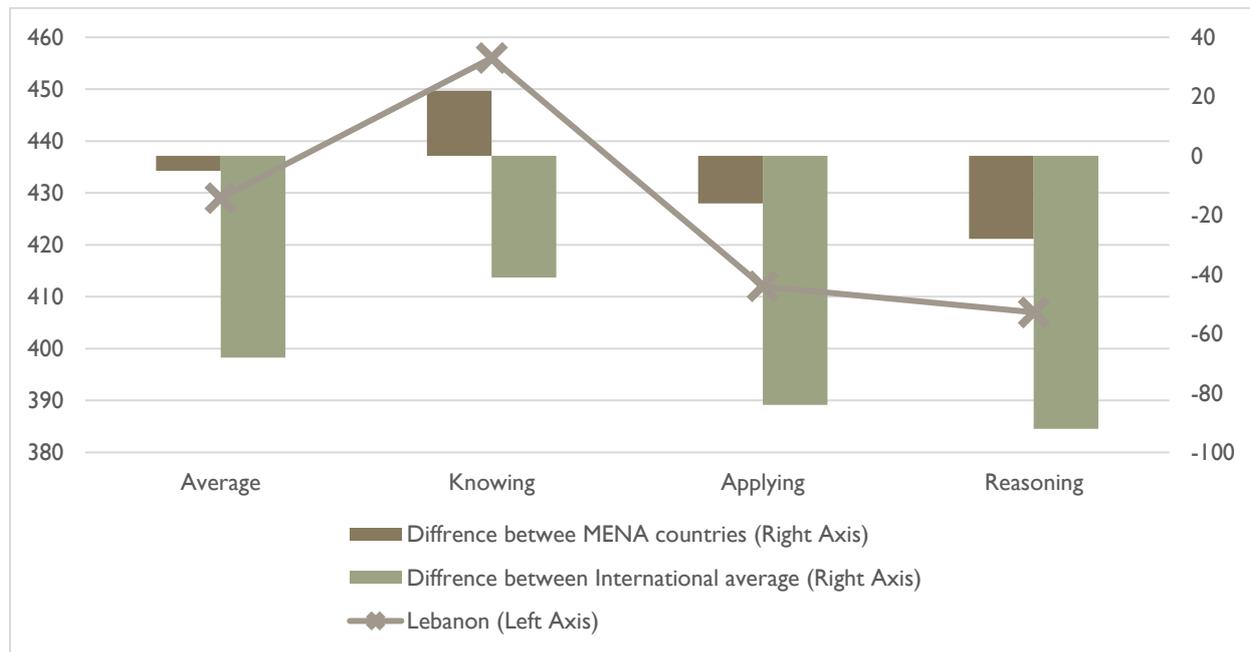
Lebanese students perform below the international average in all subdomains. The highest difference, equal to -106 points, was observed in the topic of Data and probability, while the lowest, equal to -46 points, was observed in Algebra. Compared to the average of MENA countries, Lebanon achieved relatively higher results in Algebra and Number (10 and 4 points above, respectively). According to the Lebanese curriculum, described in chapter I, it can be observed that in the subfields, which has just been introduced to the students, such as geometry, or have been described inadequately, such as Data and Probability, the disadvantage of Lebanese students was the highest. Based on the results, it is clear that Lebanese students lack a proper quality of teaching in all mathematics content domains. However, particularly more attention could be paid to curriculum related to topics in geometry and data and probability.

² In this analysis, data for Kuwait, South Africa and Saudi Arabia were missing

2.5. Mathematics Cognitive domains average results

Similarly to the analysis run for the content domains, we assess the situation of cognitive skills development. Figure 2.7. presents the average differences between the scores in cognitive domains achieved by students from Lebanon and MENA countries and between Lebanese students and the international average.

Figure 2.7. Difference between scores obtained in mathematics cognitive domains – Lebanon, MENA countries and International average³.



Source: Exhibit 3.17: Average Achievement in Mathematics Cognitive Domains. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

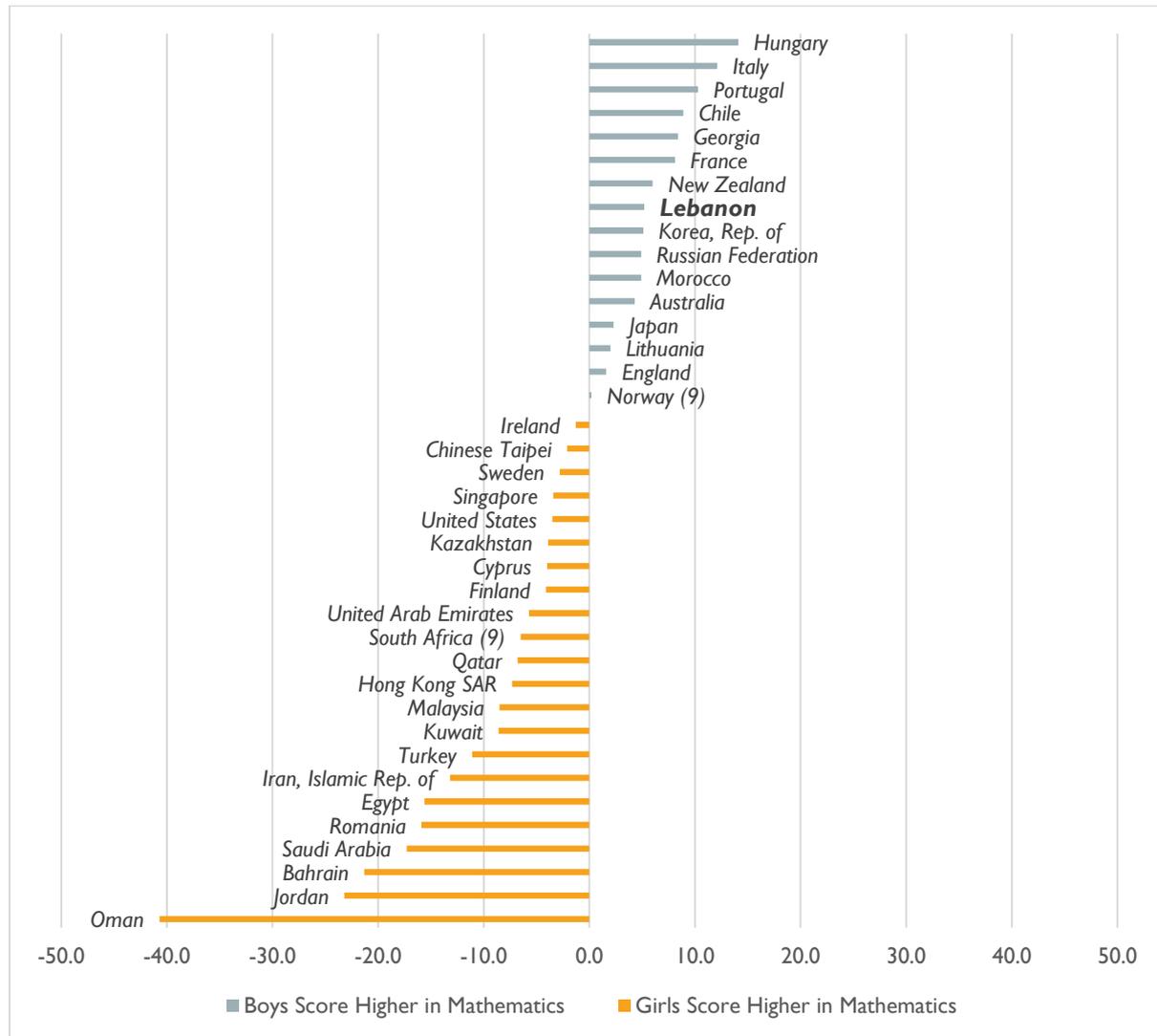
The results show a similar trend to the ones for the content domains. In particular, Lebanese students achieved lower results in every field compared to international average. Significant differences of similar magnitude were found in the Applying and Reasoning categories, while a more negligible difference was observed in the Knowing domain. Compared to students' performance in the other MENA countries, Lebanese eighth-graders scored notably better in the Knowing field but still performed worse in the Applying and Reasoning areas. These results show that Lebanese students cannot apply their knowledge or draw any conclusions practically afterward.

³ In this analysis, data for Kuwait, South Africa, Georgia and Saudi Arabia were missing.

2.6. Gender gap in mathematics performance

The gender achievement gap proved to be one of the significant issues in education worldwide. Therefore, closing this gap serves as a sign of maturity in the educational system. Figure 2.8. presents the difference between scores obtained by boys and girls in countries participating in TIMSS.

Figure 2.8. Difference between scores obtained by boys and girls in mathematics, TIMSS 2019.

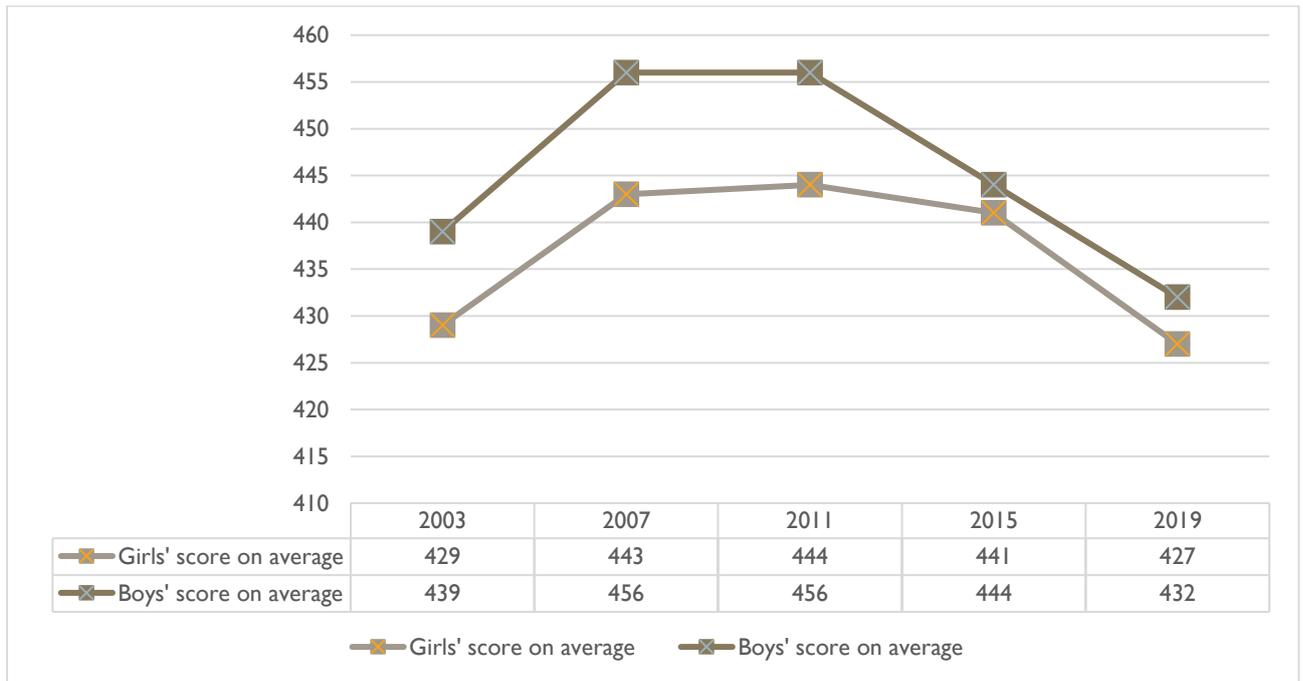


Source: Exhibit 3.5: Average Mathematics Achievement by Gender. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Lebanon is among the countries where boys scored higher than girls in mathematics, although the difference is neither large (5.2 points) nor statistically significant. This positive outcome only appears in Lebanon and Morocco when it comes to MENA countries. In the other MENA countries, girls significantly outperformed boys in mathematics (up to 40 points in Oman). Figure 2.9. presents the average scores in mathematics by gender in the years 2003-2019 in Lebanon.

In recent years there were no large differences between boys and girls in Lebanon, as confirmed by the results of the 2019 assessment. However, the most considerable difference between genders was observed in the second assessment that Lebanon participated in 2007, equal to 13 points. Since 2011, the gender gaps slightly decreased in Lebanon.

Figure 2.9 Average achievement in mathematics in Lebanon by gender.

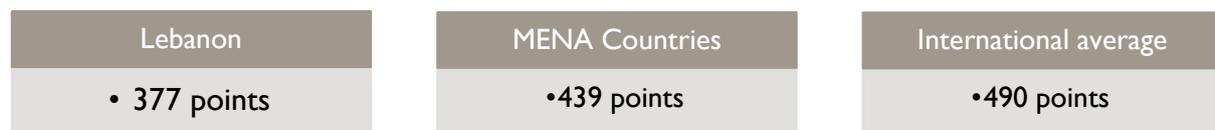


Source: Exhibit 3.5: Average Mathematics Achievement by Gender. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

2.7. Average achievement in science

Similarly to mathematics, this chapter presents the performance of eighth-graders in Lebanon in science compared to the international average and the other MENA⁴ countries. Figure 2.10. shows the average achievements in science in Lebanon, the MENA countries, and the international average.

Figure 2.10. Average results of G8 TIMSS assessment in science – Lebanon, MENA countries, international average



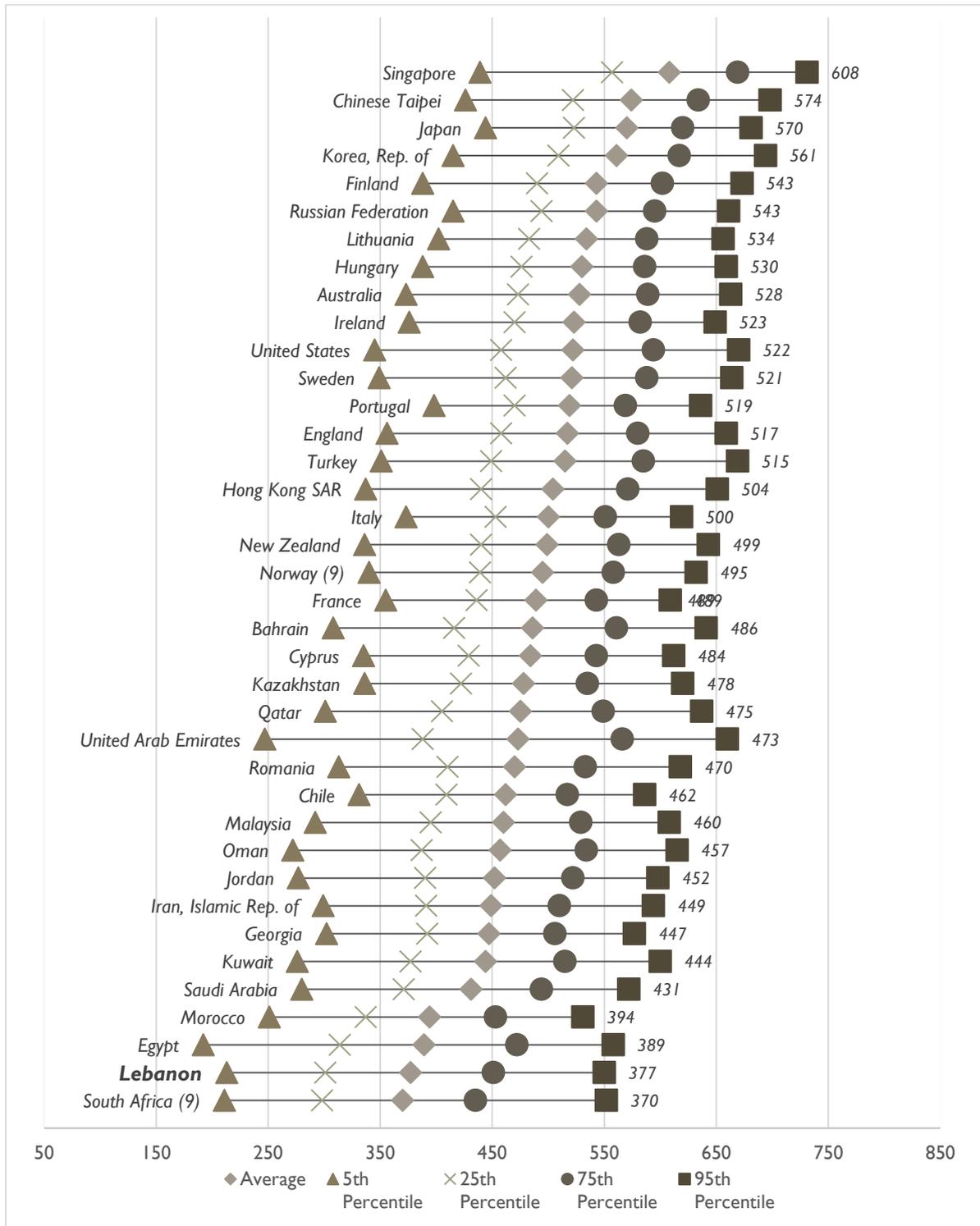
Source: Exhibit 4.1: Average Science Achievement and Scale Score Distributions. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Lebanese students achieve significantly worse results than the average in MENA countries and international average, with the difference exceeding 100 points in the latter case. Moreover, the differences in the case of science are notably worse than in the case of mathematics. Figure 2.11. presents the distribution of average scores obtained in the TIMSS science assessment by country.

Lebanon classifies 38th out of 39 participating countries and is placed among the worst MENA countries. Contrary to the mathematics assessment results, also the inequalities are extremely high.

⁴ According to UNICEF. Countries listed: Algeria, Bahrain, Djibouti, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Sudan, Saudi Arabia, Syria, Tunisia, United Arab Emirates, Yemen.

Figure 2.11. Distribution of average results of G8 TIMSS assessment in science. The numbers on the right side state for the average results

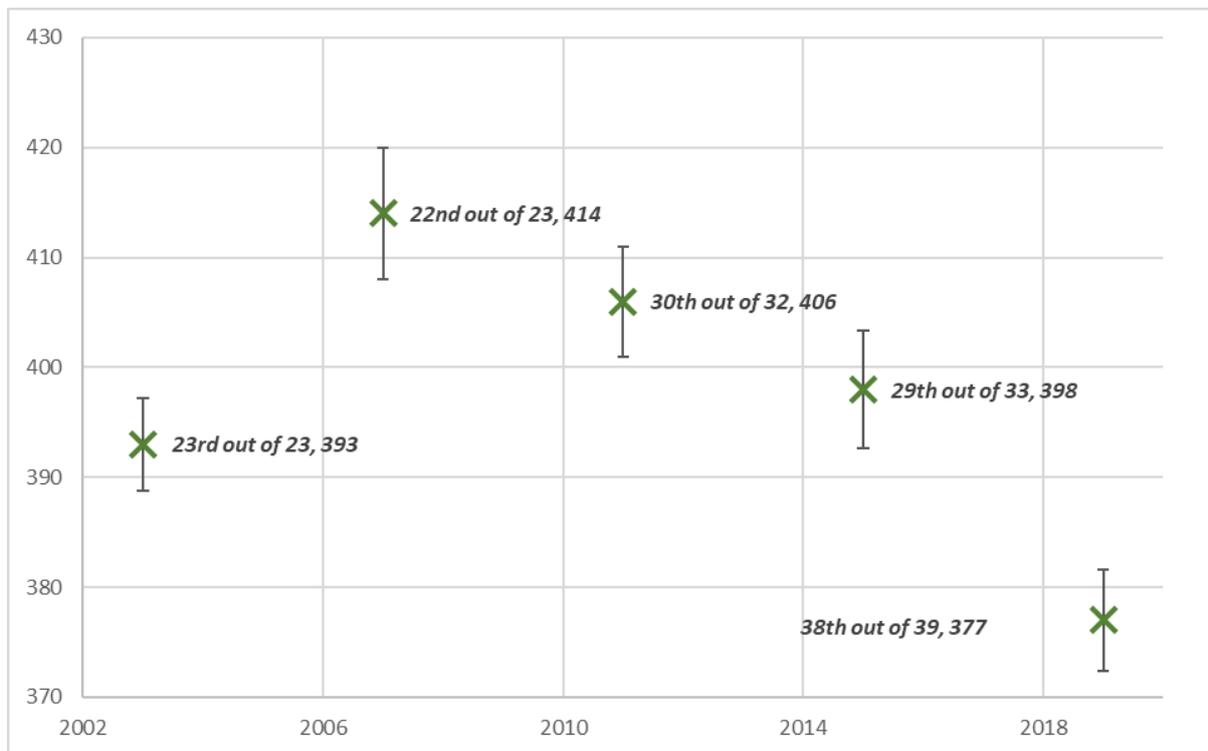


Source: Exhibit 4.1: Average Science Achievement and Scale Score Distributions. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

2.8. Trends in science achievements

To give a context of low achievement in science, Lebanese eighth-graders change in the results over the years was presented. Figure 2.12. shows the average results in science in Lebanon since 2003.

Figure 2.12. Average results G8 Science Lebanon 2003-2018



Source: Exhibit 4.3: Trend Plots of Average Science Achievement Across Assessment Years. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In general, results in science have dropped dramatically since 2007, and in the latest assessment, Lebanon achieved the lowest score since the beginning of its participation. However, the position of Lebanon has not changed over the years. Across assessments, Lebanon took one of the lowest positions in the ranking.

2.9. International benchmarks in science achievements

The TIMSS assessment framework proposes international benchmarks aimed at describing the competencies of students according to their scores. Table 3.2. shows the definition of the international benchmarks in science.

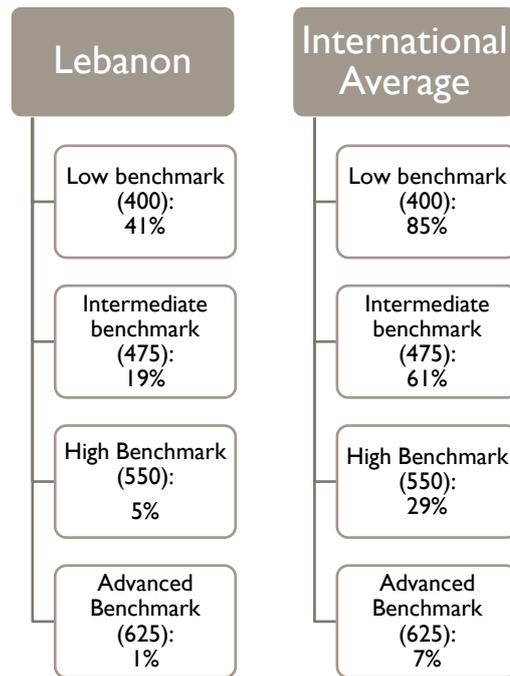
Table 2.2. International benchmarks in science definitions – TIMSS 2019

Benchmark	Score	Description
Advanced Benchmark	625	Students communicate understanding of concepts related to biology, chemistry, physics, and Earth science in a variety of contexts. Students can classify animals into taxonomic groups. They can apply knowledge of cell structures and their functions. Students show some understanding of diversity, adaptation, and natural selection. They also recognize the interdependence of populations of organisms in an ecosystem. Students demonstrate knowledge of the composition of matter and the periodic table of the elements. Students use physical properties of matter to sort, classify, and compare substances and materials. They also recognize evidence that a chemical reaction has occurred. Students communicate understanding of particle spacing and motion in different physical states. Students apply knowledge of energy transfer and electrical circuits, can relate the properties of light and sound to common phenomena, and demonstrate understanding of forces in everyday contexts. Students communicate understanding of Earth's structure, physical features, and processes. They demonstrate knowledge of the Earth's resources and their conservation.
High Benchmark	550	Students apply understanding of concepts from biology, chemistry, physics, and Earth science. Students can apply knowledge of the characteristics of groups of animals, life processes in humans, cells and their functions, genetic inheritance, ecosystems, and nutrition. Students show some knowledge and understanding of the composition and properties of matter and chemical reactions. They can apply basic knowledge of energy transformation and transfer, electrical circuits, properties of magnets, light, sound, and forces. They can apply knowledge of Earth's physical features, processes, cycles, and history, and show some understanding of Earth's resources and their use.
Intermediate Benchmark	475	Students show and apply some knowledge of biology and the physical sciences. Students demonstrate some knowledge of characteristics of animals and apply knowledge of ecosystems. They show some knowledge of the properties of matter, chemical changes, and a few physics concepts
Low Benchmark	400	Students show limited understanding of scientific principles and concepts and limited knowledge of science facts.

Source: IEA's Trends in International Mathematics and Science Study - TIMSS 2019. Downloaded from <http://timss2019.org/download>

Figure 2.13. presents the percentage of students corresponding to the international benchmarks in Lebanon and the international average.

Figure 2.13. International benchmarks in Lebanon, compared to international median

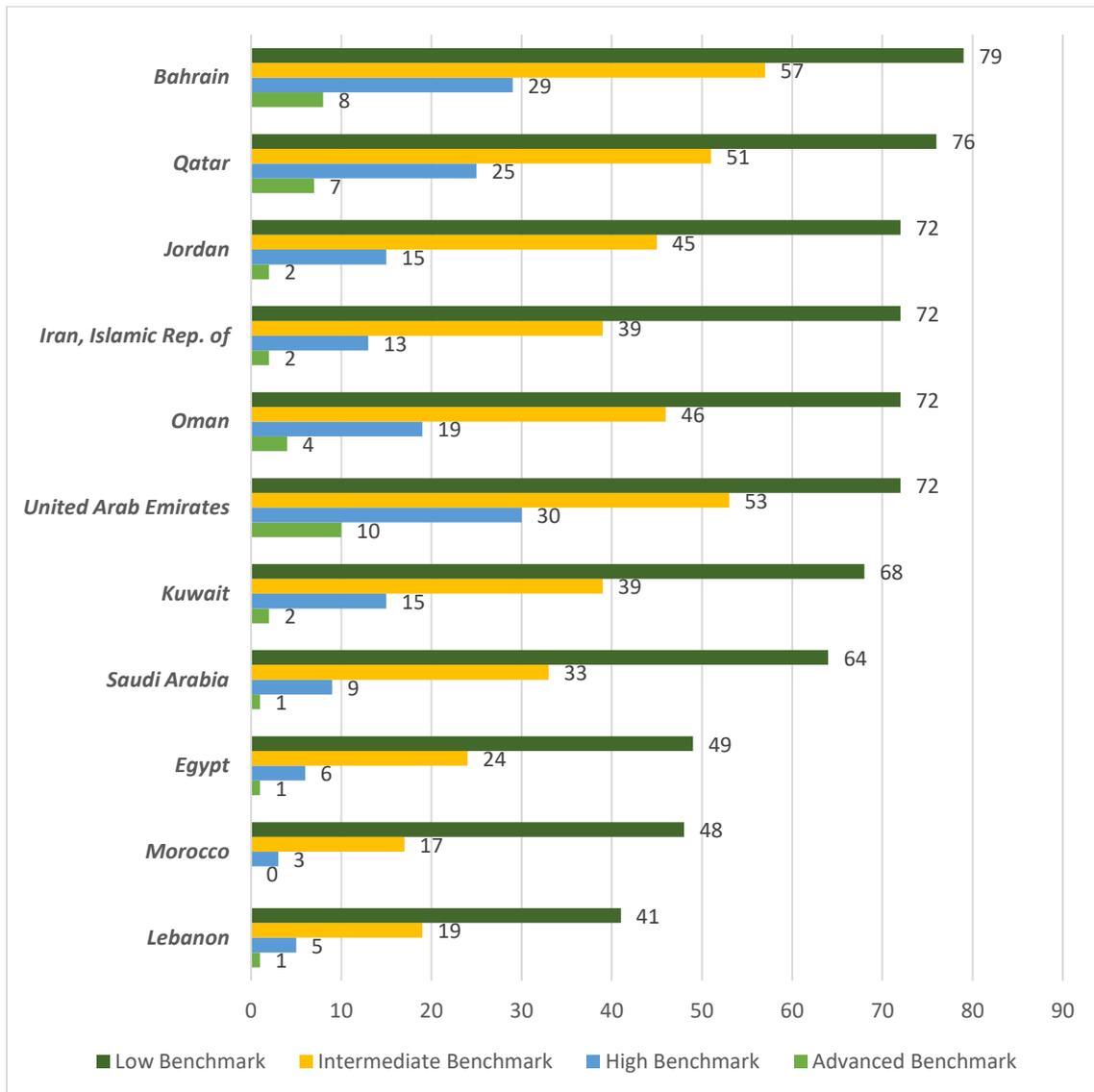


Source: Exhibit 4.8: Percentages of Students Reaching International Benchmarks of Science Achievement. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In Lebanon, only 41% of students reached the lowest benchmark indicating that more than a half of students do not possess the most basic knowledge in the field. This percentage and the share of students reaching the higher benchmark show a worrying picture. Figure 2.14. presents the percentage of students reaching international benchmarks across MENA countries.

The smallest share of students in Lebanon reaches the lowest international science benchmark, similar to Morocco and Egypt, while better performance characterizes other MENA countries. This is in contrast to the case of mathematics.

Figure 2.14. G8 International benchmarks in science in Lebanon and other Mena Countries



Source: Exhibit 4.8: Percentages of Students Reaching International Benchmarks of Science Achievement. TIMSS 2019

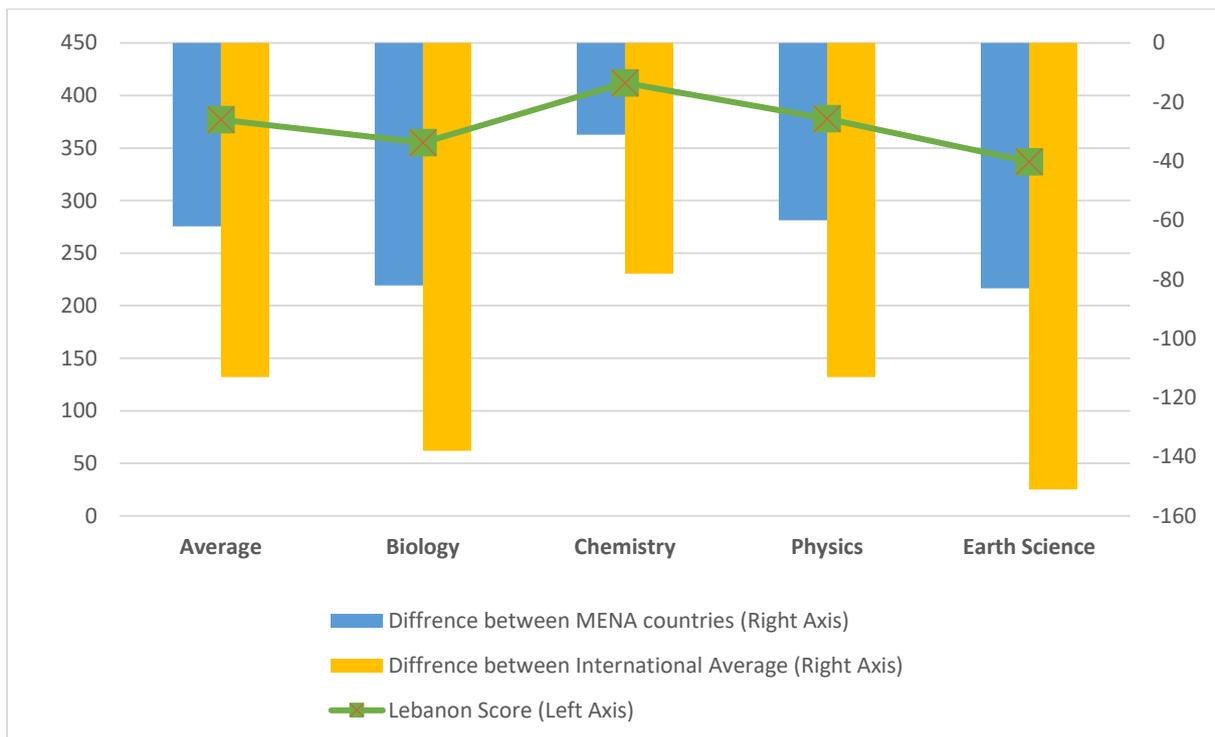
International Results in Mathematics and Science. Downloaded from:

<https://timssandpirls.bc.edu/timss2019/international-results/>

2.10. Science Content domains average results

As in Mathematics, each of the subdisciplines assessed in science can be analyzed separately. Figure 2.15. presents the difference in science content domains in Lebanon compared to the MENA countries and the international average.

Figure 2.15. Difference between scores obtained in science content domains – Lebanon, MENA countries and International average⁵.



Source: Exhibit 4.14: Average Achievement in Science Content Domains. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

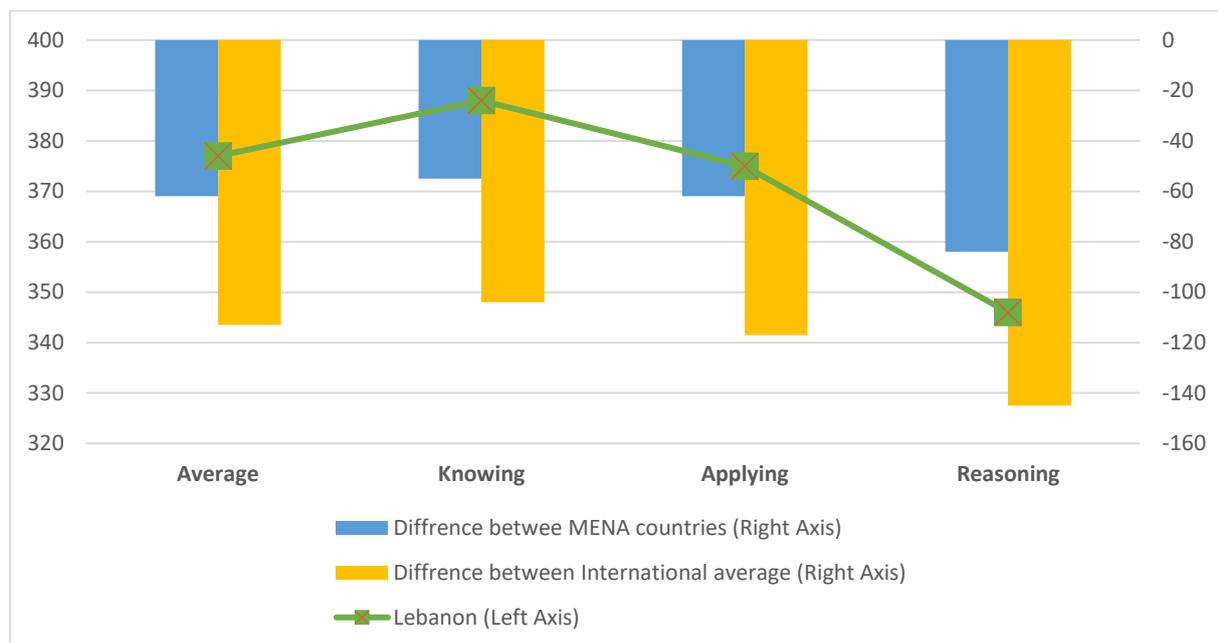
Lebanese students received relatively the lowest results in Earth Science and Biology both when compared to the international average (with the difference being equal to -151 points and -138 points, respectively) and to the other MENA countries (respectively -83 points and -82 points).

⁵ In this analysis, data for Kuwait and Saudi Arabia were missing.

2.11. Science Cognitive domains average results

The results in science cognitive subdomains from Lebanon were compared to MENA countries and the international average to assess Lebanese students' relative performance. Figure 2.16. presents the difference between the scores obtained in the science cognitive domains between Lebanon and MENA countries as well as the international average.

Figure 2.16. Difference between scores obtained in science cognitive domains – Lebanon, MENA countries and International average⁶.



Source: Exhibit 4.17: Average Achievement in Science Cognitive Domains. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

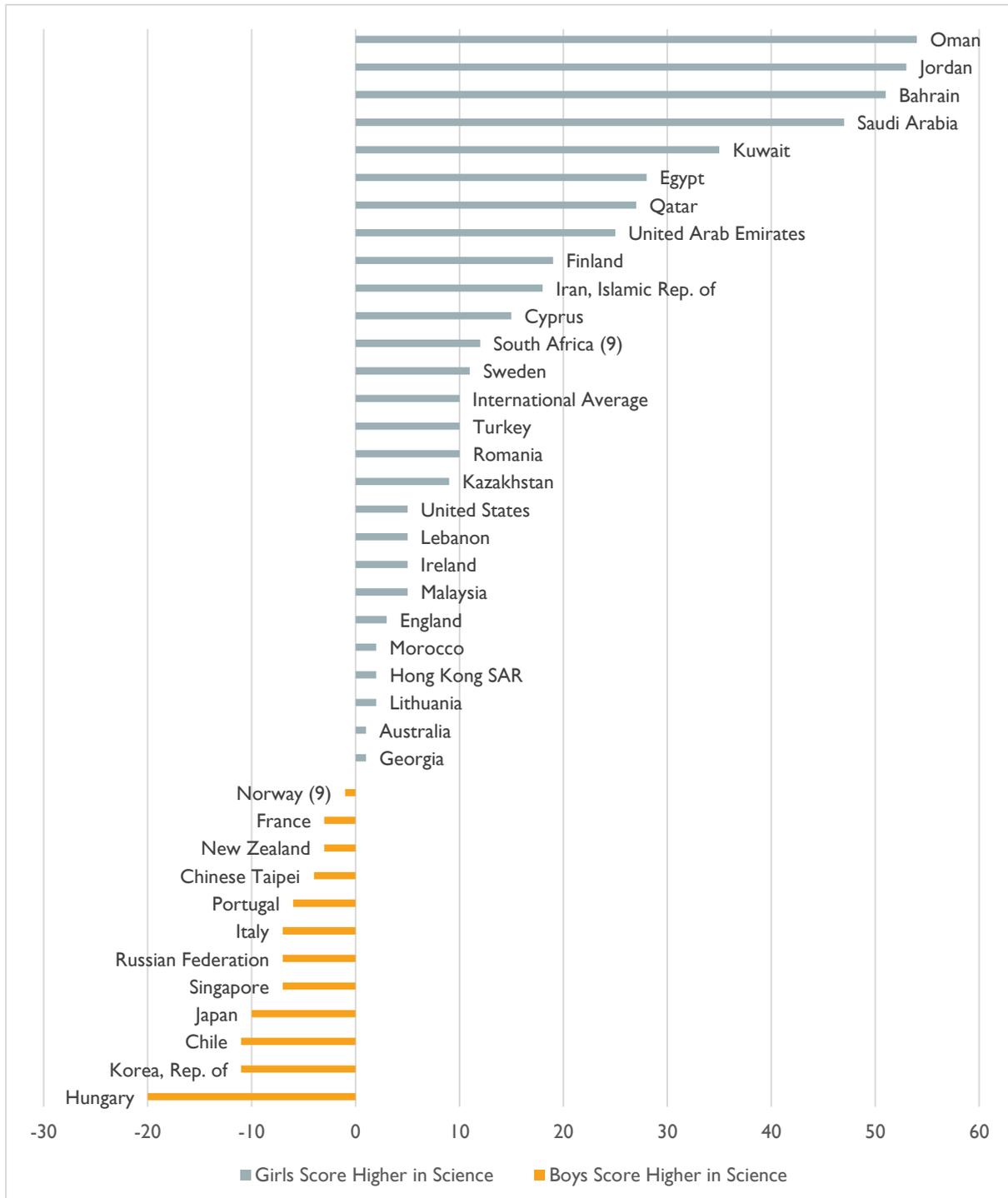
As in the case of mathematics, Lebanese students were reported to have difficulties in Applying and Reasoning and performing not much better in the Knowing subdomain. To improve the education quality in Lebanon, there is a need to provide a curriculum that can strengthen the applying and reasoning skills particularly.

⁶ In this analysis, data for Kuwait and Saudi Arabia were missing.

2.12. Gender gap in science performance

Similarly to the case of mathematics, the gender gap in students' performance in science can reflect inequalities in the education system. Figure 2.17. presents the difference between scores obtained by boys and girls.

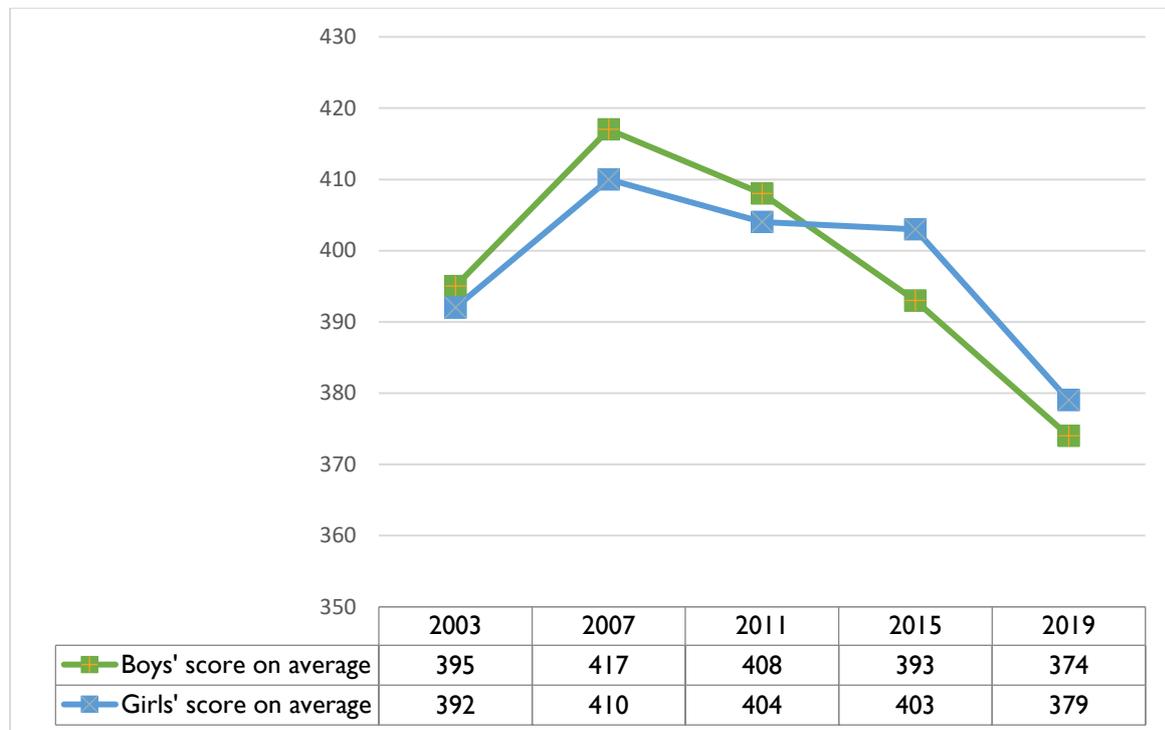
Figure 2.17. Difference between scores obtained by boys and girls in science



Source: Exhibit 4.5: Average Science Achievement by Gender. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In Lebanon, girls scored slightly better than boys, with the difference not being statistically significant. This is in contrast with the other MENA countries, where large differences between genders are observed. Figure 2.18. presents the average achievements in science with respect to gender in Lebanon.

Figure 2.18 Average achievement in science in Lebanon with respect to genders.



Source: Exhibit 4.5: Average Science Achievement by Gender. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Over the years, there were no vast differences in science achievement between genders in Lebanon. However, it can be noted that since 2015 the boys' advantage was inverted, and girls outperformed boys in the last two rounds of TIMSS.

Chapter 3. Performance inequality and home environment

This chapter discusses the relationship between students' educational achievements and factors related to the home environment, such as home resources, the early literacy, and numeracy activities, and preprimary education experience. Since both pre-school educational activities and preprimary education attendance proved to be significantly correlated to one another and with achievement, this chapter will also discuss how those relate to differences in inequality of student performance in Lebanon.

3.1. Home resources

In order to work outside school, students need proper resources at home, such as books or the internet, or even be able to ask their parents for help in doing homework. The TIMSS framework proposes an indicator that measures the accessibility to resources. Figure 3.1. presents a description of different levels of accessibility to supportive resources at home.

Figure 3.1. Description of different levels of accessibility to supportive resources at home, TIMSS 2019

Few resources

- Number of books at home: 0-25
- None home study support (i.e. internet connection or own room)
- Parents finished their education in upper secondary school or earlier

Some resources

- Number of books at home: 26-100
- Internet connection or own room at home
- Parents finished post-secondary school

Many resources

- Number of books at home > 100
- Both own room and internet connection at home
- Parents finished university or higher

Source: Exhibit 5.4: Home Educational Resources. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Three categories are formed according to the definition. Students with Few resources have less than 25 books at home or even only ask their parents for help. These students might find it extremely difficult to access support resources, and their parents' knowledge may be insufficient to complete all the tasks. Students who have Some resources have access to around 26-100 books at home, an internet connection, and their parents are expected to have better knowledge and a better sense of educational needs. Finally, students with Many resources have access to more than 100 books, have their room and connection to the internet, and their parents have obtained university degrees.

Having classified students depending on their availability of resources, it is possible to assess how this affects their mathematics performance in Lebanon compared to the international average. Table 3.1. presents the average results in the mathematics assessment regarding the accessibility to supportive learning materials in Lebanon, MENA countries, and the international average.

Table 3.1. Average score obtained in G8 TIMSS Mathematics assessment 2019 with respect to the accessibility to supportive learning resources in Lebanon, MENA countries and on International average.

Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Few Resources	22% (1.3)	396 (3.9)	13% (0.1)	433 (1.2)	22%	395
Some Resources	73% (1.3)	436 (3.2)	73% (0.2)	488 (0.5)	71%	434
Many Resources	6% (0.5)	473 (6.0)	14% (0.1)	546 (1.0)	7%	476

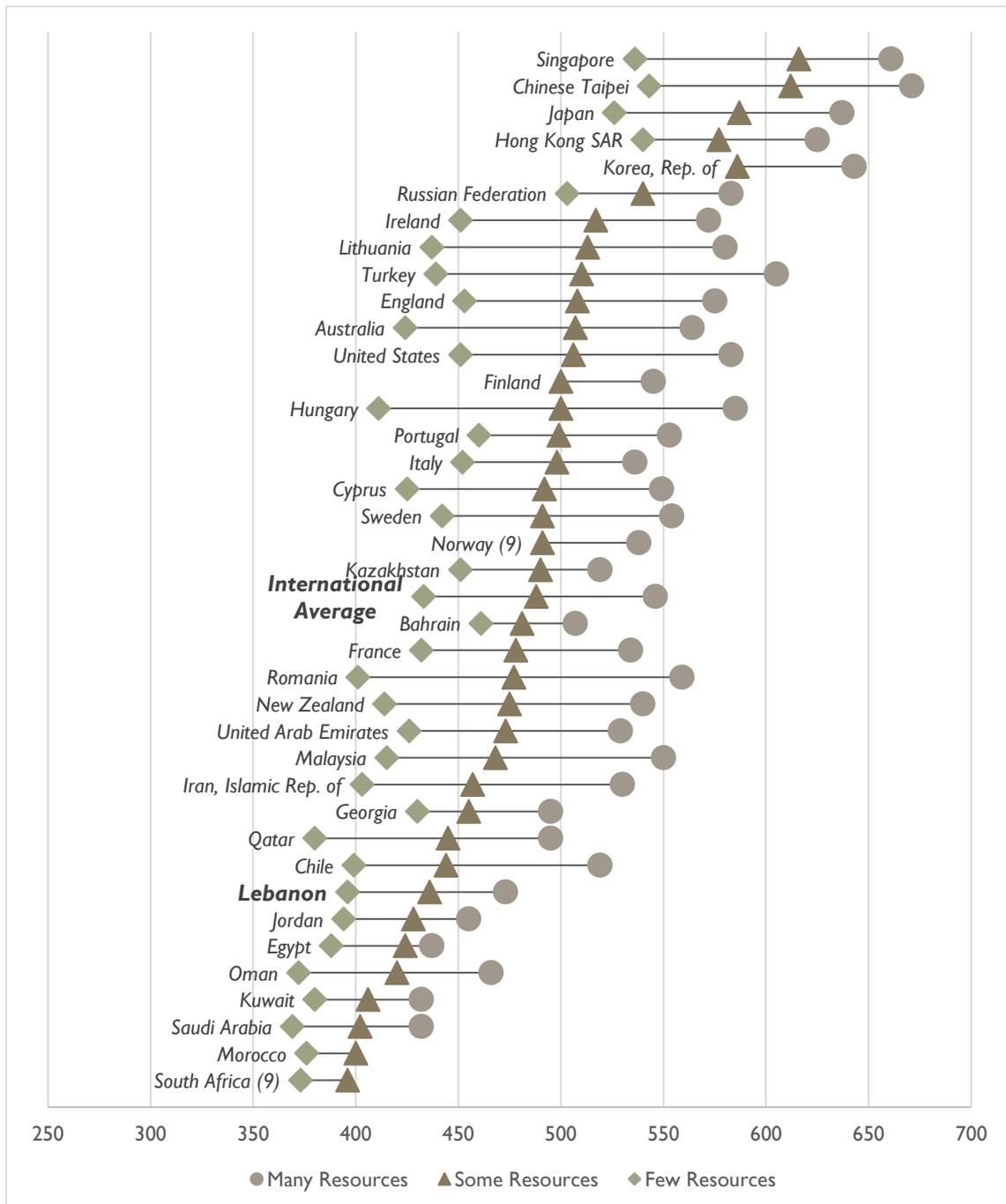
Source: Exhibit 5.5: Home Educational Resources. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In all the groups, the largest share of students have access to Some supportive resources at home. Almost ¼ of eighth-graders from Lebanon and MENA countries were reported to have access to only Few supportive learning resources. The share of Few resources as the average of all participating countries is almost twice lower.

To account for the effect of the availability of resources on the performance in mathematics, it is possible to compare the score obtained in each country with respect to the accessibility of resources. Figure 3.2. presents the average scores in TIMSS mathematics assessment 2019, by the accessibility of home resources in the participating countries.

Figure 3.2 Average score obtained in G8 TIMSS Mathematics assessment 2019 with respect to the accessibility to supportive learning resources in participating countries.



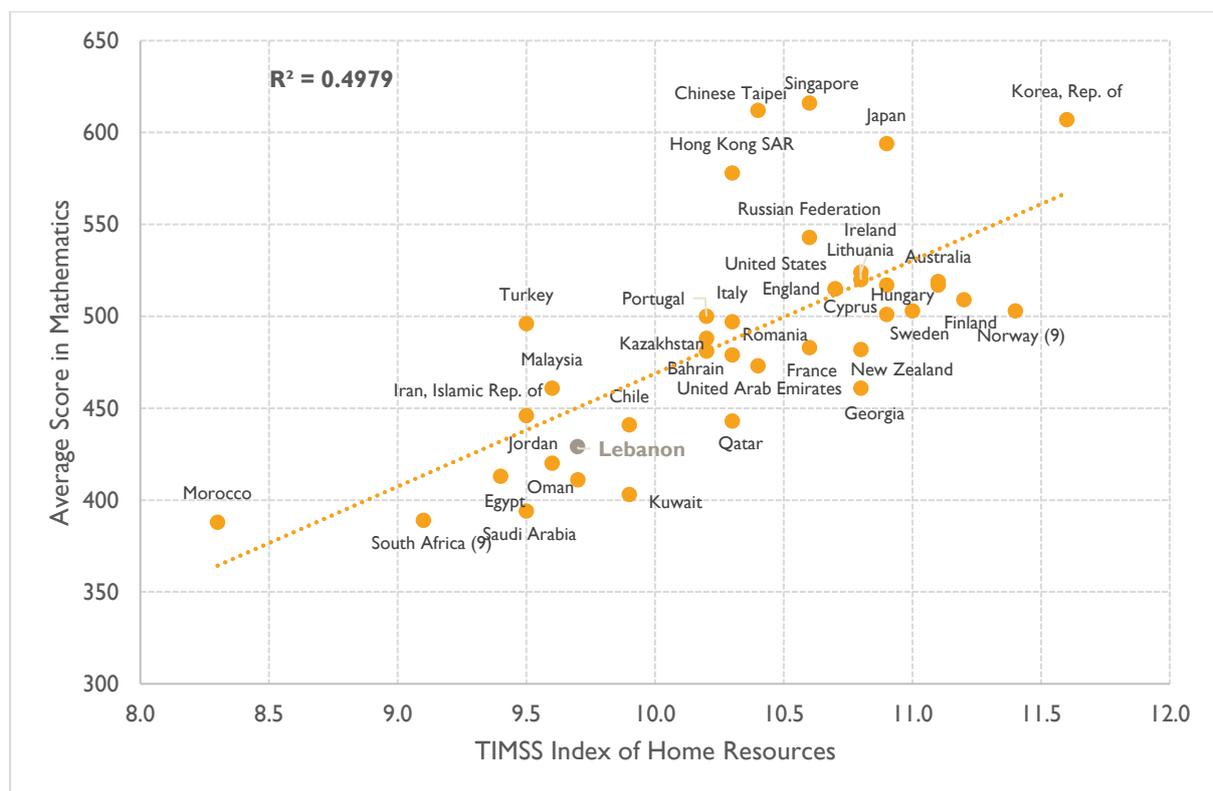
Source: Exhibit 5.5: Home Educational Resources. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirils.bc.edu/timss2019/international-results/>

The most considerable inequalities in achievement by the access to resources are observed in Turkey, Hungary and Romania. It is worth noting that the average difference in scores between the categories "Many resources" and "Some resources" is rather small in low-performing countries.

In the majority of the countries participating in the TIMSS assessment, the average score was reflected in the TIMSS index of Home resources. Only the highest-achieving Asian countries and economies, such as Singapore, Hong Kong, and Japan, outlied the trendline. In Lebanon, the average score was slightly below the trendline, which translates into underperformance with respect to the accessibility of home resources. The same applies to other MENA countries (besides Iran and Morocco), which were also found below the trendline. It is worth mentioning that the TIMSS Index of Home Resources explains almost 50% of the variability of the average score in mathematics in the countries and economies participating in the TIMSS assessment.

Figure 3.3. Average score obtained in G8 TIMSS Mathematics Assessment in 2019 against the TIMSS Index of Home Resources



Source: Exhibit 5.5: Home Educational Resources. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

The same analysis was also conducted for the results in science. Table 3.2. presents average results in science assessment with respect to the accessibility to home resources in Lebanon, MENA countries and on an international average

Table 3.2. Average score obtained in G8 TIMSS Science assessment 2019 with respect to the accessibility to supportive learning resources in Lebanon, MENA countries and on International average.

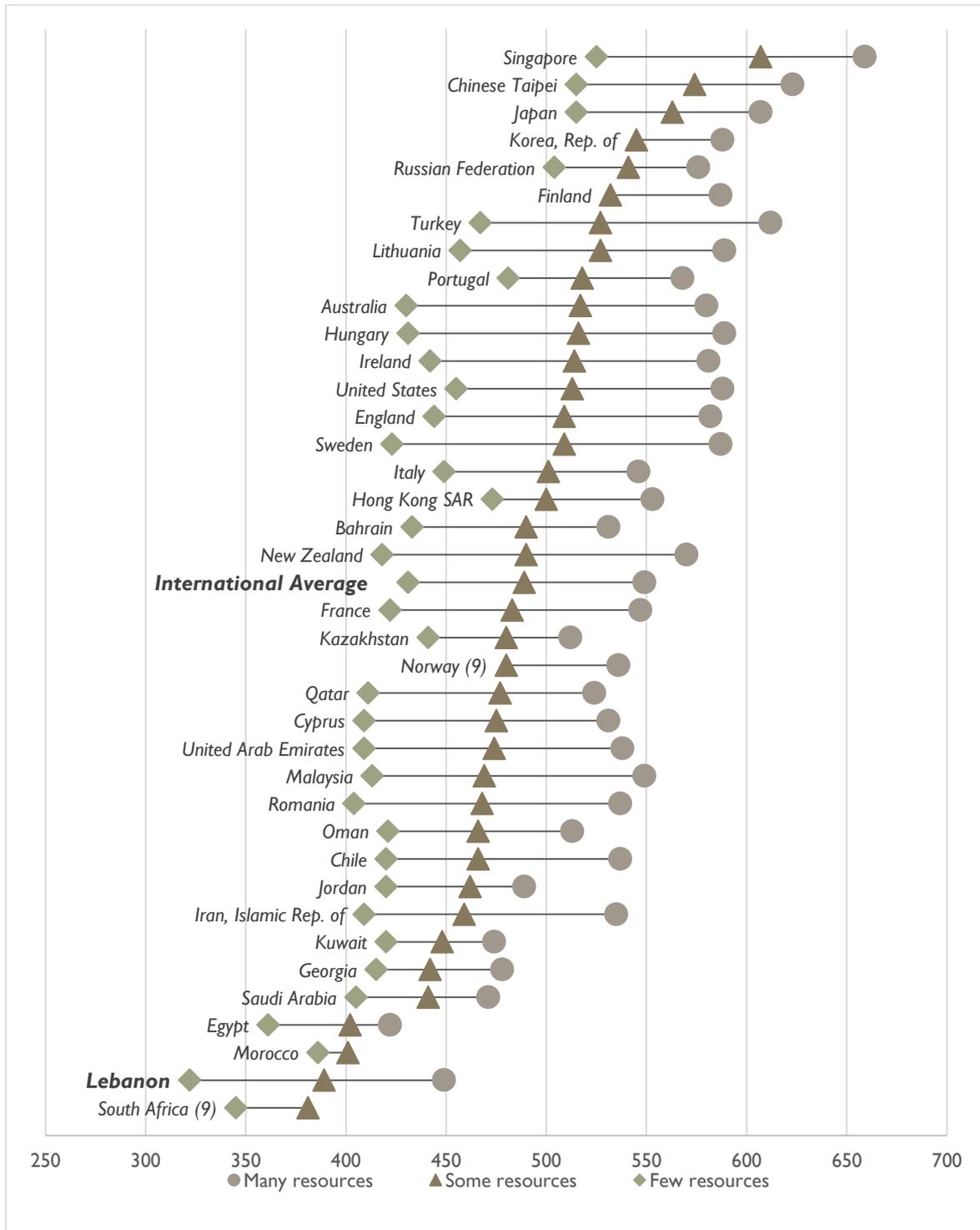
Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Few Resources	22% (1.3)	322 (6.4)	13% (0.1)	431 (1.2)	22%	400
Some Resources	73% (1.3)	389 (4.8)	73% (0.2)	489 (0.6)	71%	446
Many Resources	6% (0.5)	449 (8.9)	14% (0.1)	549 (1.0)	7%	495

Source: Exhibit 5.6: Home Educational Resources. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirils.bc.edu/timss2019/international-results/>

There is a significantly stronger association between home resources and students' achievements in Lebanon than the presented benchmarks. To fully understand the significance of home resources when learning science, the differences in assessment scores between groups in participating countries were analysed. Figure 3.4. presents average scores obtained in the TIMSS science assessment by the three levels of home resources.

Figure 3.4. Average score obtained in G8 TIMSS Science assessment 2019 with respect to the accessibility to supportive learning resources in participating countries.

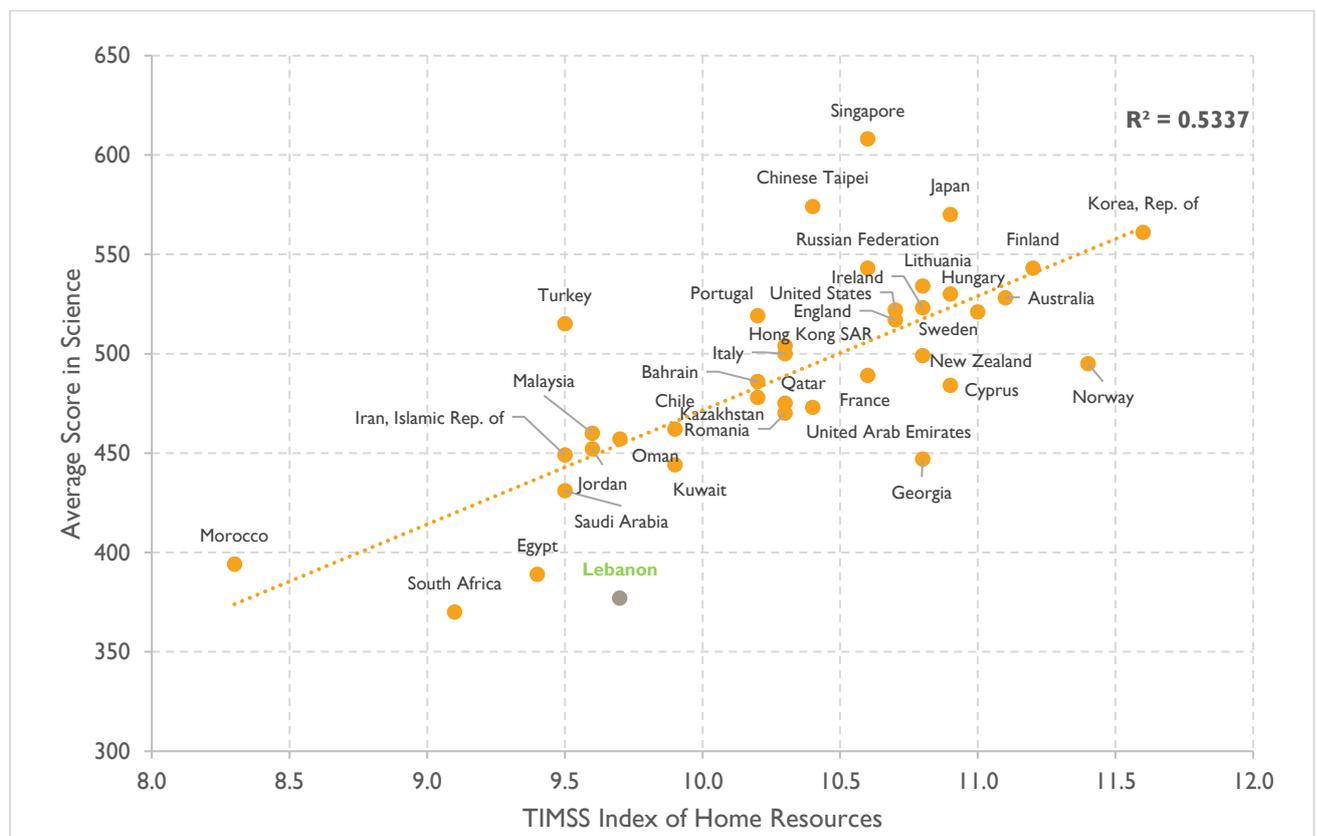


Source: Exhibit 5.6: Home Educational Resources. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In most countries, the educational differences in the achievements due to the accessibility of home resources are pretty vast, and Lebanon is where the relative differences between groups are the largest. These differences might reflect the socioeconomic disparities between Lebanese students, as the accessibility to supportive resources at home is strongly correlated with the socioeconomic status. The distributions of the science and mathematics achievements have shown the positive influence of home resources on students' performance. The performance of Lebanese students turned out to be highly sensitive to the increase in the accessibility to home resources, as the increase in resources is corresponding to fairly higher average results in mathematics and science.

Figure 3.5. Average score obtained in G8 TIMSS Science assessment 2019 against the index of home resources



Source: Exhibit 5.6: Home Educational Resources. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

3.2. Language spoken at home

The different language of assessment and that spoken at home is often perceived as one of the primary reasons for the low performance of Lebanese students. The language of learning is crucial when it comes to an understanding the material taught. In Lebanon, students begin to be taught in a foreign language at 13, in 7th grade. Such policy may cause difficulties in acquiring knowledge if the understanding of the foreign language is not fluent.

TIMSS questionnaires consist of questions concerning the frequency of using the language of the test at home. Table 3.3. presents the average results scored in the mathematics assessment for the frequencies of using the language of test at home.

Table 3.3. Average score obtained in G8 TIMSS Mathematics assessment 2019 with respect to the frequency of using the language of instruction at home in Lebanon, MENA countries and on International average.

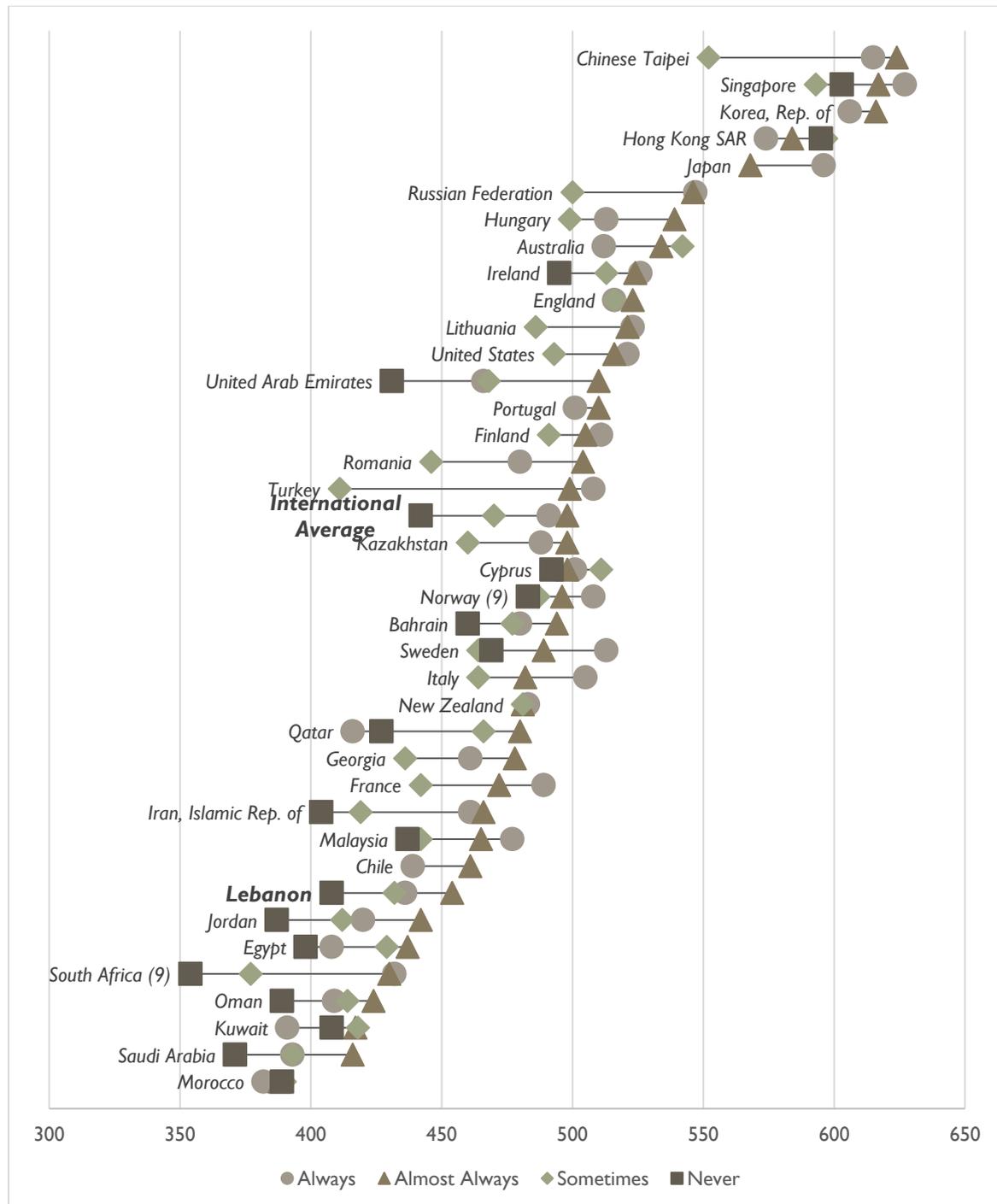
Category	Lebanon		International Average		MENA Countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Never	23% (1.2)	408 (4.4)	4% (0.1)	442 (2.0)	9%	407
Sometimes	58% (1.2)	432 (3.3)	15% (0.1)	470 (1.4)	27%	429
Almost Always	12% (0.7)	454 (4.7)	15% (0.1)	498 (0.9)	16%	448
Always	7% (0.6)	436 (5.9)	66% (0.2)	491 (0.6)	48%	424

Source: Exhibit 5.9: Students Speak the Language of the Test at Home. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirils.bc.edu/timss2019/international-results/>

The percentage of Lebanese students who speak the language of teaching at home is only 7%, which is notably less than in MENA countries and much less than the international average. In Lebanon, the largest share of students who never use their language of instruction at home and the lowest share of

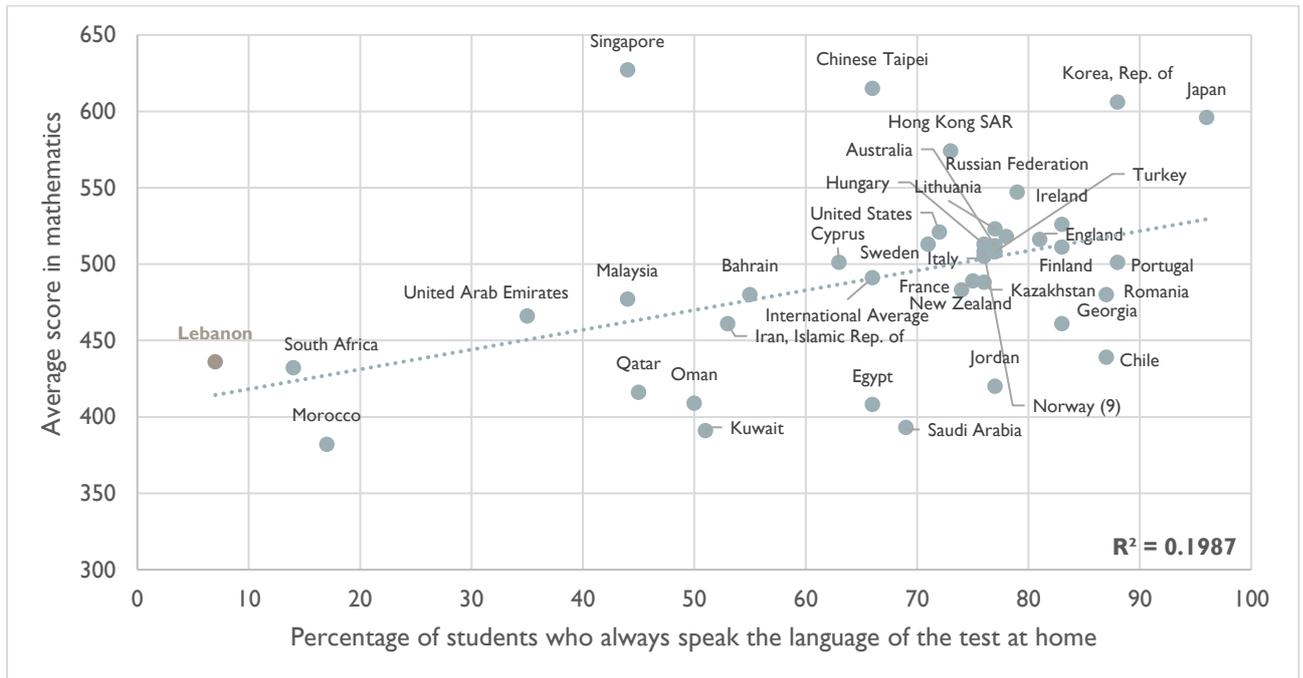
students who always use it were found. Almost ¼ of Lebanese students are learning STEM subjects in a foreign language. To further account for the impact of the language of instruction on scores, the assessment results among all the participating countries were presented by the frequency of using a foreign language at home (Figure 3.6).

Figure 3.6. Average score obtained in G8 TIMSS mathematics assessment 2019 with respect to the frequency of using the language of instruction at home in participating countries.



Source: Exhibit 5.9: Students Speak the Language of the Test at Home. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Figure 3.7. The Average Score in mathematics against the share of students who always speak the language of the test at home



Source: Exhibit 5.9: Students Speak the Language of the Test at Home. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirils.bc.edu/timss2019/international-results/>

Results show that in those countries, where the share of students that are not speaking the language of the test at home, the correlation between the achievement and consistency of spoken language is relatively higher. Similarly to mathematics, it is worth investigating the impact of the language of instruction on learning science. Table 3.4. presents average scores obtained by students in science with respect to the frequency of using the language of education at home.

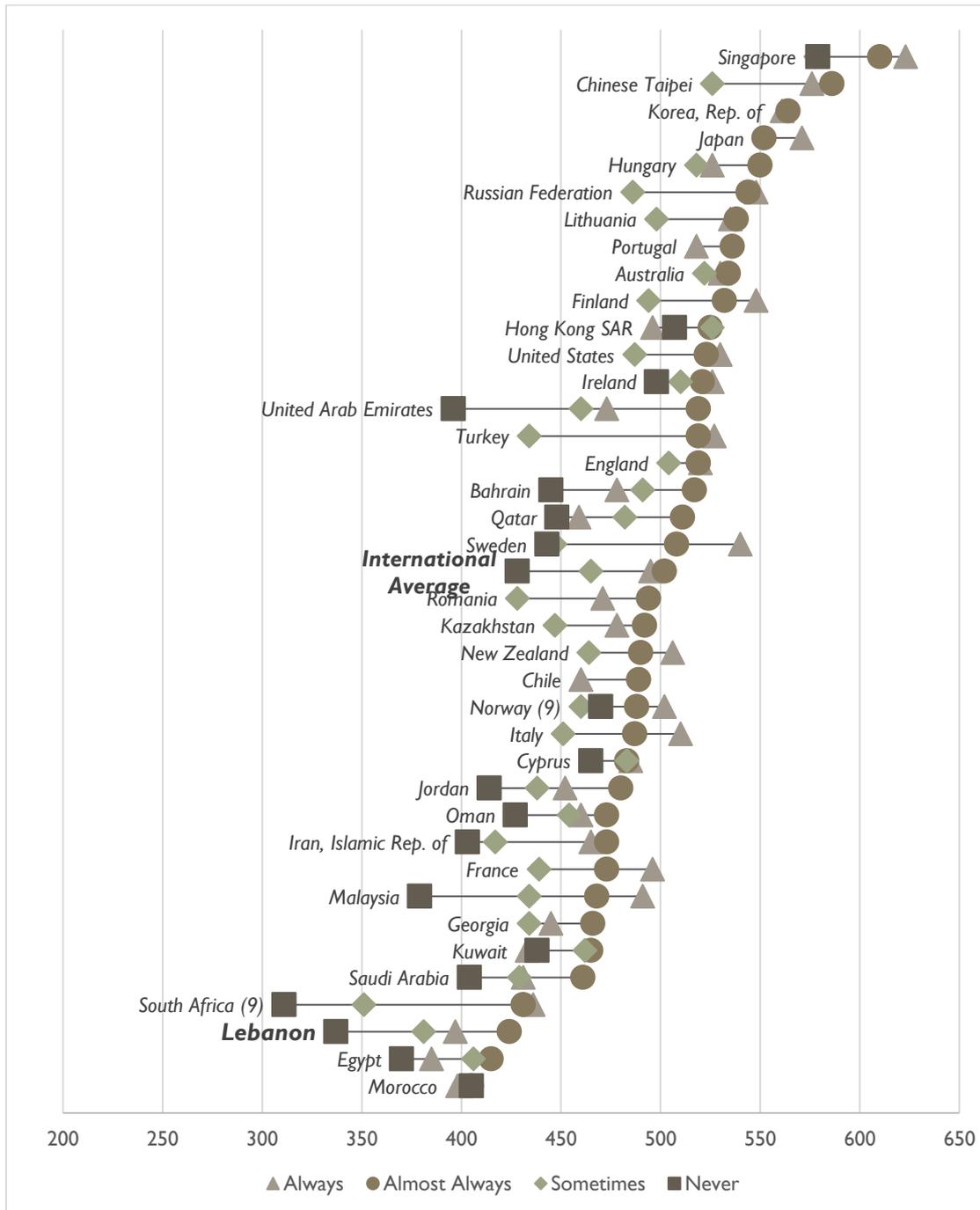
Table 3.4. Average score obtained in G8 TIMSS Science assessment 2019 with respect to the frequency of using language of instruction at home in Lebanon, MENA countries and on International average.

Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Never	23% (1.2)	337 (6.6)	4% (0.1)	428 (2.4)	9%	408
Sometimes	58% (1.2)	381 (5.2)	15% (0.1)	465 (1.4)	27%	439
Almost Always	12% (0.7)	424 (7.1)	15% (0.1)	502 (0.9)	16%	468
Always	7% (0.6)	397 (8.0)	66% (0.2)	495 (0.6)	48%	439

Source: Exhibit 5.10: Students Speak the Language of the Test at Home. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Students obtained the best performance in the "Almost Always" category. In the case of Lebanon and the MENA countries, there was a vast difference in achievement between the "Almost Always" and the "Always" categories. In Lebanon, the range of differences between groups is larger than in MENA countries and the international average. Such differences might reflect the sensitivity of Lebanese students to language problems. In Lebanon, beginning from the third cycle of education, students start learning mathematics and science in a foreign language (English or French). As Lebanon used to be a French colony, English might be the third language of Lebanese students and their parents. In consequence, some parts of the curricula might remain incomprehensible for students. Thus, it is not surprising how the differences according to the frequency of speaking in the assessment language at home are reflected in Lebanon and other countries. Figure 3.8. presents average achievements in science with respect to the frequency of using the language of instruction at home – results are consistent.

Figure 3.8. Average score obtained in G8 TIMSS science assessment 2019 with respect to the frequency of using the language of instruction at home in participating countries.



Source: Exhibit 5.10: Students Speak the Language of the Test at Home. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Learning in a foreign language is a characteristic of the Lebanese educational system. Based on 95% confidence intervals, it was possible to determine the significance of the differences between students

by the frequency of speaking in the language of the test at home. As shown below, there were no statistical differences in the mathematics and science scores between students classified into “always” and “sometimes” categories. In the case of science, the results of “always” and “almost always” were statistically indistinguishable. However, students who never use the language of the test at home have achieved significantly poorer results. It is worth mentioning that this group consists of almost 25% of Lebanese eighth-graders.

Table 3.5. The significance of the differences in results, by frequency of speaking in the language of the test at home

	Confidence Intervals 95%							
	Always		Almost Always		Sometimes		Never	
Mathematics	424.4	447.6	444.8	463.2	425.5	438.5	399.4	416.6
Science	381.3	412.7	410.1	437.9	370.8	391.2	324.1	349.9

Source: Exhibit 5.9: Students Speak the Language of the Test at Home Exhibit 5.10: Students Speak the Language of the Test at Home. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Chapter 4. School Composition and Resources

This chapter discusses how the structure and capacity of schools, such as the school's composition by socioeconomic background and the school's instructional resource shortages, can impact educational outcomes. Data shows that the difference in achievement between more and less equipped schools is significant.

4.1 Socioeconomic background

Students in TIMSS were asked about their socioeconomic background and were classified according to it. The results can be categorized to form an indicator that describes the percentage of students from either affluent or disadvantaged backgrounds. Figure 4.1. presents the definition of such an indicator.

Figure 4.1. Description of the level of affluence according to TIMSS 2019.

More Disadvantaged

- Schools where more than 25% of the student body comes from economically disadvantaged homes and not more than 25% of the student body comes from economically affluent homes

Neither More Disadvantaged nor More Affluent

- All other response combinations

More Affluent

- Schools where more than 25% of the student body comes from economically affluent homes and not more than 25% of the student body comes from economically disadvantaged homes

Source: Exhibit 6.1: School Composition by Socioeconomic Background of the Student Body. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In schools classified into More Disadvantaged category, more than $\frac{1}{4}$ of all students come from a disadvantaged background, while in schools classified as More Affluent, more than $\frac{1}{4}$ of students come from an affluent background.

In order to determine the achievement differences between students from different environments, table 4.1. presents the average scores obtained in the TIMSS mathematics assessment with respect to students' socioeconomic background.

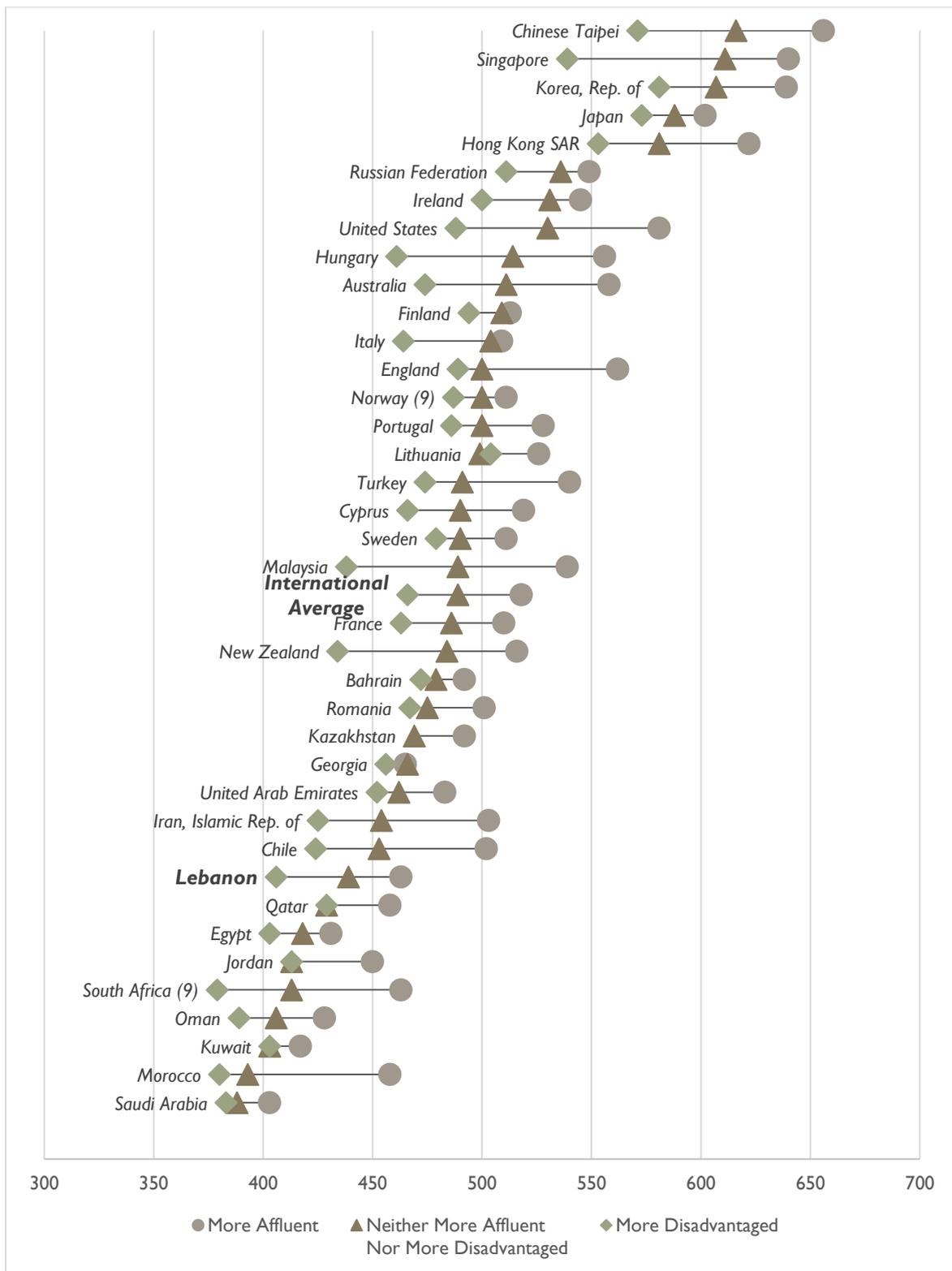
Table 4.1. Average score obtained in G8 TIMSS Mathematics assessment 2019 with respect to students' socioeconomic background.

Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
More Disadvantaged	44% (5.3)	406 (5.0)	32% (0.5)	466 (1.2)	38%	414
Neither More Disadvantaged nor More Affluent	31% (4.4)	439 (6.3)	33% (0.6)	489 (1.1)	33%	426
More Affluent	25% (3.4)	463 (5.0)	35% (0.5)	518 (1.3)	29%	453

Source: Exhibit 6.4: School Composition by Socioeconomic Background of the Student Body. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Compared to the international average, Lebanon and the MENA countries have fewer students assigned to the more affluent categories. Moreover, a larger share of Lebanese students was classified into the "More Disadvantaged" category than the MENA countries. Figure 4.2. presents the average achievement in mathematics by children's socioeconomic background in all TIMSS participating countries.

Figure 4.2. Average achievement in mathematics with respect to the socioeconomic background of children.



Source: Exhibit 6.4: School Composition by Socioeconomic Background of the Student Body. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Across all countries, the same pattern is visible, namely that the highest scores are obtained by "More Affluent" students, while the lower results are obtained by "More Disadvantaged" students." The same analysis was conducted for the domain of science. Table 4.2. presents average achievements in science by the socioeconomic composition of students in schools.

Table 4.2. Average score obtained in G8 TIMSS Science assessment 2019 with respect to students' socioeconomic background.

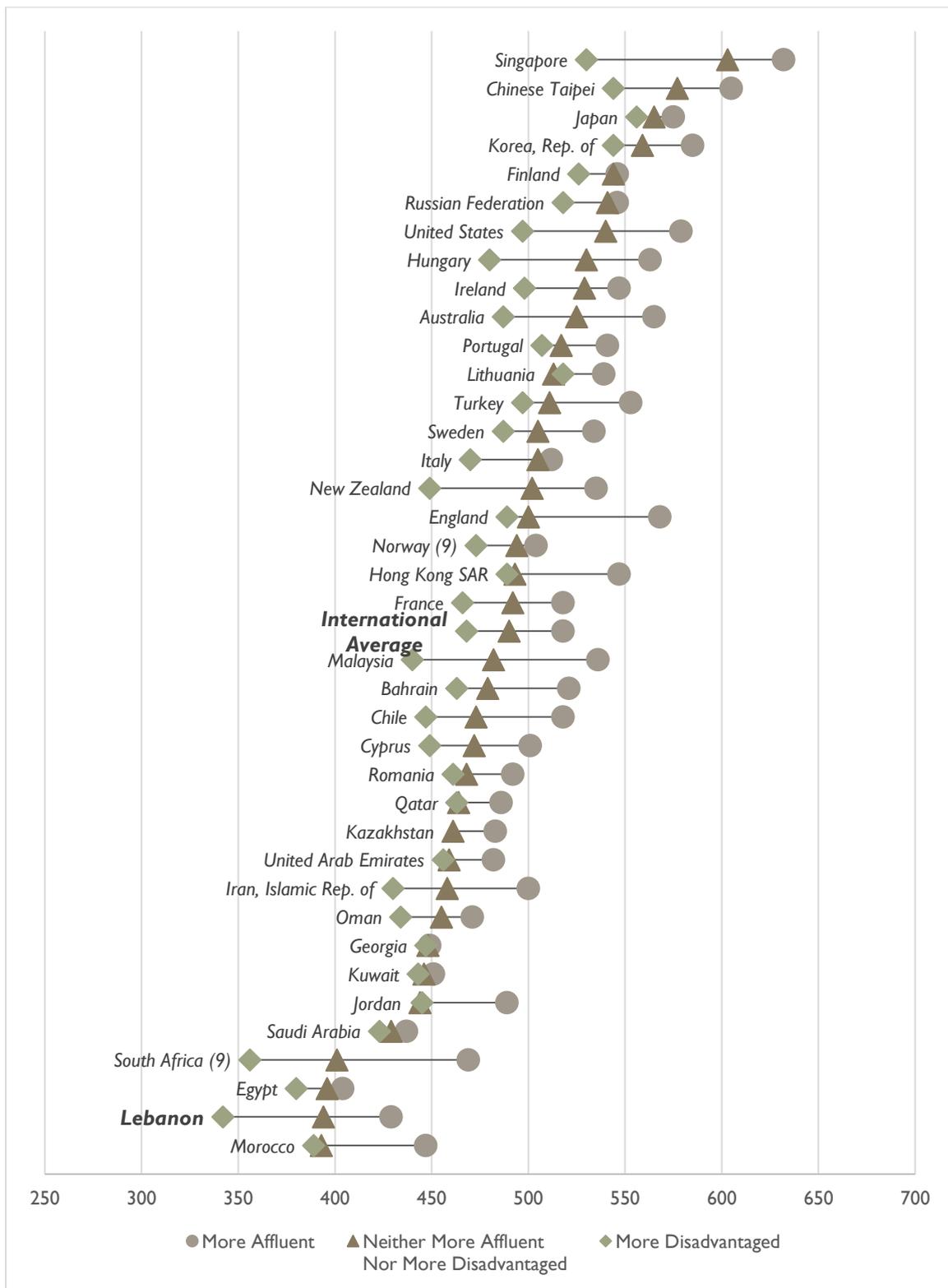
Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Percentage of students	Average Score	Average Score
More Disadvantaged	44% (5.3)	342 (8.1)	32% (0.5)	468 (1.3)	38%	424
Neither More Disadvantaged nor More Affluent	31% (4.4)	394 (10.0)	33% (0.6)	490 (1.2)	33%	438
More Affluent	25% (3.4)	429 (9.4)	35% (0.5)	518 (1.3)	29%	465

Source: Exhibit 6.5: School Composition by Socioeconomic Background of the Student Body. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

The peculiarity of the results for Lebanon is that the difference in the results is considerably larger between the "More disadvantaged" and the "Neither more Disadvantaged nor More Affluent" categories than in benchmarking groups of countries. Such observation may suggest the underperformance of the least affluent group.

Figure 4.3. shows the distribution of average results in science by the socioeconomic composition of schools. For science, in Lebanon, the differences in achievement are more substantial than in the case of mathematics.

Figure 4.3. Average Achievement in Science with respect to the socio-economic background of children.



Source: Exhibit 6.5: School Composition by Socioeconomic Background of the Student Body. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

4.2 School resources shortage

Above, the relationship between the home resources and achievement in mathematics and science was proven. In this section, the school resources' impact on results is analyzed. The teaching and learning of mathematics require a broad set of tools and resources for teachers and students, whose lack can hinder the instruction. Based on reports made by the school's principals concerning the accessibility of such resources, the TIMSS study introduced an indicator that describes whether the process of learning was affected by resources shortages. Figure 4.4. presents the scale of this indicator.

Figure 4.4. The scale of instruction Affected by Mathematics Resources Shortages Index.



Source: Exhibit 6.13: Instruction Affected by Mathematics Resource Shortages – Principals' Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Table 4.3. presents the average results in the TIMSS mathematics assessment by the level of affection of resources shortages in Lebanon, MENA countries and an international average.

The distribution of students in each category is similar in Lebanon and the MENA countries. In Lebanon, there are no differences in achievement between children who were affected a lot and somewhat affected, while students who were not affected received slightly better results in mathematics. A fairly similar situation is observed for the international average, where the best results were obtained by students who were not affected by the resources shortages.

Table 4.3. Average score obtained in G8 TIMSS Mathematics assessment 2019 with respect to the level of affection of school resources shortages.

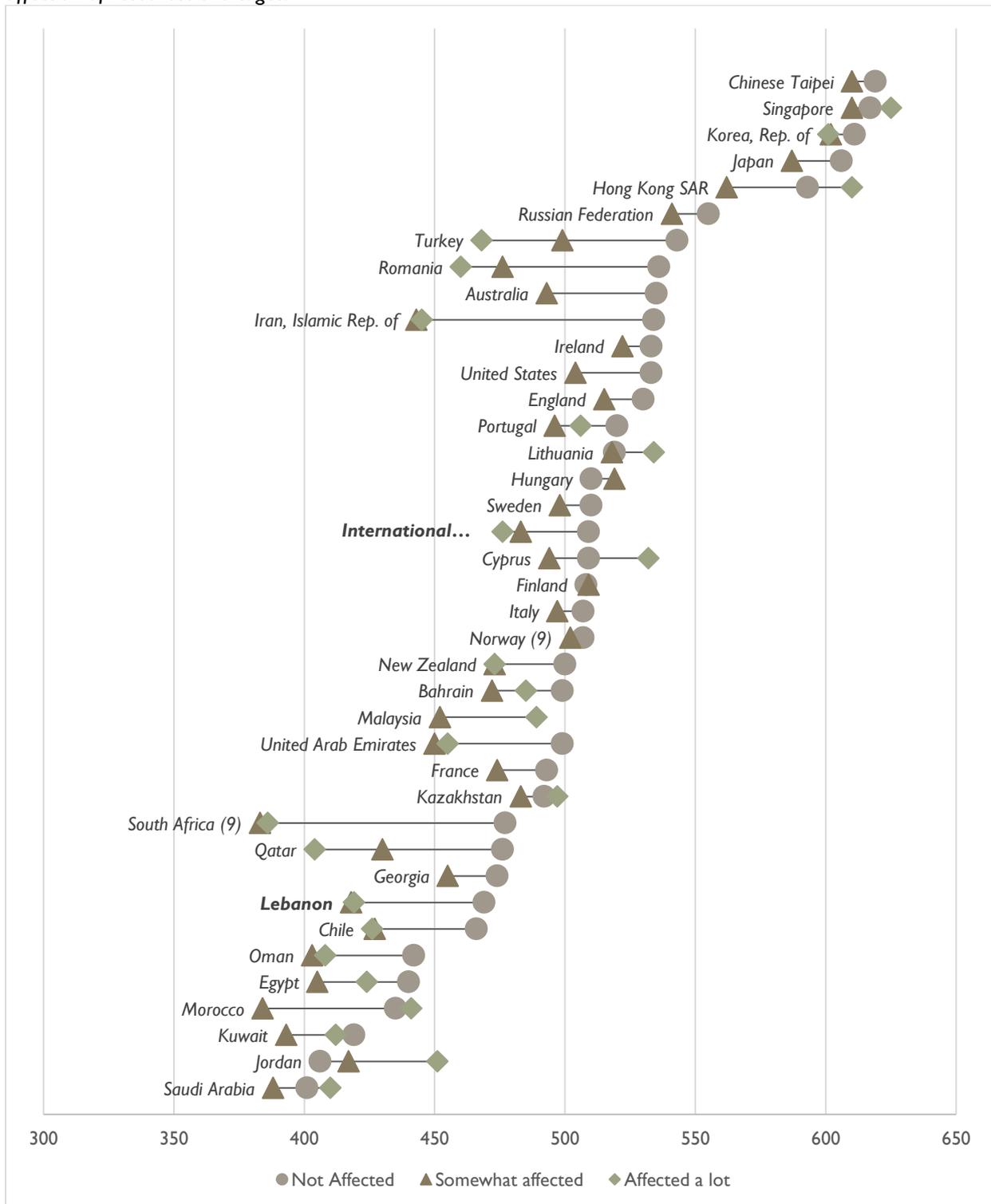
Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Not Affected	21% (3.0)	469 (6.7)	30% (0.5)	509 (1.6)	19%	456
Somewhat affected	66% (3.5)	418 (3.7)	63% (0.6)	483 (1.7)	66%	418
Affected a lot	13% (2.6)	419 (10.0)	7% (0.3)	476 (4.1)	15%	432

Source: Exhibit 6.15: Instruction Affected by Mathematics Resource Shortages. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirils.bc.edu/timss2019/international-results/>

Figure 4.5. investigates the average results in the mathematics assessment with respect to the level of experienced influence of resources shortages.

In the majority of countries, the best results were obtained by students who were not affected by the resources shortages, with a few countries where the level of resources shortages either do not play a key role when it comes to mathematics performance (i.e. Finland, Norway, Kazakhstan), or even disturb the process of learning (i.e. Jordan, Cyprus, Malaysia). Lebanon can be classified as a group of countries where students who were not affected by resources shortages performed significantly better than those achieved by other students. This conclusion underlines the role of providing proper school equipment, as such policy might reduce inequalities between schools.

Figure 4.5. Average score obtained in G8 TIMSS Mathematics assessment 2019 with respect to the level of affection of resources shortages.



Source: Exhibit 6.15: Instruction Affected by Mathematics Resource Shortages. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Similarly, in order to describe the accessibility of resources that can support learning in science (such as experimental equipment, science textbooks, library resources, and computer software made for science instruction), The scale of Instruction Affected by Science Resources Shortages was constructed. Again, as in the case of mathematics, a focus was on teachers' qualifications and the condition of school buildings and facilities. The index presented in figure 4.6 shows the scale of the shortages experienced by the schools, as reported by their principals.

Figure 4.6 The scale of Instruction Affected by Science Resources Shortages Index



Source: Exhibit 6.16: Instruction Affected by Science Resource Shortages – Principals’ Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirils.bc.edu/timss2019/international-results/>

Table 4.4. presents the average scores obtained in the science assessment with respect to the level of experienced influence of resources shortages in Lebanon, MENA countries and an international average.

Table 4.4. Average score obtained in G8 TIMSS Science assessment 2019 with respect to the level of affection of school resources shortages.

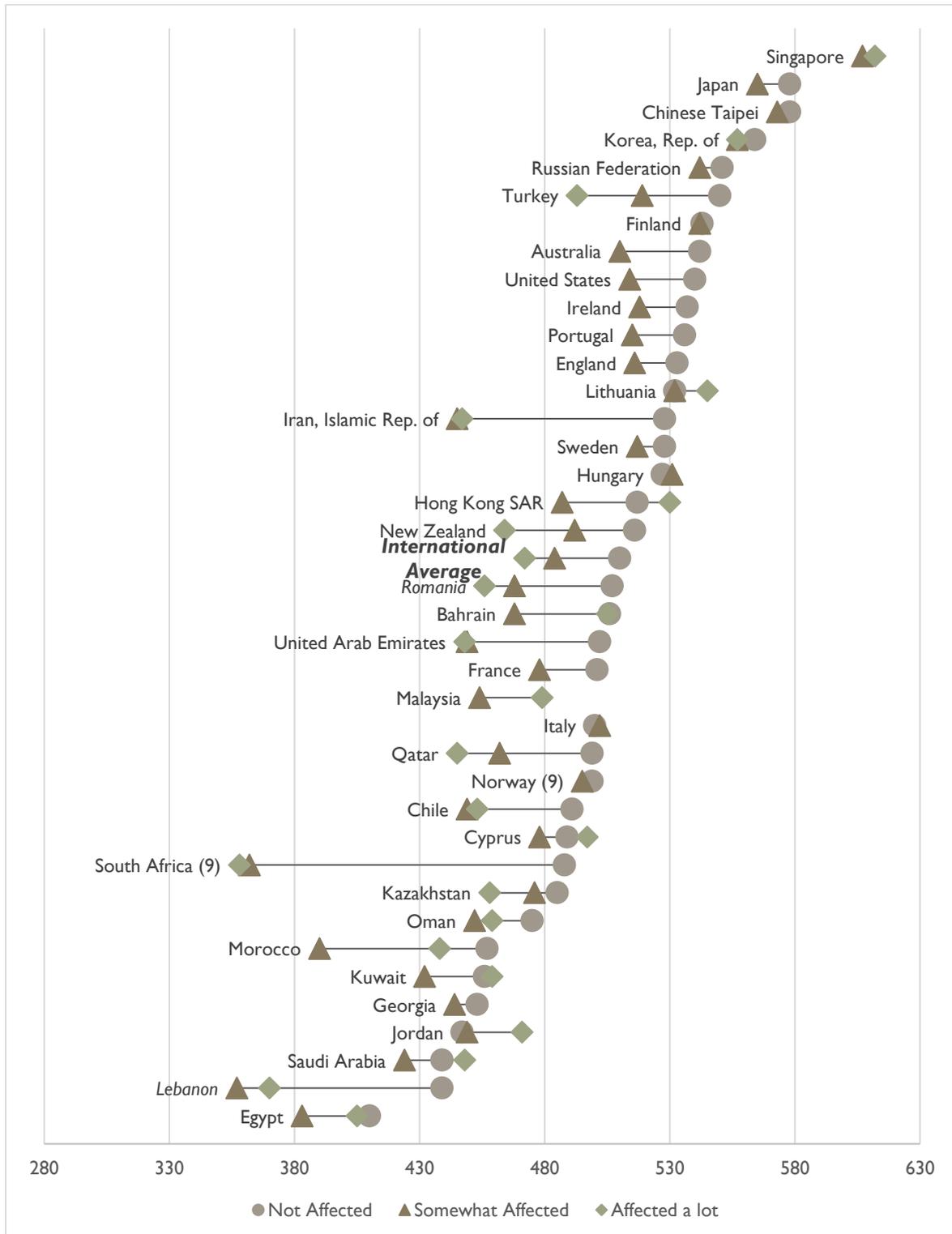
Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Not Affected	21% (2.9)	439 (10.5)	30% (0.5)	510 (1.7)	30%	510
Somewhat affected	66% (3.7)	357 (6.3)	63% (0.6)	484 (0.8)	63%	484
Affected a lot	13% (2.7)	370 (16.0)	7% (0.3)	472 (0.3)	7%	472

Source: Exhibit 6.16: Instruction Affected by Science Resource Shortages – Principals’ Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirils.bc.edu/timss2019/international-results/>

Even though the best results were scored by students who were not affected by the resources shortages, there is no obvious pattern for the other two categories. In Lebanon and MENA countries, eighth-graders attending schools indicated as *Somewhat affected* scored a little lower than those labelled as “Affected a lot”, with the opposite being found at the international level. The inequalities in performance in Lebanon remain large compared to those observed for the mathematics assessment.

The country-level analysis allows investigating the relationship between the shortage of resources and the performance in the science assessment. Figure 4.6. presents average achievements in science according to the level of affection of resources shortages.

Figure 4.6. Average score obtained in G8 TIMSS Science assessment 2019 with respect to the level of affection of resources shortages.



Source: Exhibit 6.16: Instruction Affected by Science Resource Shortages – Principals’ Reports. TIMSS 2019

International Results in Mathematics and Science. Downloaded from:

<https://timssandpirls.bc.edu/timss2019/international-results/>

Chapter 5. School Climate

This chapter focuses on the relationship between **school climate** and educational achievement. The empirical evidence shows that the sense of school belonging positively affects achievement. This chapter also discusses the different categories of the index of the sense of belonging.

5.1. Sense of school belonging

Before the COVID-19 pandemic, the school was a place where students were both learning and engaging in social activities, yet some students struggled to find any friends or feel any positive attitude with the school, which can cause difficulties in learning. Therefore, to design policies aimed at creating a positive atmosphere in school, it is worth analyzing the level of students' sense of belonging to their school.

To measure a **sense of belonging index**, students were asked how they felt about their schools in terms of safety and belonging in the TIMSS assessment. Based on their answers, an indicator was calculated, and three categories were introduced, namely High sense of school belonging, Moderate sense of school belonging, and Low sense of school belonging. Figure 5.1. shows the scale of the Sense of School belonging index.

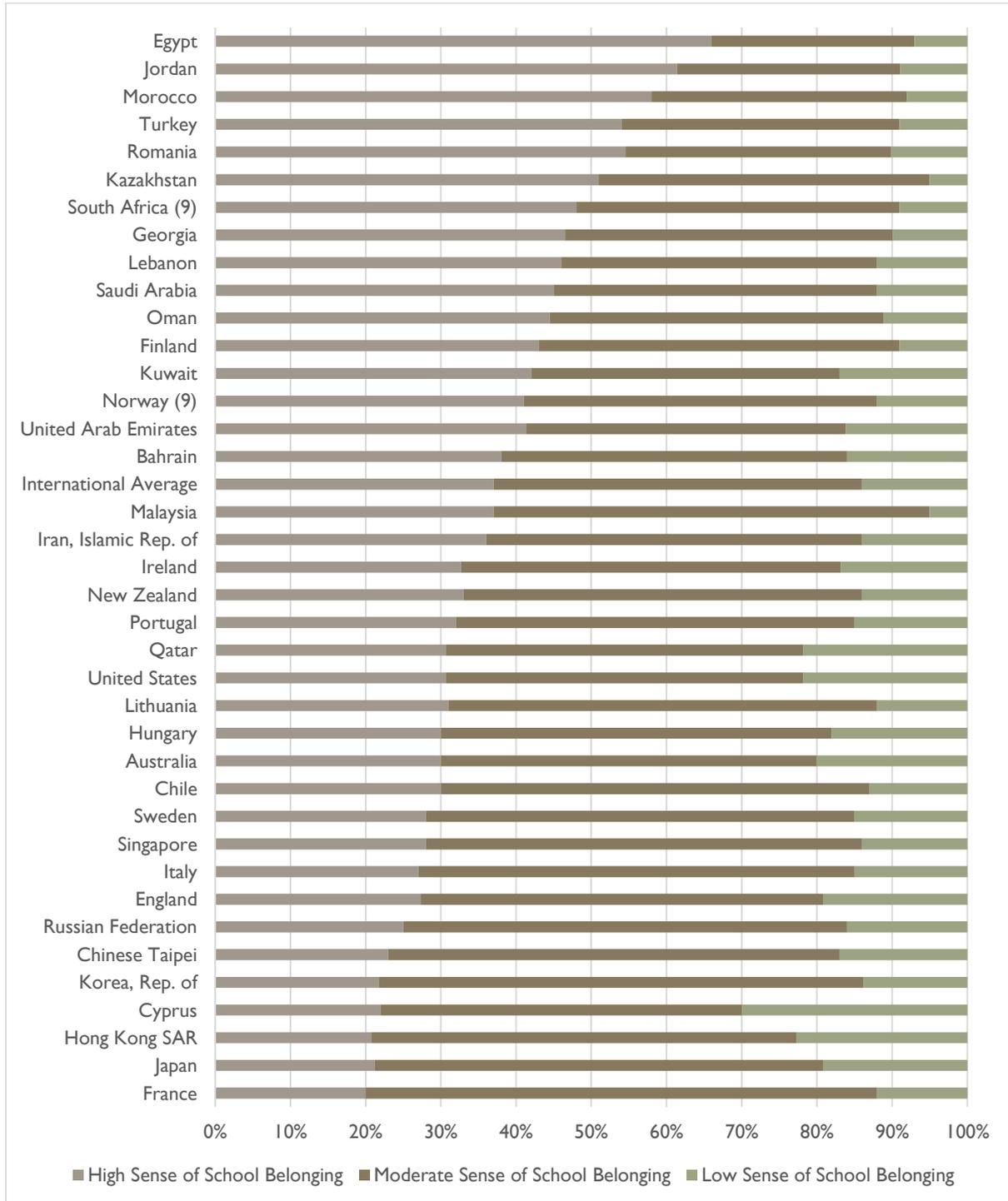
Figure 5.1. Scale description of the sense of school belonging index



Source: Exhibit 7.9: Students' Sense of School Belonging. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

For the sake of brevity, the percentage of students assigned to each index category was analyzed. Figure 5.2. shows the distribution of the sense of belonging index among students in participating countries.

Figure 5.2. The distribution of the sense of belonging index among eighth-graders from countries participating in the TIMSS assessment



Source: Exhibit 7.12: Students' Sense of School Belonging. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

The majority of the students worldwide generally feel a moderate sense of school belonging. In Lebanon, most students have either a high or a moderate sense of school belonging (46% and 42% of students, respectively), which indicates that most Lebanese eighth-graders have experienced a positive school climate, similar to other MENA countries.

The index of sense of school belonging can impact achievements in mathematics since feeling safe in school can make it easier to focus during lessons. Table 5.1. provides data concerning the students' results concerning the index of sense of school belonging.

Table 5.1. The results in G8 TIMSS Mathematics Assessment with respect to the sense of belonging index among eighth-graders.

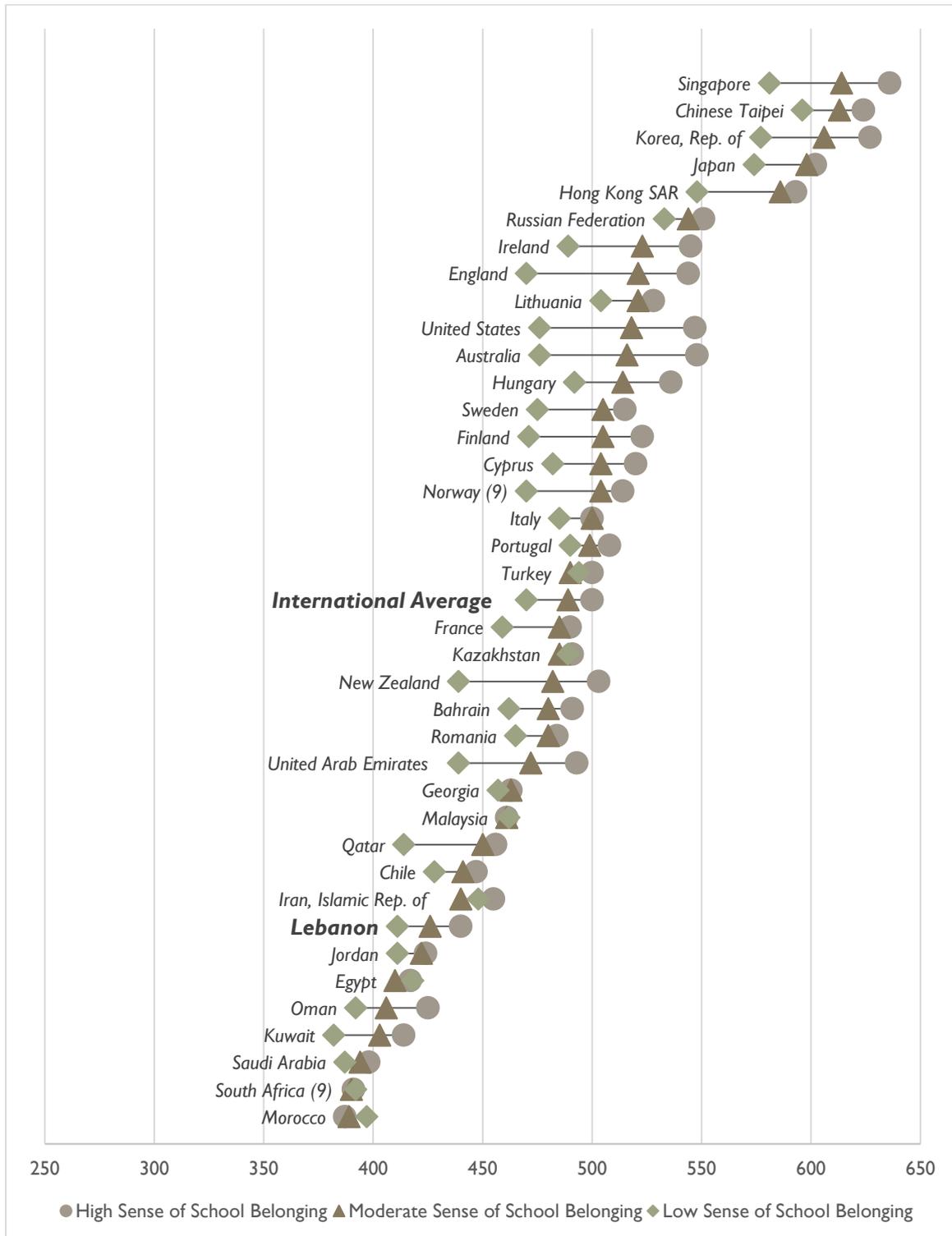
Category	Lebanon		International Average		MENA Countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
High Sense of School Belonging	46% (1.4)	440 (3.5)	37% (0.2)	500 (0.7)	47%	431
Moderate Sense of School Belonging	42% (1.1)	426 (3.8)	49% (0.2)	489 (0.6)	40%	421
Low Sense of School Belonging	12% (0.8)	411 (5.6)	14% (0.1)	470 (0.9)	13%	410

Source: Exhibit 7.12: Students' Sense of School Belonging. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

The best scores in mathematics were obtained by students who manifested a high sense of school belonging in every geographical area. This result shows that providing a friendly atmosphere at school can be linked to better results in mathematics.

Figure 5.3. shows the distribution of the results with respect to the declared level of sense of school belonging at the country level.

Figure 5.3. The scores obtained in the G8 TIMSS Mathematics Assessment with respect to the sense of belonging index.



Source: Exhibit 7.12: Students' Sense of School Belonging. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirils.bc.edu/timss2019/international-results/>

In the vast majority of the countries, students with a high connection to their schools scored the best results in mathematics. It can also be observed that very small differences were reported in the majority of the MENA countries (except for the United Arab Emirates and Qatar). In contrast, in Lebanon, a moderate range of inequalities was found.

Table 5.2. presents the average achievements in science with respect to the sense of school belonging.

Table 5.2. The results in G8 TIMSS Science Assessment with respect to the sense of belonging index among eighth-graders.

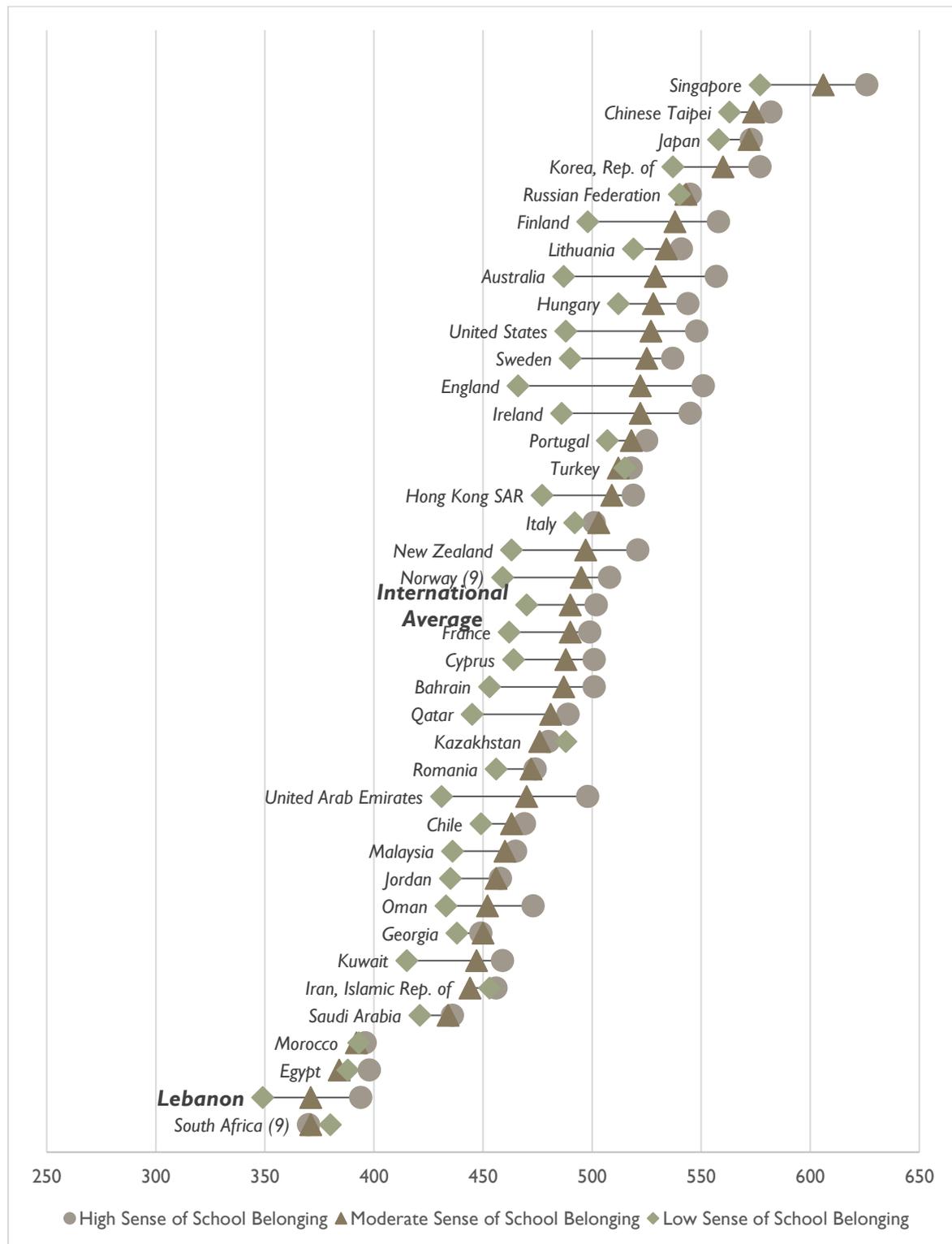
Category	Lebanon		International Average		MENA Countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
High Sense of School Belonging	46% (1.4)	394 (4.9)	37% (0.2)	502 (0.7)	47%	451
Moderate Sense of School Belonging	42% (1.1)	371 (6.4)	49% (0.2)	490 (0.6)	40%	438
Low Sense of School Belonging	12% (0.8)	349 (8.7)	14% (0.1)	470 (1.0)	13%	420

Source: Exhibit 7.12: Students' Sense of School Belonging. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Similar to the case of mathematics, students who declared a high sense of belonging scored the highest score in science on average. Lebanon presents larger inequalities between students than the MENA countries and the international average. Figure 5.4. presents the analysis at the country level.

Figure 5.4. The scores obtained in G8 TIMSS Science Assessment with respect to the sense of belonging index.



Source: Exhibit 7.12: Students' Sense of School Belonging. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In most countries, the best performance in science was found among students feeling the strongest connection to their school. The results appear to be in line with the ones found for the case of the assessment in mathematics.

5.2. School emphasis on academic success

Providing a safe atmosphere for learning and development should be the primary goal of the educational institution since the lack of belief in one's abilities can result in worse outcomes. Therefore, emphasizing the importance of success remains an important indicator when framing the education system.

The TIMSS assessment introduced an indicator to measure how much the school has put emphasis on academic success. This indicator was calculated based on questions concerning the expectations of teachers and parents, parental involvement in school activities, and the desire of students to do well in school. The scale of this **emphasis on the academic success index** is shown in figure 5.5.

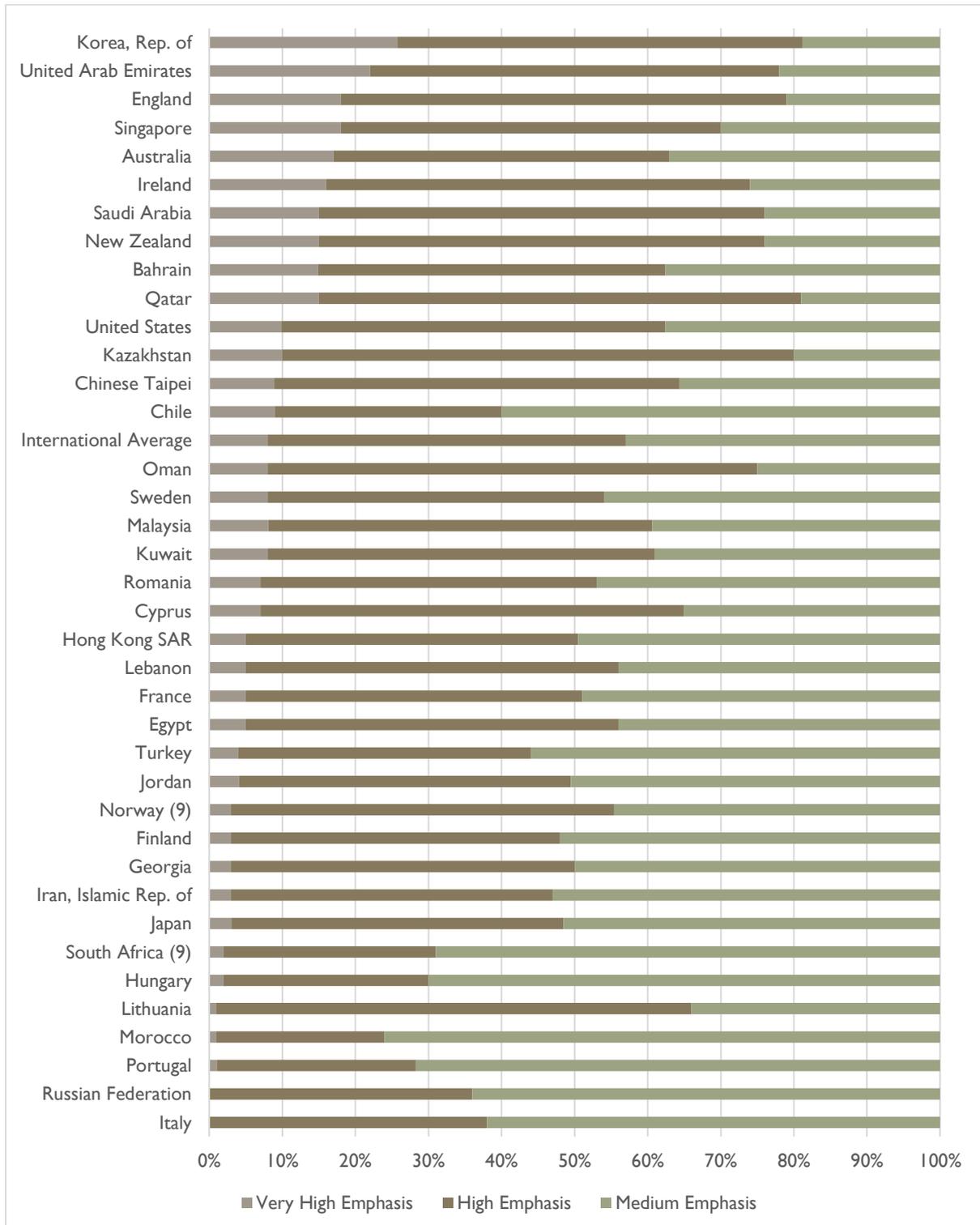
Figure 5.5. Scale description of the school's emphasis on academic success



Source: Exhibit 7.1: School Emphasis on Academic Success – Principals' Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Students were divided into three categories, based on the level of emphasis that the school has put on their academic success, namely Very High Emphasis, High Emphasis and Medium Emphasis. Figure 5.6. shows the shares of students assigned to each category.

Figure 5.6. The distribution of level of school's emphasis among eighth-graders from countries participating in the TIMSS assessment



Source: Exhibit 7.4: School Emphasis on Academic Success – Principals' Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Even though a high emphasis is put on students' academic success In Lebanon, only 56% of eighth-graders were reported to have experienced either a high or a very high emphasis on their academic success.

To see the importance of the emphasis on academic success on students' achievements, it is worth analyzing whether any pattern is observed between these two variables. Table 5.3. shows the data concerning the results in mathematics with respect to the school's emphasis on academic success.

Table 5.3. The results in G8 TIMSS Mathematics Assessment with respect to school's emphasis on academic success.

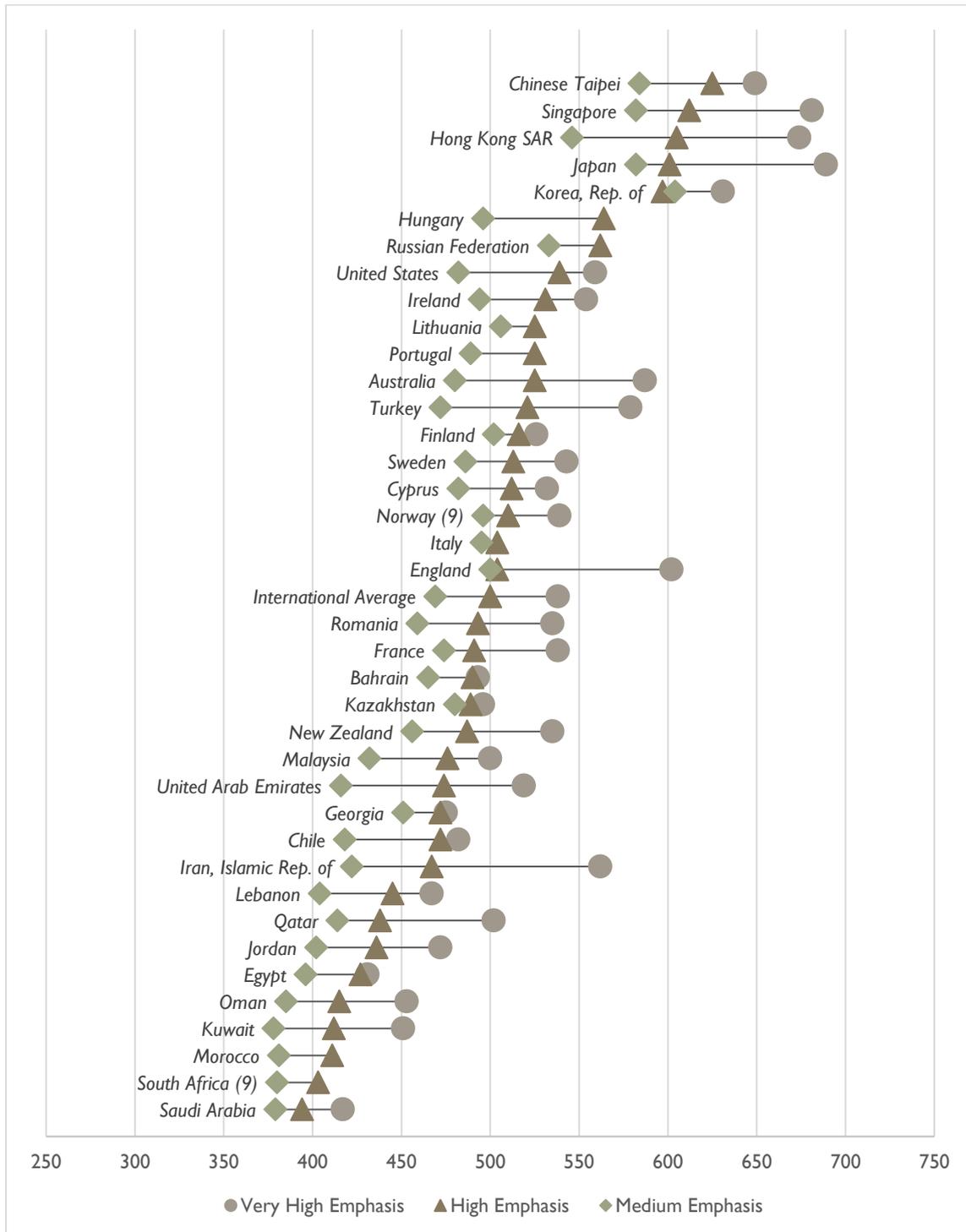
Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Very high emphasis	5% (1.8)	467 (14.1)	8% (0.3)	538 (3.0)	9%	477
High emphasis	51% (3.3)	445 (3.9)	49% (0.6)	500 (0.8)	51%	437
Medium emphasis	44% (3.4)	404 (4.6)	43% (0.6)	469 (0.9)	39%	404

Source: Exhibit 7.4: School Emphasis on Academic Success – Principals' Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

More emphasis on academic success correlates with higher results in mathematics. In Lebanon, considerably fewer students experienced a high emphasis on their academic success than in MENA countries and internationally. This shows that the relation between emphasis put on academic success and educational outcomes can be crucial in modeling new educational solutions.

Figure 5.6. shows the average score in mathematics with respect to the level of school's emphasis on academic success.

Figure 5.6. The scores obtained in G8 TIMSS Mathematics Assessment with respect to the school's emphasis on academic success.



Source: Exhibit 7.4: School Emphasis on Academic Success – Principals’ Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In all the countries, the best results in mathematics were obtained by students who experienced a very high emphasis on academic success. Lebanon is in a group of countries where the inequality between a very high and a high emphasis are not as large as between a high and a medium levels of emphasis. Since very few students in Lebanon experienced a very high emphasis on their academic success, policymakers should bear in mind that this factor alone might have a strong impact on the effectiveness of the Lebanese system of education.

Similarly to mathematics, it is worth assessing whether the average score of Lebanese students in science was influenced by the emphasis put by the school on academic success. Table 5.4. shows the average results in science with respect to different levels of school's emphasis on academic success.

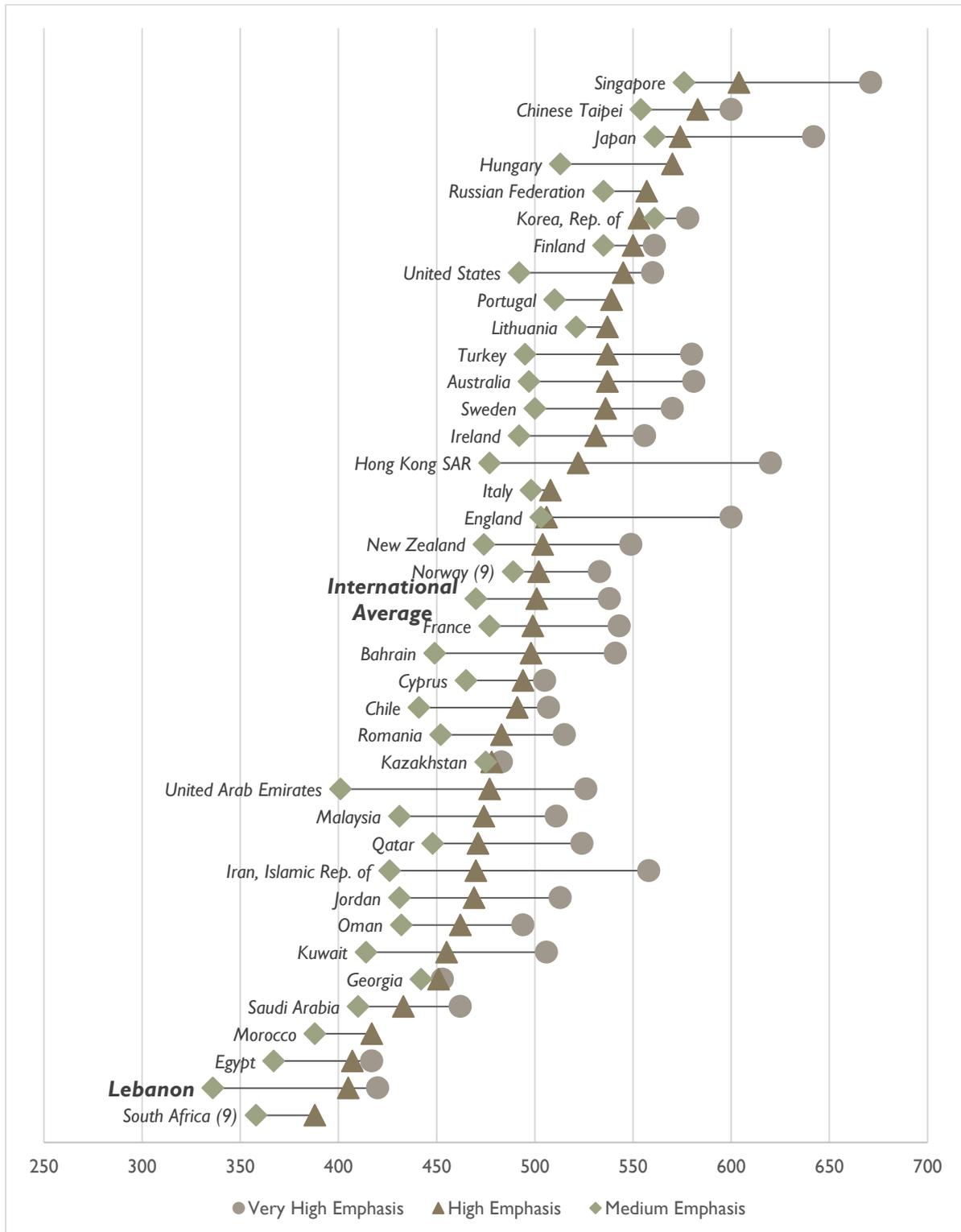
Table 5.4. The results in G8 TIMSS Science Assessment with respect to the school's emphasis on academic success.

Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Very high emphasis	5% (1.8)	420 (13.9)	8% (0.3)	538 (2.6)	9%	496
High emphasis	51% (3.3)	405 (5.6)	49% (0.6)	501 (0.8)	51%	451
Medium emphasis	44% (3.4)	336 (8.1)	43% (0.6)	470 (1.0)	39%	409

Source: Exhibit 5.4: School Emphasis on Academic Success – Principals' Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirils.bc.edu/timss2019/international-results/>

It can be seen that a high emphasis on academic success correlates positively with achievements in science. Thus, while students in Lebanon are underperforming in science, their results improved when they experienced a high level of emphasis. Similarly to the case of mathematics, analyzing the distribution of the results with respect to the school's emphasis on academic success might provide valuable insights. A visualization of science performance is shown in figure 5.7.

Figure 5.7. The scores obtained in G8 TIMSS Science Assessment with respect to the school's emphasis on academic success.



Source: Exhibit 7.5: School Emphasis on Academic Success – Principals’ Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In countries participating in the assessment, the highest scores in science were obtained by students who experienced the highest level of *emphasis on academic success*, with large differences in outcomes observed between the students. In Lebanon, the observed inequalities in scores between students are above the average. Additionally, in a few countries, including Lebanon, the differences between a very high and a high emphasis are much lower than between a high and a medium emphasis on academic success. Such a pattern might suggest that the impact of the emphasis on academic success is observable up to some point. It may be observed that the effect of increasing the emphasis on academic success is lower when the initial emphasis was already high.

For both mathematics and science, additional analysis was conducted – the results of Lebanese students, by the emphasis on academic success were tested whether there is a significant difference between them. For this purpose, a 95% confidence interval comparison was used. As it can be observed, the differences between Lebanese Very High Emphasis and High Emphasis students in mathematics and science achievements are not significant. This mainly results from large standard error observed in the case of “Very High Emphasis”. However, the statistical comparison has found that the students who experienced medium emphasis on academic success scored significantly lower in mathematics and science.

Table 5.5. The significance of the differences between Lebanese students, by Emphasis on Academic success

	Confidence Intervals 95%					
	Very High Emphasis		High Emphasis		Medium Emphasis	
Mathematics	439.364	494.64	437.356	452.644	394.984	413.016
Science	392.756	447.24	394.024	415.976	320.124	351.876

Source: Own calculations based on: *Exhibit 7.4: School Emphasis on Academic Success – Principals’ Reports. Exhibit 7.5: School Emphasis on Academic Success – Principals’ Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>*

Chapter 6. School Discipline and Safety

Problems with **safety at school** proved to be negatively correlated with educational achievements. This chapter discusses the issues related to discipline based on the principals' reports on the problems in their own schools. Moreover, this chapter also discusses students' reports on bullying exposure, which is one of the biggest challenges in low-performing countries.

6.1. Students' feeling of safety and order

Providing a safe and orderly atmosphere is one of the main goals for schools. It is crucial that students regard their school as a safe place so that learning takes place without unnecessary stress and fear. In the TIMSS questionnaire, students were asked about their feeling of safety at schools, including issues such as the neighborhood of the school, the sense of safety, the respect paid to the teachers, and whether the school has developed proper safety policies and practices. Based on the responses, an indicator describing the **feeling of safe and orderly at schools** was introduced. The subcategories for this index are shown in figure 6.1.

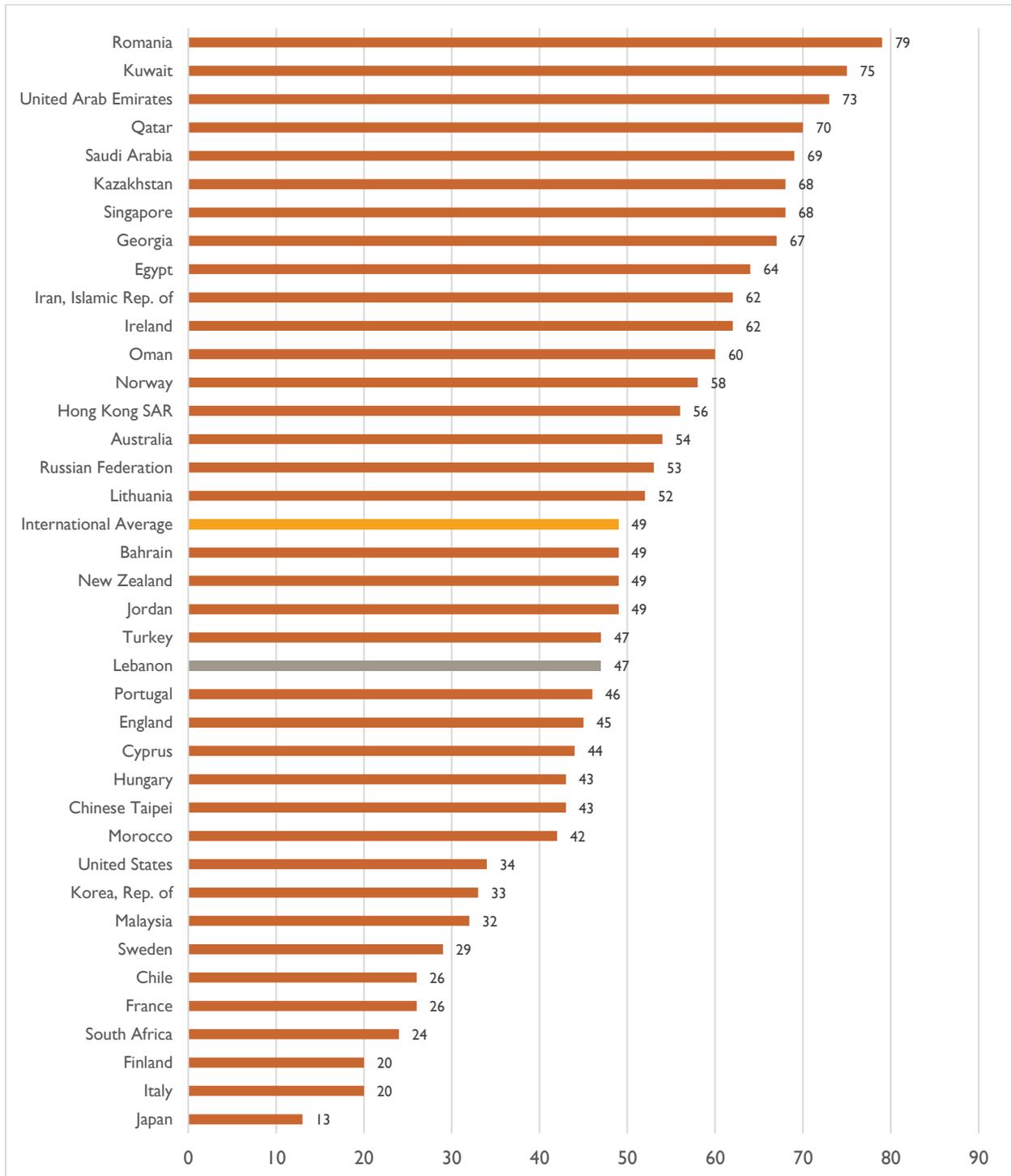
Figure 6.1. Scale description of feeling safe and orderly at schools indicator



Source: Exhibit 8.6: Safe and Orderly School – Teachers' Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

The categories are Very safe and orderly, Somewhat safe and orderly, and Less than safe and orderly, and have been introduced to categorize students into bands which allows to focus on the shares of students in each of them. Figure 6.2. presents the percentage of eighth-graders who experienced a very safe and orderly atmosphere at school, which can strongly influence learning conditions.

Figure 6.2. Percentage of students feeling very safe and orderly at schools in countries participating in G8 TIMSS assessment



Source: Exhibit 8.9: Safe and Orderly School – Teachers’ Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In Lebanon, 47% of students felt very safe at school, which, while being similar to the international average, is nevertheless relatively smaller than in the other MENA countries.

As the safe atmosphere is hypothesized to strongly influence students' education, it may be worth evaluating the impact of feeling safe on students' achievements in mathematics. Table 6.1. presents the average performance in mathematics depending on the feeling of safety and orderly at schools.

Table 6.1. Average score obtained in G8 TIMSS Mathematics assessment 2019 with respect to students' sense of safety and orderly.

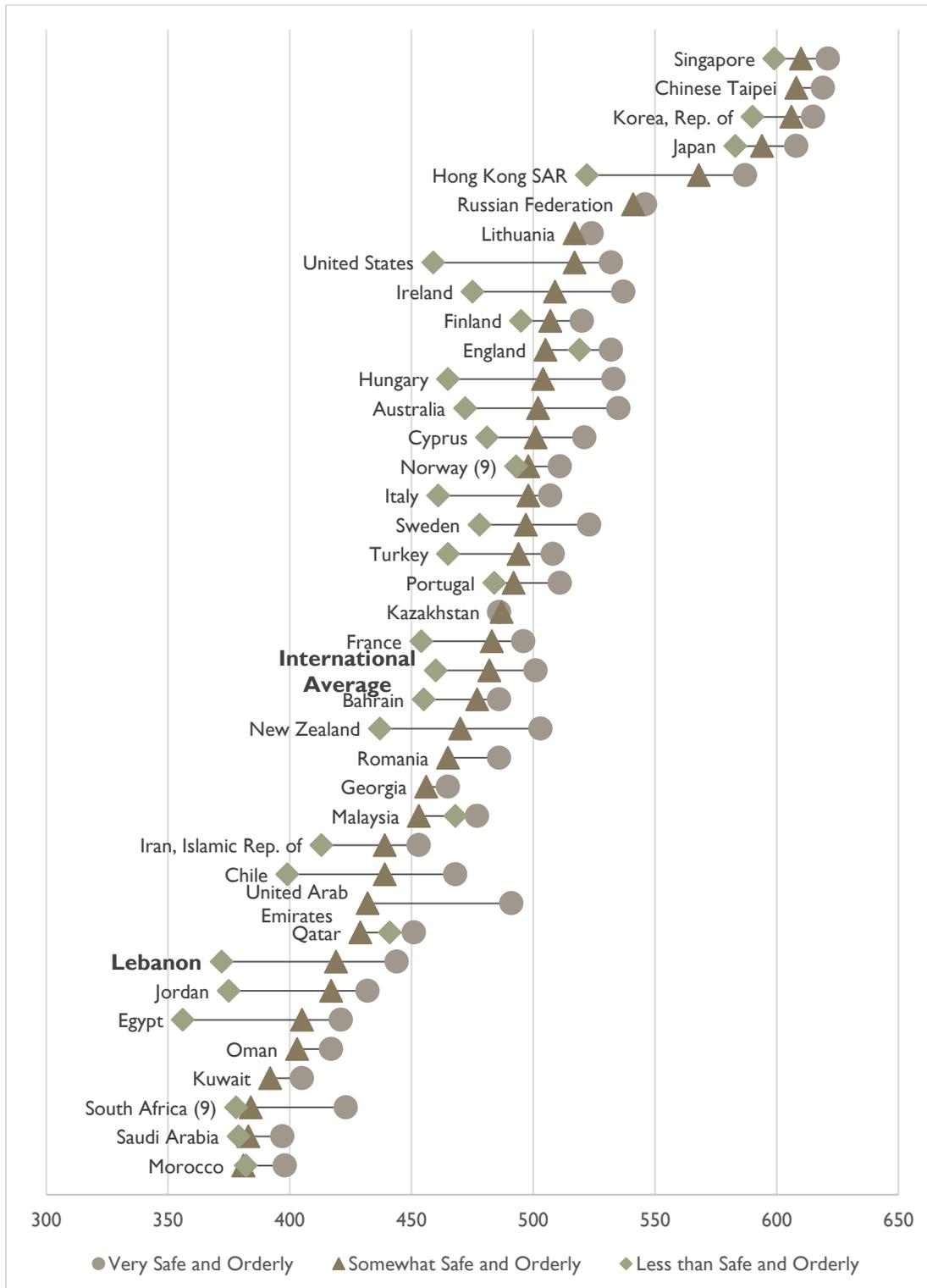
Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Very Safe and Orderly	48% (4.4)	444 (4.8)	48% (0.5)	501 (0.9)	60%	431
Somewhat Safe and Orderly	48% (4.5)	419 (4.4)	45% (0.6)	482 (1.0)	35%	410
Less than Safe and Orderly	4% (1.5)	372 (11.3)	6% (0.3)	460 (2.5)	5%	388

Source: Exhibit 8.9: Safe and Orderly School – Teachers' Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

A similar share in each category is found in Lebanon and on international average, contrary to MENA countries where a larger percentage of students experienced a very safe and orderly atmosphere at schools. When the atmosphere is regarded as safer and more orderly, better results in mathematics are achieved, with larger differences between categories. Compared to MENA countries and the international average, the inequalities in mathematics performance between Lebanese students regarding the feeling of safety are significantly broader.

A country-level analysis, presented in figure 6.3., shows the average results in mathematics with respect to the students' feeling of safety and order at schools.

Figure 6.3. Average score in mathematics according to the sense of safety and order at schools in countries participating in G8 TIMSS assessment



Source: Exhibit 8.9: Safe and Orderly School – Teachers’ Reports TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Students who felt very safe and orderly at schools received the highest score in the mathematics assessment in all the countries. However, in a few countries, such as Qatar, Malaysia, and England, students who felt less than safe and orderly scored higher in the assessment than those who experienced a moderately safe atmosphere at school. In the MENA countries, including Lebanon, the differences between the categories do not appear to have a consistent trend.

Since feeling safe and orderly at school was observed to affect the mathematics achievements' score positively, valuable insights might come from the same analysis conducted in the science domain. Table 6.2. presents the average performance of eighth-graders in science with respect to the feeling of safety and order at schools.

Table 6.2. Average score obtained in G8 TIMSS Science assessment 2019 with respect to students' sense of safety and orderly.

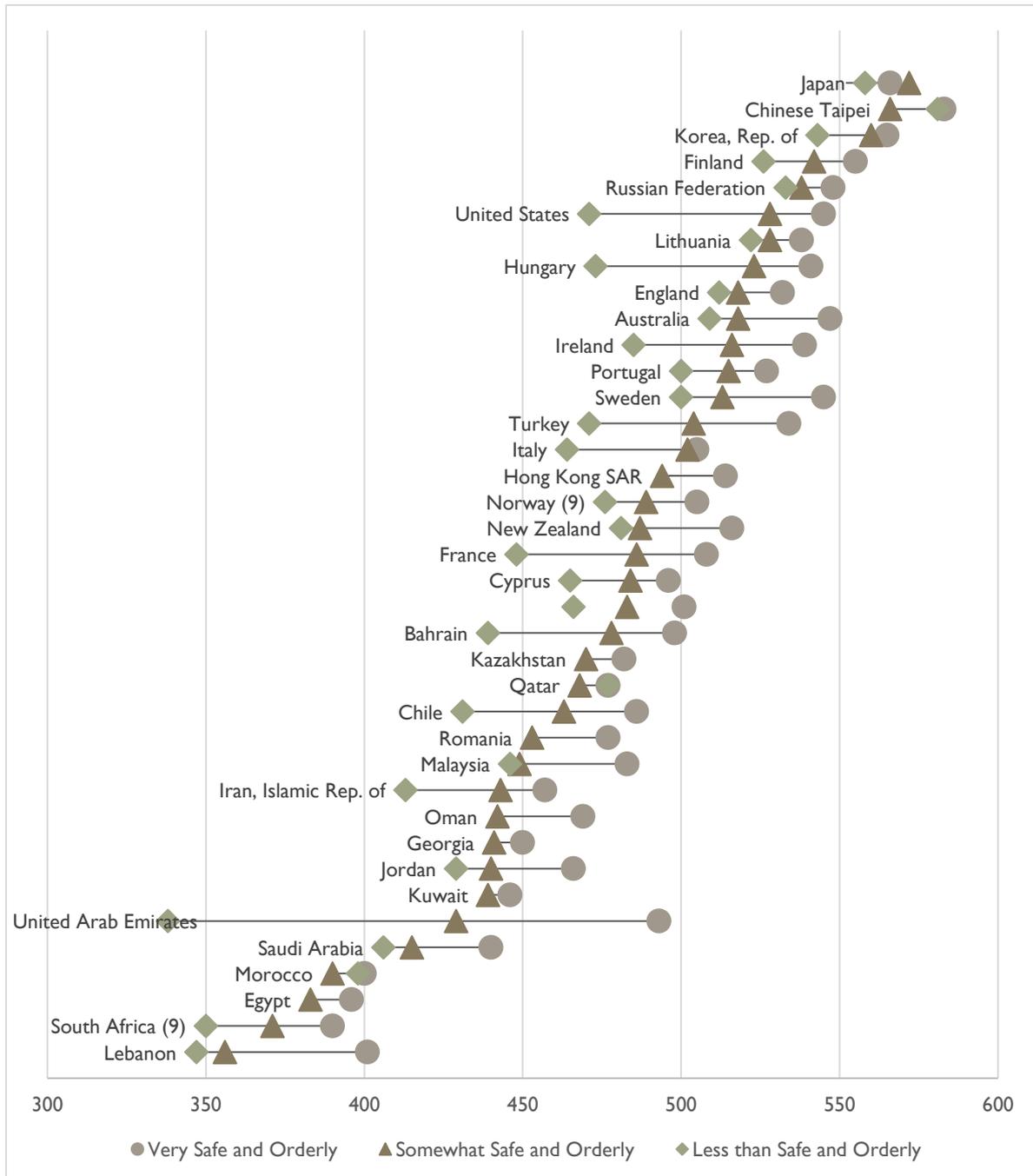
Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Very Safe and Orderly	48% (3.4)	401 (6.5)	48% (0.5)	501 (0.9)	60%	449
Somewhat Safe and Orderly	48% (3.4)	356 (6.2)	45% (0.5)	483 (1.0)	35%	426
Less than Safe and Orderly	4% (1.3)	347 (15.7)	6% (0.3)	466 (2.5)	5%	406

Source: Exhibit 8.10: Safe and Orderly School – Teachers' Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Just like in the case of mathematics, students who felt the safest atmosphere at schools are leading in the science performance in Lebanon, MENA countries, and on the international average. While the differences between students' scores classified into different categories are larger than in the case of mathematics. Yet, the impact of safety and order at school seems to be significant for science too.

Figure 6.4. presents the results of the country-level analysis of the relationship between the feeling of safety in school and the differences in achievements in the science assessment

Figure 6.4. The average score in science according to the sense of safety and order at schools in countries participating in G8 TIMSS assessment



Source: Exhibit 8.10: Safe and Orderly School – Teachers’ Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In all the countries, except Qatar and Chinese Taipei, an increase in the *feeling of safety and order at schools* correlates with higher results. At the same time, the range of the inequalities between groups did not follow any recognizable pattern. In Lebanon, these inequalities are quite vast, and undoubtedly schools should consider the range of problems that may occur as a result of a disordered atmosphere.

6.2. School discipline

Providing high-quality learning would not be possible if high discipline among students was not a target, even though one may expect that too strict rules might cause fear among students. Thus, the correlation between the disciplinary climate and school achievements should be analyzed, as a disciplinary climate might be a key factor when conducting new policies for the development of educational systems. In order to measure whether any problems connected with discipline have occurred, an additional questionnaire was given to the principals of the schools, including questions related to whether students are used to cheating, arrive late at school, skip classes, and engage in theft and vandalism. Based on the responses, TIMSS introduced an indicator to describe the **extent of discipline issues** at schools, whose scale is shown in figure 6.4.

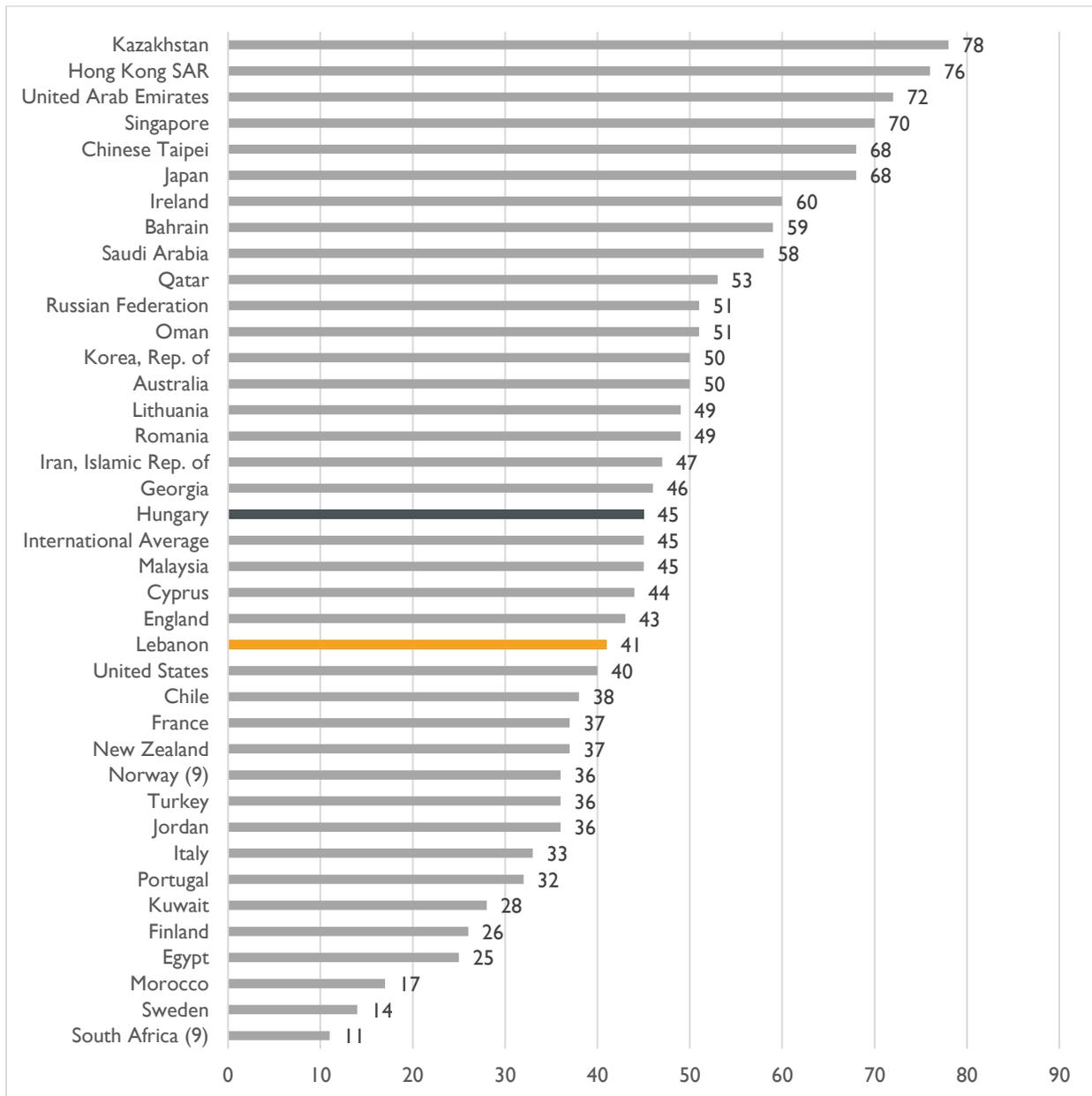
Figure 6.4. Scale description of the occurrence of discipline issues at schools indicator



Source: Exhibit 8.1: School Discipline – Principals’ Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Schools were classified into three categories concerning the level of occurred discipline issues, namely Hardly any problems, Minor problems, and Moderate to severe problems. In terms of the data analysis, the percentage of students assigned to each category and their results in mathematics and science have been considered. Figure 6.5. presents the percentage of students who, according to the principal’s reports, caused hardly any discipline problems.

Figure 6.5. Percentage of students who cause hardly any discipline problems in TIMSS participating countries



Source: Exhibit 8.4: School Discipline – Principals’ Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

The differences in the percentages of students causing hardly any discipline problems are quite wide between countries, with Lebanon in the 24th position out of 39 countries and no specific visible pattern in the MENA countries. Table 6.3. presents the average achievement in mathematics with respect to the level of observed discipline problems at school to account for possible correlations.

Table 6.3. Average score obtained in G8 TIMSS Mathematics assessment 2019 with respect to the level of observed discipline problems among students

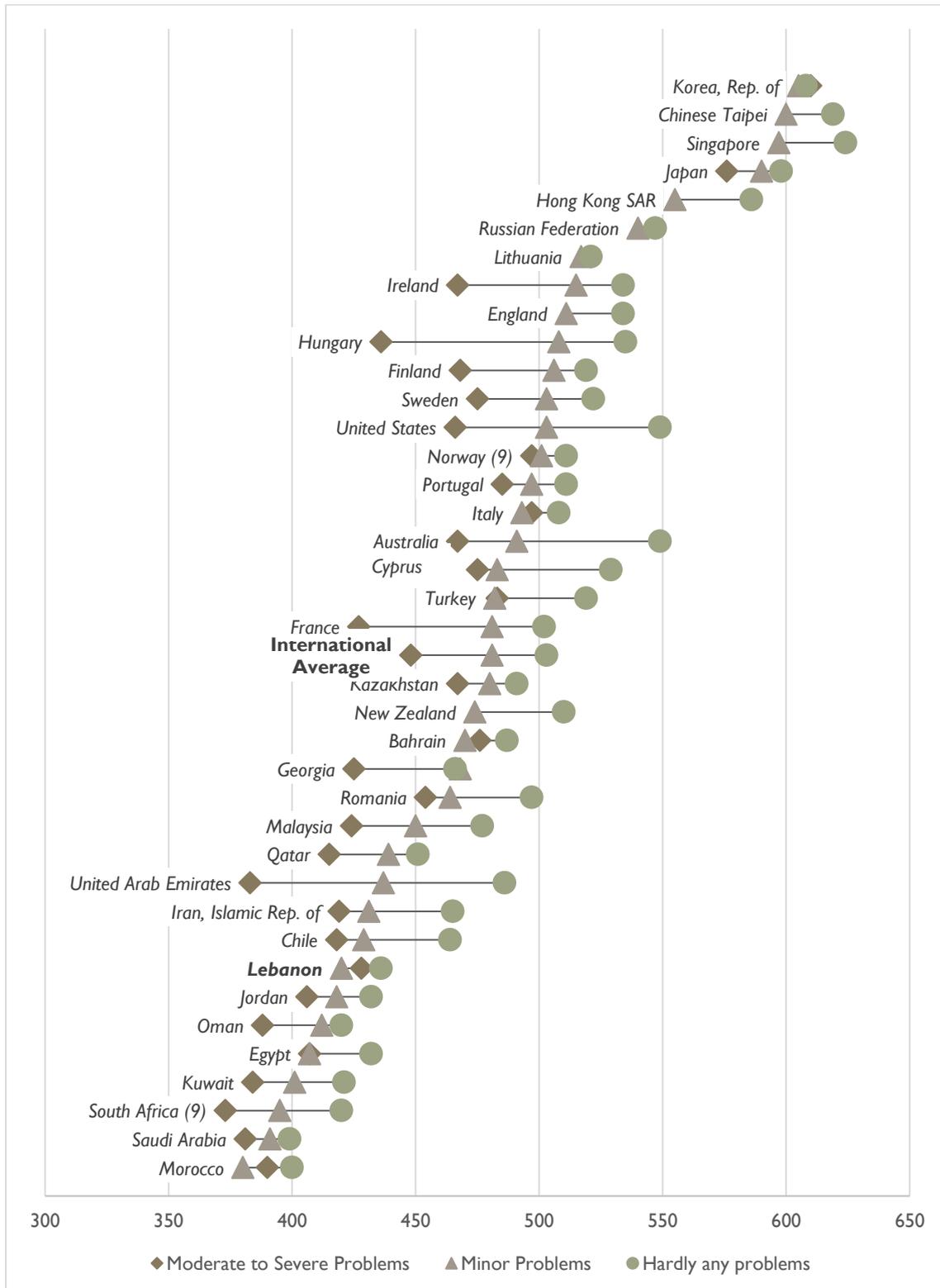
Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Hardly any problems	41% (4.3)	436 (4.3)	45% (0.6)	503 (1.0)	44%	439
Minor problems	35% (4.0)	420 (5.9)	43% (0.6)	481 (1.0)	34%	419
Moderate to Severe Problems	24% (3.7)	428 (7.9)	11% (0.4)	448 (2.1)	22%	407

Source: Exhibit 8.4: School Discipline – Principals’ Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

The best performance in mathematics can be found among students who caused hardly any problems in every geographical area and a roughly similar share of students assigned to this category. In Lebanon and MENA countries, slightly more students caused moderate to severe problems than on the international average. Additionally, while on international average and in MENA countries, the decrease in discipline correlates with better results in mathematics, such a pattern is not observed in Lebanon.

The dependency of the performance in mathematics on disciplinary climate can be better interpreted with an analysis of the distribution of the average results in mathematics in participating countries. Such analysis is shown in figure 6.6.

Figure 6.6 Average results in G8 TIMSS Mathematics assessment with respect to the frequency of occurrence of discipline problems among students.



Source: Exhibit 8.4: School Discipline – Principals’ Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In every country, the best results were obtained by students who belonged to the category of hardly any problems, and the worst performance is instead found among students who caused moderate to severe discipline problems. However, no recognizable pattern is observed in the range of inequalities between categories. In Lebanon, there was considerably little difference between the categories.

The same analysis can be conducted regarding science achievements and is presented in table 6.4. with the average scores in the science assessment depending on the level of observed discipline problems.

Table 6.4. Average score obtained in G8 TIMSS Science assessment 2019 with respect to the level of observed discipline problems among students

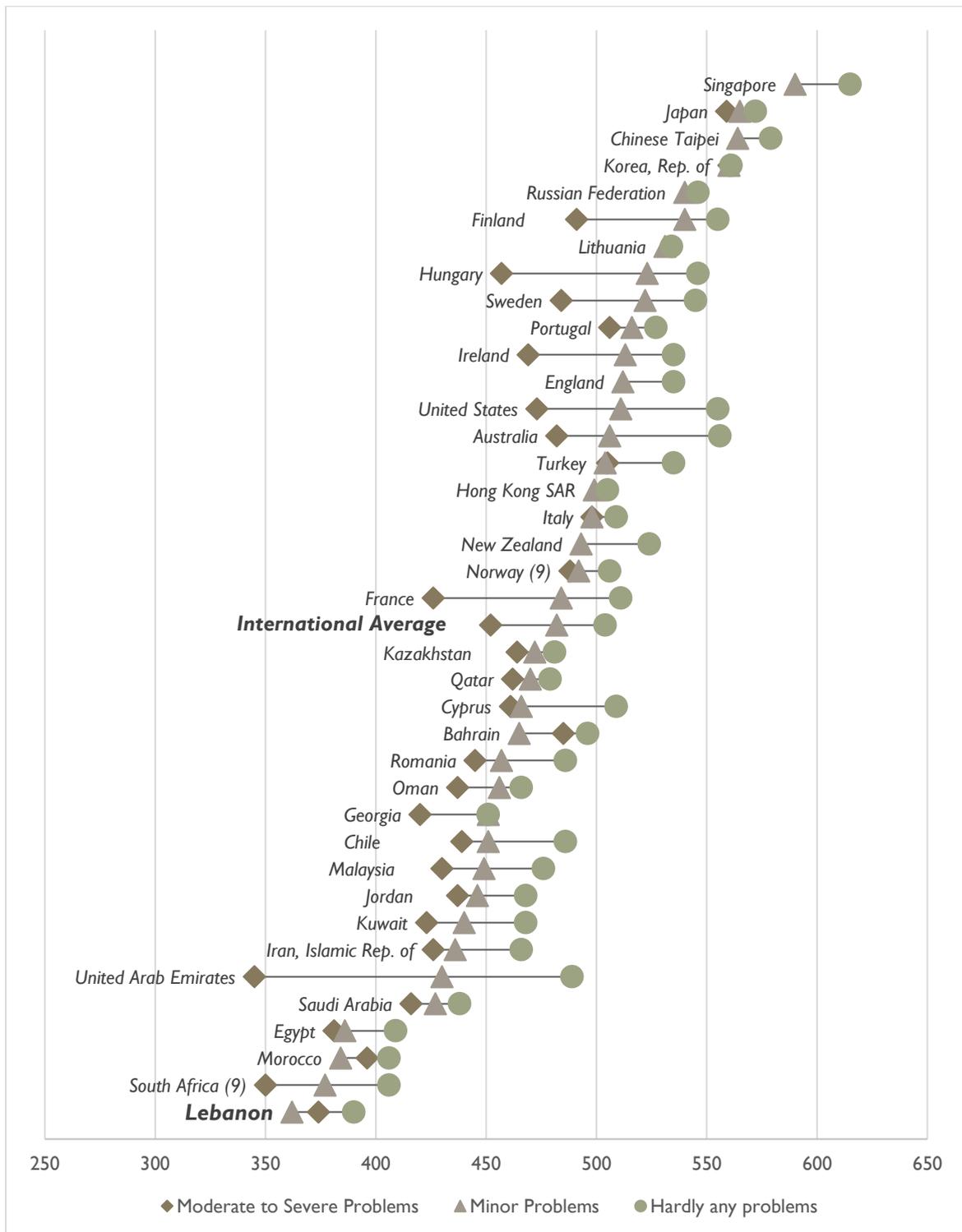
Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Hardly any problems	41% (4.3)	390 (7.7)	45% (0.6)	504 (1.0)	44%	452
Minor Problems	35% (4.0)	362 (8.7)	43% (0.6)	482 (1.0)	34%	427
Moderate to Severe Problems	24% (3.7)	374 (12.1)	11% (0.4)	452 (2.1)	22%	417

Source: Exhibit 8.5: School Discipline – Principals’ Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In each country group, the highest results were obtained by students who were reported to cause hardly any discipline problems, which can mean that disciplinary climate might positively influence students’ performance in science. However, it is not possible for Lebanon to conclude that a decrease in the frequency of reported discipline problems generates higher results in science, contrary to the other geographical areas.

As the range of observed inequalities between categories might be different in each country, the distributions of the scores obtained in the science assessment concerning the occurrence of disciplinary problems among students were analyzed. Figure 6.7. presents the average results in science assessments depending on students' level of disciplinary problems.

Figure 6.7. Average results in G8 TIMSS Science assessment with respect to the frequency of occurrence of discipline problems among students.



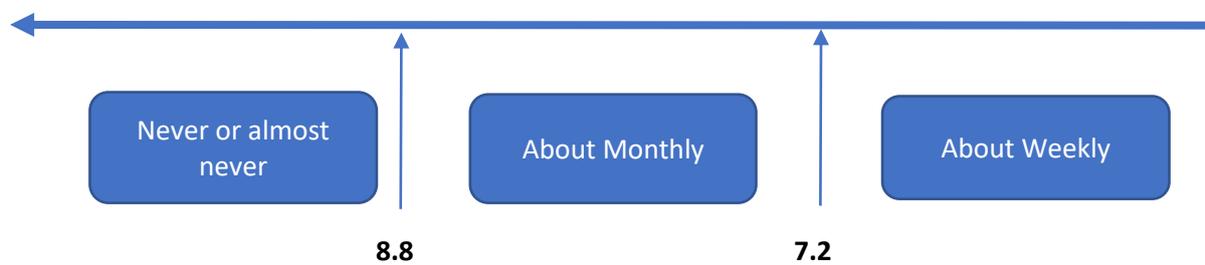
Source: Exhibit 8.5: School Discipline – Principals’ Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In all the listed countries, the highest achievements in science were observed among students who caused hardly any disciplinary problems. When it comes to the differences between categories describing the significance level of discipline problems, no straightforward conclusion can be made since the inequalities are not consistent across countries. Nevertheless, relying upon this analysis, the importance of discipline in schools should be emphasized.

6.3. Bullying

Bullying is an example of anti-social behavior which causes psychological and possibly physical harm. Some students can be victims of bullying and might therefore identify their school as a place of fear and stress, leading to worse results and irreversible long-term problems. In order to understand the occurrence of bullying in schools, the additional questionnaires also asked whether the students had experienced it. The questionnaires accounted for gossiping, spreading lies about others, thefts, and threats. Based on the reported **occurrence of bullying** activities, a bullying indicator was designed (Figure 6.8). The scale is divided into three categories to make it easier to understand the occurrence of bullying acts at schools.

Figure 6.8. Scale description of the occurrence of bullying acts at schools



Source: Exhibit 8.14: Student Bullying. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Exposure to bullying is believed to impact students' achievements strongly negatively. In order to account for this, the data concerning the percentage of students exposed to different frequencies of bullying acts and their average achievements in mathematics are shown in table 6.5.

Table 6.5. Average score obtained in G8 TIMSS Mathematics assessment 2019 with respect to frequency of observed bullying acts among students

Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Never or Almost Never	63% (1.6)	438 (3.3)	71% (0.2)	496 (0.6)	65%	439
About Monthly	27% (1.2)	425 (3.9)	23% (0.1)	482 (0.8)	25%	421
About Weekly	10% (0.9)	403 (4.9)	6% (0.1)	428 (1.5)	10%	379

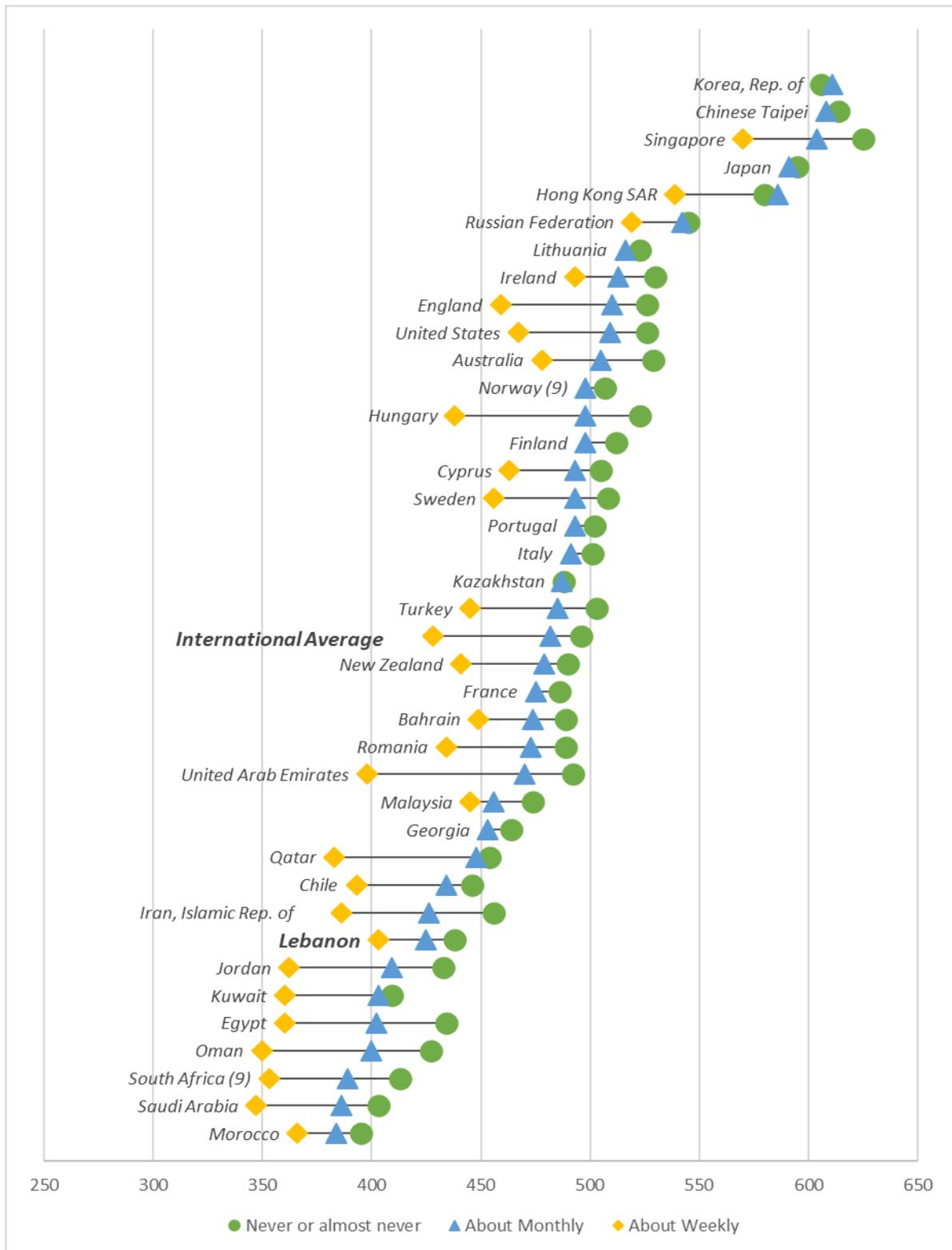
Source: Exhibit 8.15: Student Bullying. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

The percentage of students who never experienced any bullying acts was the greatest in all the groups, with students on international average being slightly less exposed to bullying. In terms of the results, an increase in the frequency of bullying acts correlates with a lower average scores in mathematics. Interestingly, the dependency between the frequency of bullying acts and the average performance in mathematics is considerably smaller in Lebanon than in the other groups.

The country distributions of results in mathematics are presented in Figure 6.9. with respect to frequency of bullying acts, to account for local differences among eighth-graders.

In the majority of the listed countries, the highest results in mathematics are observed among students who were never bullied. At the same time, in most cases, students who were bullied about weekly scored fairly worse results in mathematics on average. While the inequalities between groups are large in most of the countries, the differences in Lebanon are relatively low.

Figure 6.9. Average scores obtained in G8 TIMSS Mathematics assessment 2019 with respect to frequency of observed bullying acts among students in participating countries.



Source: Exhibit 6.9: Student Bullying. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Bullying might cause some difficulties in achieving results in science as well. Table 6.6. presents average achievement in science with respect to the frequency of bullying acts.

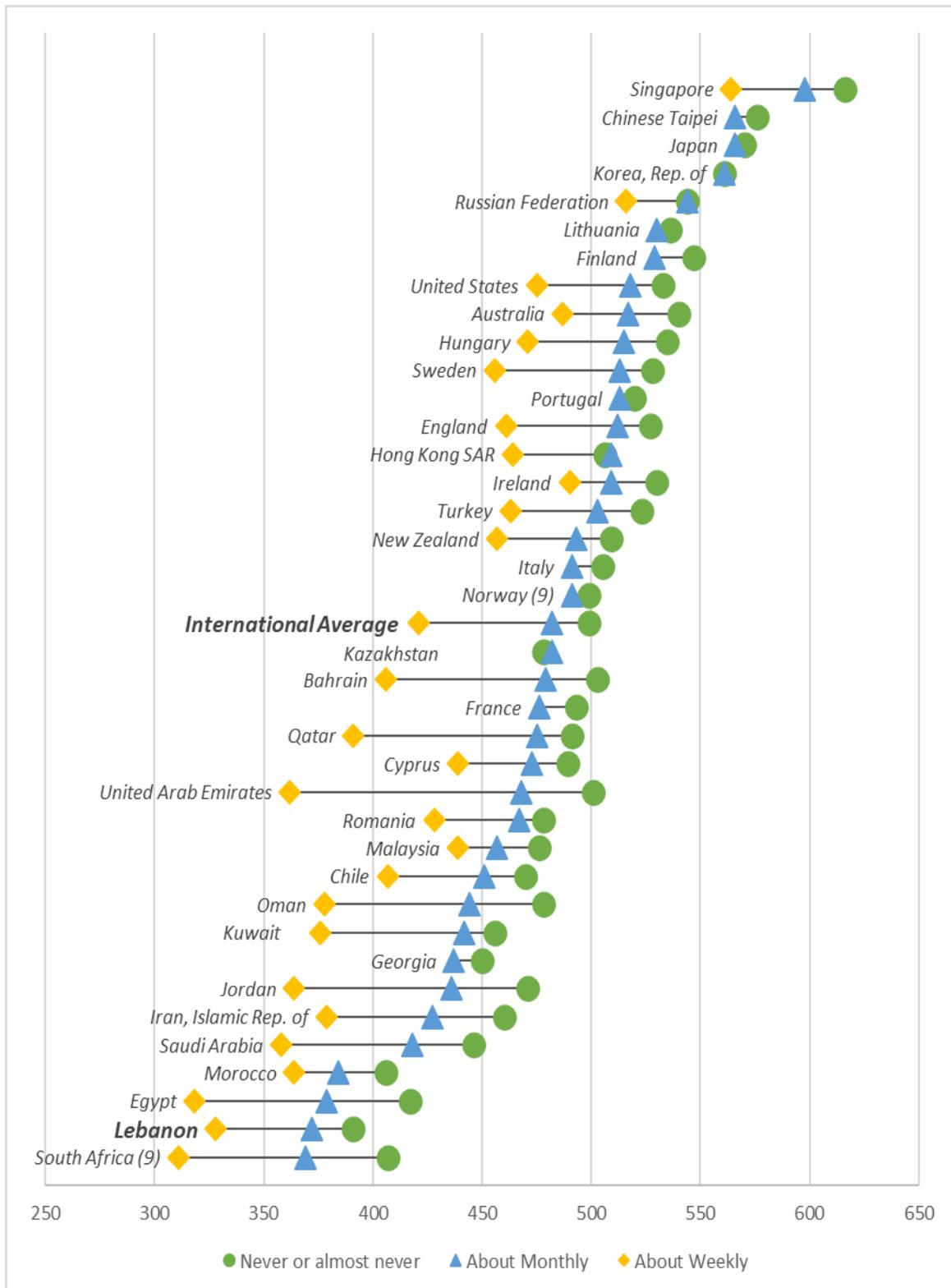
Table 6.6. Average score obtained in G8 TIMSS Science assessment 2019 with respect to frequency of observed bullying acts among students

Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Never or Almost Never	63% (1.6)	391 (4.9)	71% (0.2)	499 (0.6)	65%	456
About Monthly	27% (1.2)	372 (6.8)	23% (0.1)	482 (0.8)	25%	429
About Weekly	10% (0.9)	328 (7.3)	6% (0.1)	421 (1.6)	10%	366

Source: Exhibit 8.16: Student Bullying. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Students who experienced bullying acts weekly have achieved lower scores in science by far. Figure 6.10. presents the average performance in science depending on the frequency of experienced bullying acts among eighth-graders at the country level.

Figure 6.10. Average scores obtained in G8 TIMSS Science assessment 2019 with respect to frequency of observed bullying acts among students in participating countries.



Source: Exhibit 8.16: Student Bullying. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In terms of achievement in science, considerably higher differences between categories are found. As in the case of Mathematics, the best performance in science can be found among students who never or almost never experienced bullying acts. Moreover, it is possible to observe relatively high differences between groups in the MENA countries.

Chapter 7. Teacher Preparation, Professional Development, & Job Satisfaction

This chapter presents **teachers' reports about their formal education** and how this relates to educational achievements across several characteristics. In addition to teachers, also the experience and education of school principals is discussed.

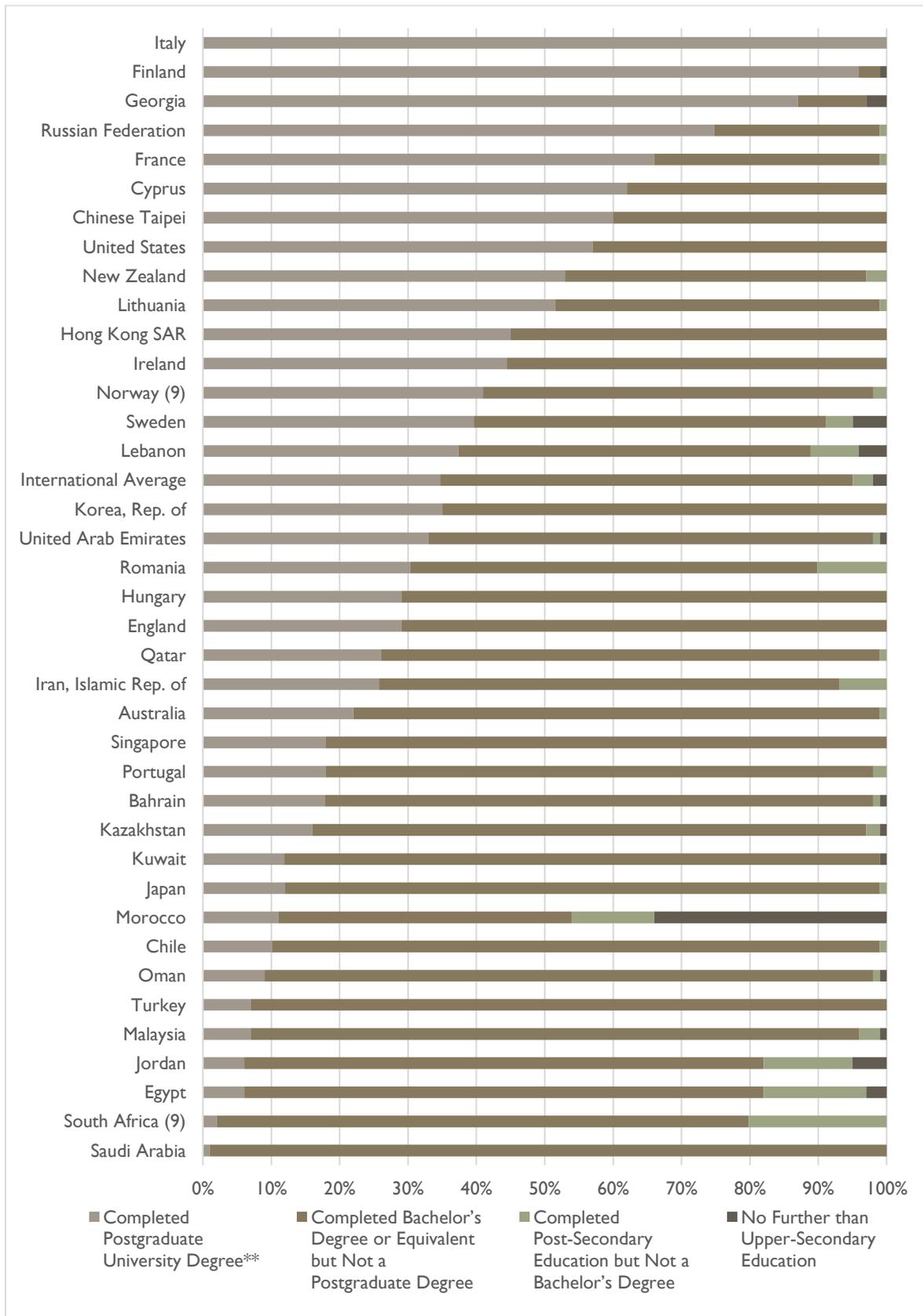
7.1. Teachers' and principal's level of education

The requirements for becoming a teacher might vary by country, and differences in conditions can also be observed depending on the type of school. In order to teach properly, a piece of deep knowledge and ability are needed, and a diploma of higher education usually accounts for this. Figure 7.1. shows the percentage distribution of mathematics teachers by their **highest educational attainment**.

In most countries, the majority of mathematics teachers have completed an undergraduate degree. In Lebanon, 88% of mathematics teachers have completed any tertiary education, which is one of the highest levels among the MENA countries and slightly higher than the international average. However, relatively many teachers in Lebanon (i.e., 4%) finished their education at the upper-secondary school level.

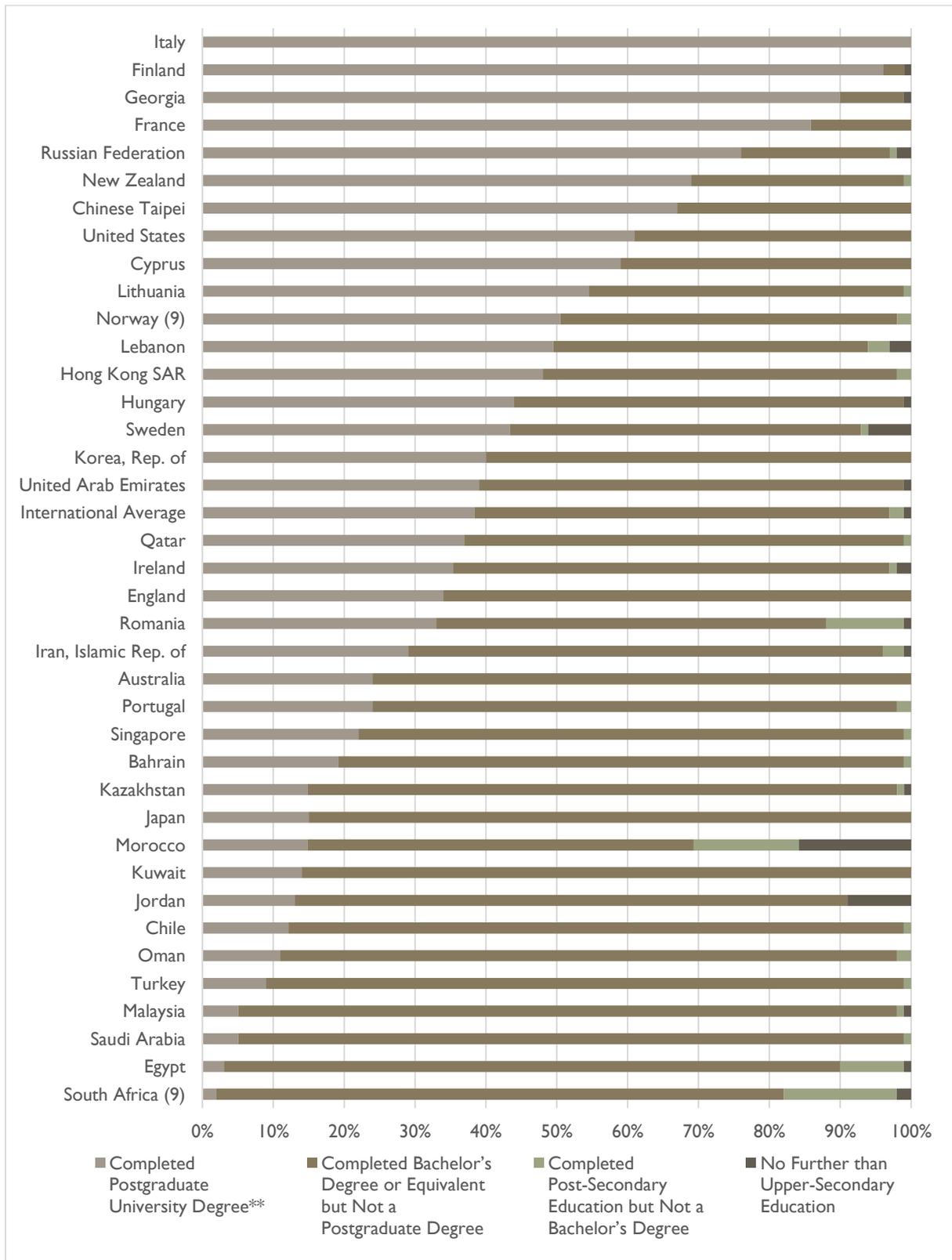
As in the case of mathematics, different educational requirements may be expected from science teachers. Figure 7.2. presents the percentage distribution of science teachers' highest level of education in the countries participating in the assessment.

Figure 7.1. Percentage of mathematics teachers by the highest level of degree completed.



Source: Exhibit 9.3: Teachers' Formal Education. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Figure 7.2. Percentage of science teachers by the highest level of degree completed.



Source: Exhibit 9.4: Teachers' Formal Education. TIMSS 2019 International Results in Mathematics and Science.

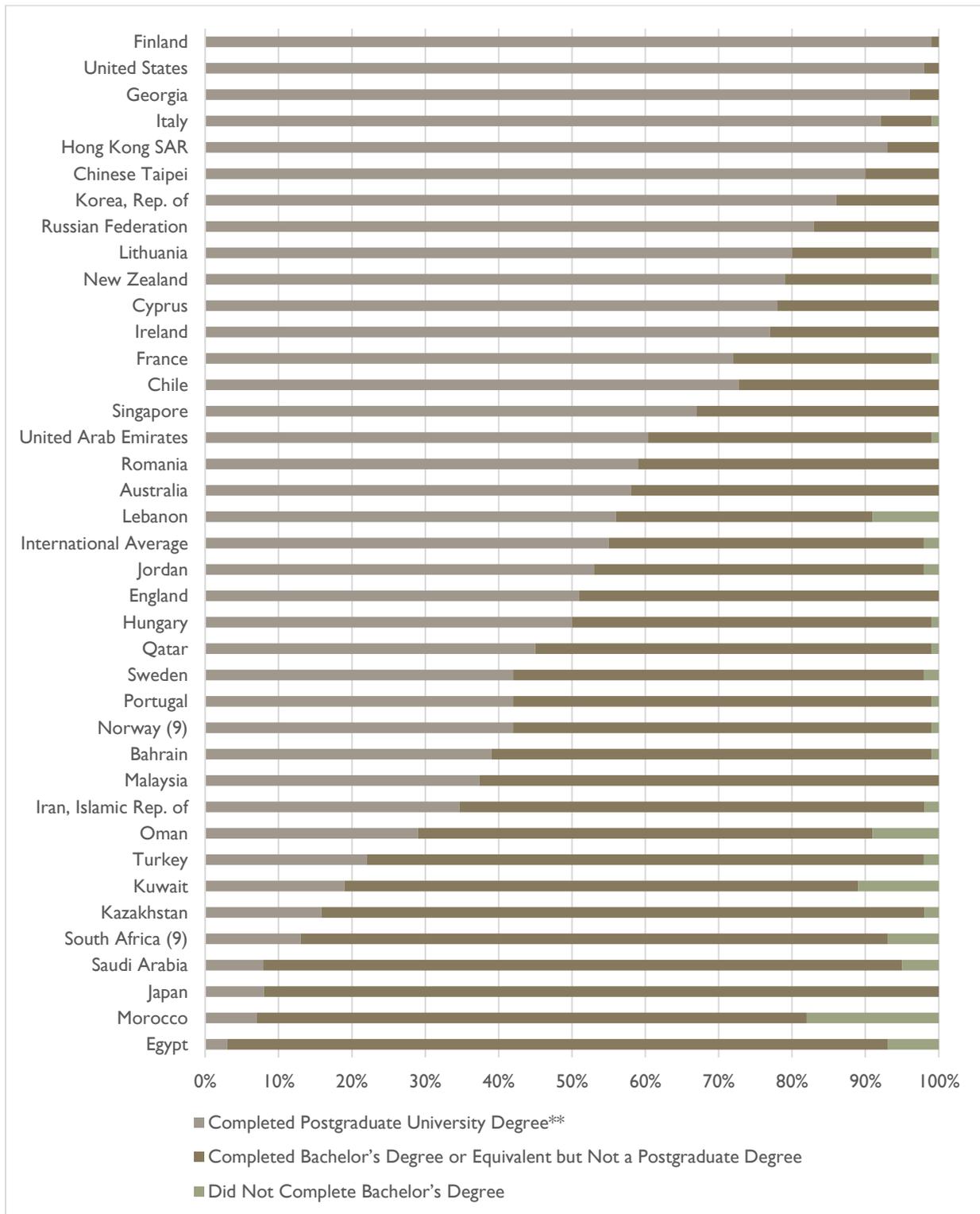
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In most countries, the education level of science teachers is similar to the one of mathematics teachers, also noting that in some countries mathematics and science are taught by the same person. However, significant differences in teachers' education were observed in several countries, including Lebanon, where more science teachers have completed postgraduate studies compared to mathematics. Also, in Lebanon, considerably more science than mathematics teachers have obtained at least a bachelor's degree, which should translate to better competencies in teaching this discipline on average. Nevertheless, this is not reflected in the average scores obtained by Lebanese eighth-graders in the mathematics and science assessments.

Principals should possess a range of skills such as leadership, the ability to recognize problems, and human resource management, while also understanding the problems faced by teachers on a daily basis. Figure 7.3. presents the percentage distribution of **education among school principals** in the countries participating in the assessment.

Like in the case of mathematics and science teachers, most principals have obtained at least a bachelor's degree in most countries. However, the education level of schools' principals varies strongly among participating countries. In the top achieving countries, such as Finland, Chinese Provinces, and Korea, there are no principals without at least a bachelor's degree, and the share of postgraduate graduates exceeds 75%. In other countries, most principals have obtained at least a bachelor's degree. When it comes to principals who did not obtain a higher degree, principals from MENA countries are overrepresented in that category. For example, around 1 in 10 principals did not obtain a higher education diploma in Kuwait, Lebanon, and Oman. Even though the share of principals in that category is relatively substantial, it can significantly impact the quality of management of the educational institution. This can be confirmed by the fact that a high share of principals whose education is lower than a bachelor's degree is observed in countries with the weakest results in mathematics and science, such as Morocco and South Africa.

Figure 7.3. Percentage of principals by the highest level of degree completed.



Source: Exhibit 6.20: Principals' Formal Education. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

7.2. Teachers' and principal's experience

The process of acquiring teaching skills can also occur through gaining work experience and not only thanks to formal education. Therefore, to determine whether teachers' experience influences students' performance in mathematics, it is worth analyzing how the results are distributed among country groups depending on the teacher's experience. The relevant data are presented in Table 7.1.

Table 7.1. Average score obtained in G8 TIMSS Mathematics assessment 2019 with respect to the experience of the mathematics teacher.

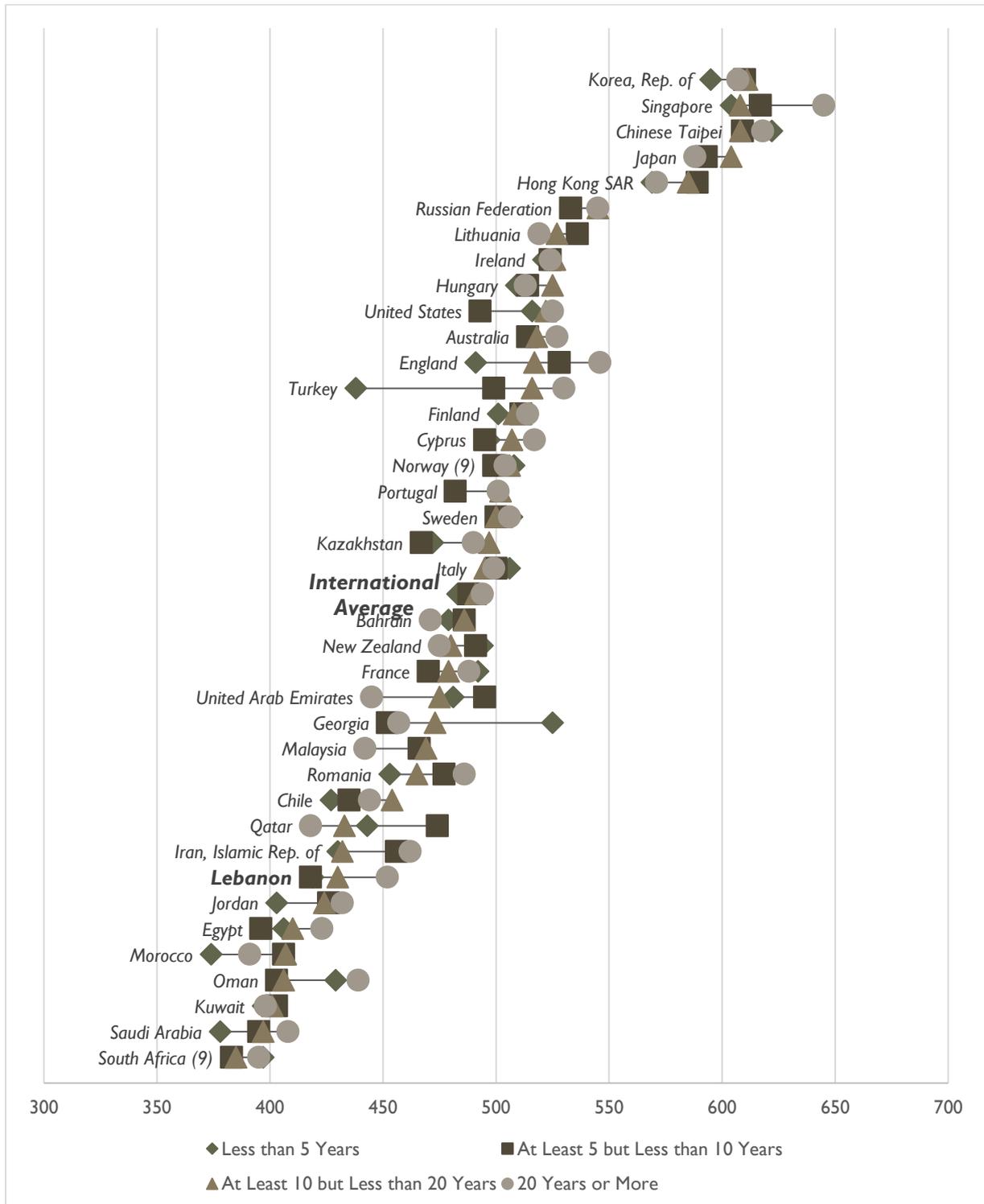
Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
20 years or more	26% (3.7)	452 (7.7)	35% (0.5)	494 (1.2)	25%	431
At least 10 but less than 20 Years	30% (3.8)	430 (7.9)	33% (0.6)	491 (1.1)	37%	427
At least 5 but less than 10 Years	26% (3.1)	418 (6.4)	18% (0.5)	488 (1.8)	21%	433
Less than 5 Years	18% (3.7)	419 (9.1)	14% (0.4)	483 (2.6)	16%	422

Source: Exhibit 9.11: Teachers' Years of Experience. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

On average, fewer teachers have high levels of experience in Lebanon and the MENA countries compared to the international average. Interestingly, while in other countries, no significant influence of the teacher's experience on students' educational performance was observed, in Lebanon, the inequalities between categories were observed and were substantial for teachers with more than ten years of service. The differences in student performance may indicate that Lebanese teachers are inadequately prepared for the profession in the early years of their careers.

Figure 7.4. Average score obtained in G8 TIMSS Mathematics assessment 2019 with respect to the experience of the mathematics teacher among participating countries.



Source: Exhibit 9.11: Teachers' Years of Experience. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In order to understand the possible impact of teachers' experience on students' performance in the mathematics assessment, it is essential to analyze how the results have been distributed across countries. Figure 7.4. shows the distribution of the results in mathematics according to the teacher's experience.

Based on the rule of thumb, in most countries, there are no significant differences in the outcomes of the assessment depending on the teacher's experience. However, in a few countries, including Lebanon, more experienced teachers perform significantly better than others, possibly indicating an inadequate preparation of teachers at the beginning of their careers. The implementation of additional retraining courses can serve as an idea of providing a solution for this issue.

A similar analysis was conducted in the case of the assessment in science. Table 7.2. shows the average scores obtained during such assessment concerning the experience of teachers.

Table 7.2. Average score obtained in G8 TIMSS Mathematics assessment 2019 with respect to the experience of the science teacher.

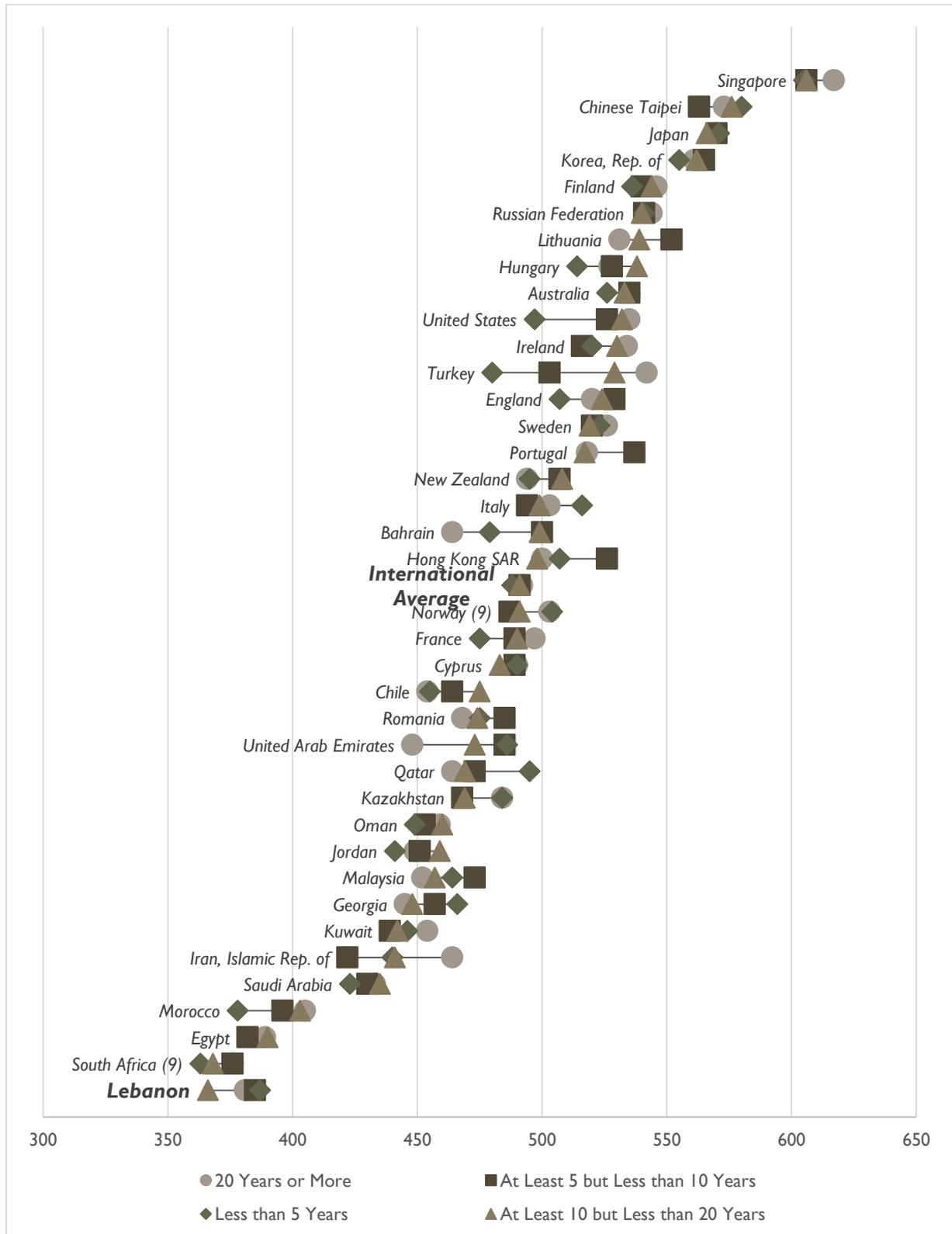
Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
20 years or more	16% (2.1)	381 (13.2)	34% (0.5)	492 (1.3)	23%	437
At least 10 but less than 20 Years	36% (2.7)	366 (7.7)	32% (0.5)	491 (1.0)	38%	440
At least 5 but less than 10 Years	24% (2.4)	385 (8.6)	18% (0.4)	491 (1.5)	24%	438
Less than 5 Years	24% (2.1)	387 (7.9)	15% (0.4)	488 (1.7)	15%	442

Source: Exhibit 9.12: Teachers' Years of Experience. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In Lebanon, significantly fewer teachers have twenty years or more of professional experience than the MENA countries and the international average. At the same time, almost one-fourth of science teachers in Lebanon have less than five years of experience. It is worth noting that no significant trend was observed in the educational outcomes depending on teachers' experience in any of the groups, which can mean that teachers' experience is not essential for satisfying educational outcomes.

As in the case of mathematics, the distributions of results by countries were analyzed and presented in Figure 7.5. There is no pattern among the participating countries corresponding to the influence of teachers' experience on students' achievements. It is well reflected in the international average, as regardless of the teacher's experience, there is no significant difference in the students' results. In fact, only in few countries the difference between students based on their teachers experience was observable (i.e. UAE, Turkey, USA, Bahrain).

Figure 7.5. Average score obtained in G8 TIMSS Science assessment 2019 with respect to the experience of the mathematics teacher among participating countries.



Source: Exhibit 9.12: Teachers' Years of Experience. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Table 7.3. The significance of the differences between Lebanese students, by teachers' professional experience.

	95% confidence interval							
	20 Years or More		At Least 10 but Less than 20 Years		At Least 5 but Less than 10 Years		Less than 5 Years	
Mathematics	436.9	467.1	414.5	445.5	405.5	430.5	401.2	436.9
Science	355.1	406.9	350.9	381.1	368.1	401.9	371.5	402.5

Source: Exhibit 9.11: Teachers' Years of Experience. Exhibit 9.12: Teachers' Years of Experience. TIMSS 2019

International Results in Mathematics and Science. Downloaded from:

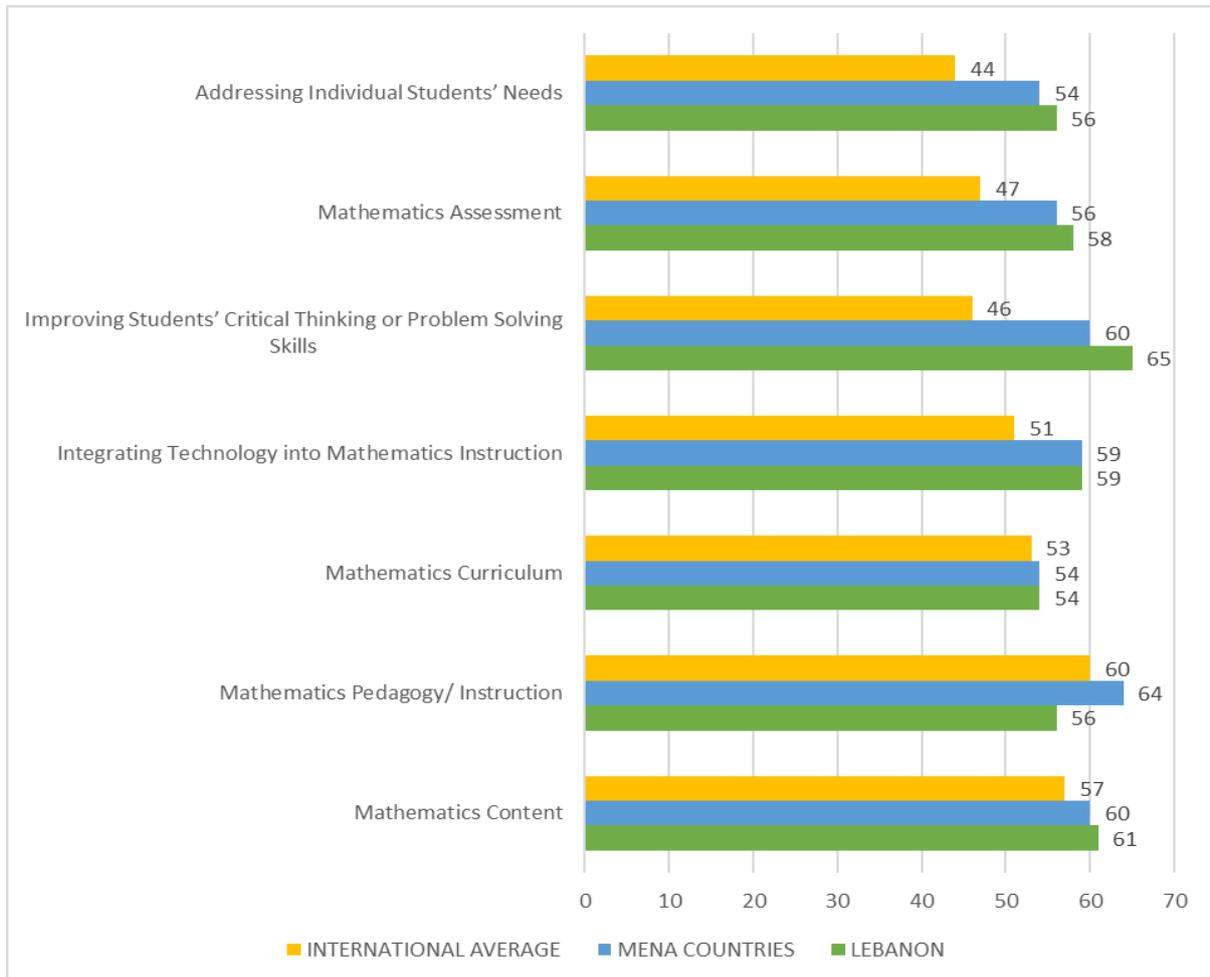
<https://timssandpirls.bc.edu/timss2019/international-results/>

Based on the 95% confidence intervals of students' achievements in mathematics and science, it can be found that there were no significant differences between students' achievements in either mathematics or science. Only those, students whose mathematics teachers had at least 5 but less than 10 years of professional experience have scored significantly lower than eighth-graders taught by the most experienced teachers (20 years or more).

7.3. Teachers' development

Teaching requires constant development since teachers are expected to provide high-quality and up-to-date teaching. Teachers often have the opportunity to participate in various types of training, leading to new skills and providing a better understanding of the ongoing changes in education. Therefore, it is essential to stress the role of **participation in additional courses**, and figure 7.6. shows the share of teachers who took part in training courses, depending on the training subject.

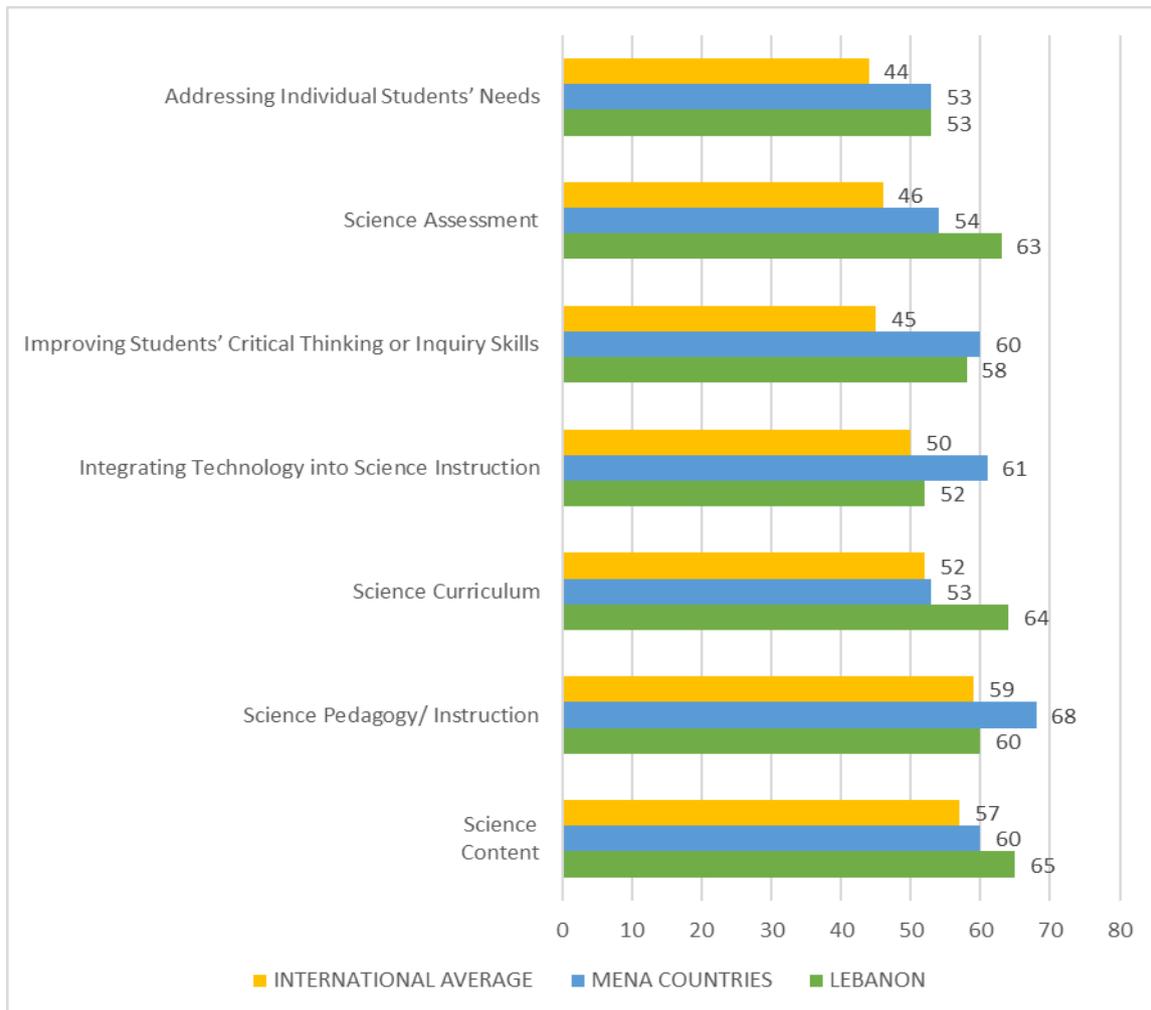
Figure 7.6. Percentage of teachers that participated in Professional Development Courses in Mathematics in last two years



Source: Exhibit 9.15: Teachers' Participation in Professional Development in Mathematics in the Past Two Years. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In most categories, the interest in training among Lebanese teachers was the highest compared to the MENA countries and the international average. **The most popular choice of mathematics teachers in Lebanon is the training to improve students' critical and analytical thinking skills. In contrast, Lebanese teachers were the least interested in the courses concerning the core curriculum in mathematics.** Moreover, Lebanese teachers are less willing to participate in additional pieces of training on the instruction of mathematics than their colleagues from other geographical areas. To improve the participation rate, compulsory training can be introduced to keep teachers up to date with the changes in the teaching techniques. A similar analysis was conducted in case of science teachers, whose results can be found in figure 7.7.

Figure 7.7. Percentage of teachers that took participated in in Professional Development Courses in Science in last two years



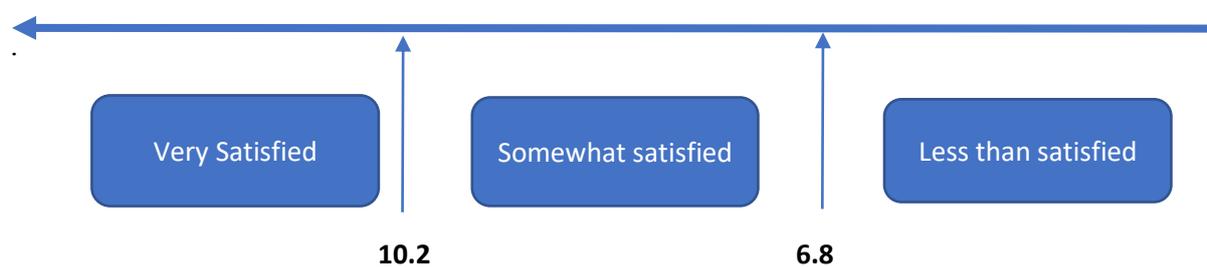
Source: Exhibit 9.16: Teachers' Participation in Professional Development in Science in the Past Two Years. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirils.bc.edu/timss2019/international-results/>

For Lebanon, the results are similar to the case of mathematics, while in the MENA countries, the interest in training among teachers is higher. For Lebanon, the results are quite similar to the case of mathematics. However, relatively few teachers were interested in introducing technology into instruction or addressing students' individual needs in Lebanon. In comparison, in MENA countries, science teachers were much more interested in developing their skills through participating in the development courses in general. Significantly large differences can be found between the MENA countries and Lebanon in the courses concerning the integration of technology into science and science instruction, as respectively 11% and 8% more MENA teachers want to develop their skills in this field. It may explain the differences in the results obtained in science, where Lebanon achieved one of the worst scores among the participating countries, much lower than the mean in the MENA countries. Nevertheless, Lebanon's most popular training courses concerned science content, science curriculum, and science assessment, meaning that improvements might be observed in the future.

7.4. Teachers' job satisfaction

Teachers can enjoy the educational success of their students, professional development, and follow their passion on a daily basis. However, many factors such as high expectations of parents or students' behavior may negatively influence the perceived job satisfaction. To account for this, a **job satisfaction index** has been developed, calculated based on teachers' responses about whether they are either enthusiastic or inspired or if they feel proud when thinking about their profession. Figure 7.8. shows the scale of the index.

Figure 7.8. Scale description of teachers' job satisfaction index



Source: Exhibit 9.21: Teachers' Job Satisfaction. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Based on their answers, teachers were categorized into different groups depending on the perceived level of job satisfaction. Table 7.3. shows the percentage of teachers by job satisfaction and the average scores achieved by their students in mathematics.

Table 7.3. Average score obtained in G8 TIMSS Mathematics assessment 2019 with respect to the job satisfaction of the mathematics teachers.

Category	Lebanon		International Average		MENA countries	
	Percentage of Teachers	Average Score	Percentage of Teachers	Average Score	Percentage of Teachers	Average Score
Very Satisfied	70% (3.6)	432 (4.2)	54% (0.6)	493 (0.9)	73%	432
Somewhat Satisfied	29% (3.6)	425 (8.0)	39% (0.6)	486 (1.1)	23%	422
Less than Satisfied	1% (0.7)	NA	7% (0.3)	490 (2.4)	4%	394

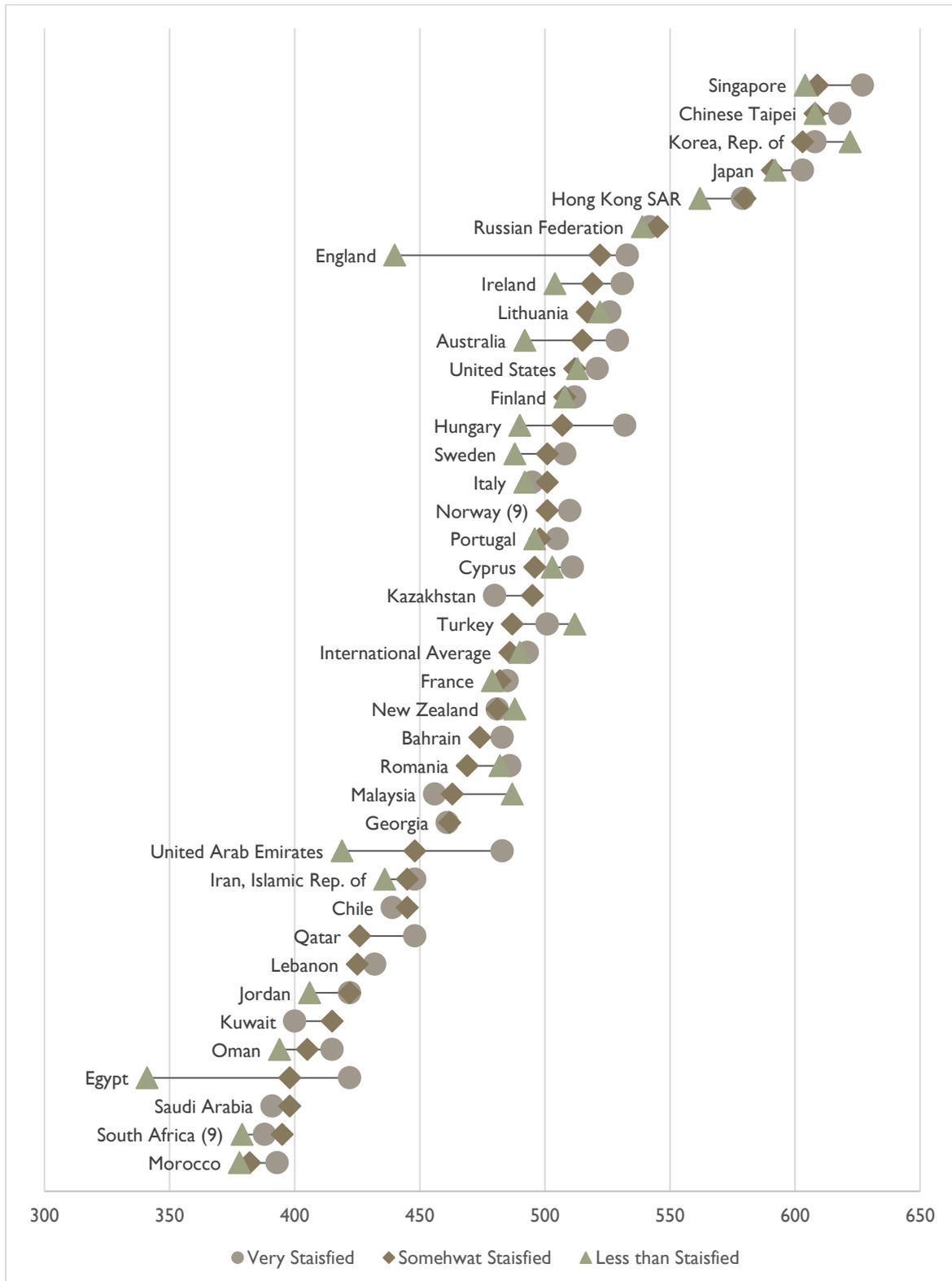
Source: Exhibit 9.24: Teachers' Job Satisfaction. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In the MENA countries and Lebanon, many more teachers were very satisfied with their work, compared to the international average. The highest scores were achieved by those students taught by the most satisfied teachers.

In order to examine whether the job satisfaction of teachers can affect the performance of students in mathematics, distribution analysis of the results in individual countries was shown in Figure 7.9. In most countries, the students whose teachers were very satisfied with their work achieved the best results. At the same time, there were no significant differences between the categories, reflecting a weak relationship between teachers' job satisfaction and educational outcomes.

Figure 7.9. Average achievements in mathematics depending on the job satisfaction of mathematics teachers among participating countries.



Source: Exhibit 9.24: Teachers' Job Satisfaction. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

The same analyses of the average score obtained in the TIMSS Science assessment regarding job satisfaction were conducted for teachers in Science. The results are presented in Table 7.4

Table 7.4. Average score obtained in G8 TIMSS Science assessment 2019 with respect to the job satisfaction of the science teachers.

Category	Lebanon		International Average		MENA countries	
	Percentage of Teachers	Average Score	Percentage of Teachers	Average Score	Percentage of Teachers	Average Score
Very Satisfied	63% (3.2)	385 (6.0)	53% (0.5)	494 (0.8)	71%	444
Somewhat Satisfied	35% (3.1)	362 (8.1)	39% (0.5)	486 (1.1)	25%	427
Less than Satisfied	2% (0.6)	NA	8% (0.3)	488 (2.2)	4%	431

Source: Exhibit 9.25: Teachers' Job Satisfaction. TIMSS 2019 International Results in Mathematics and Science.

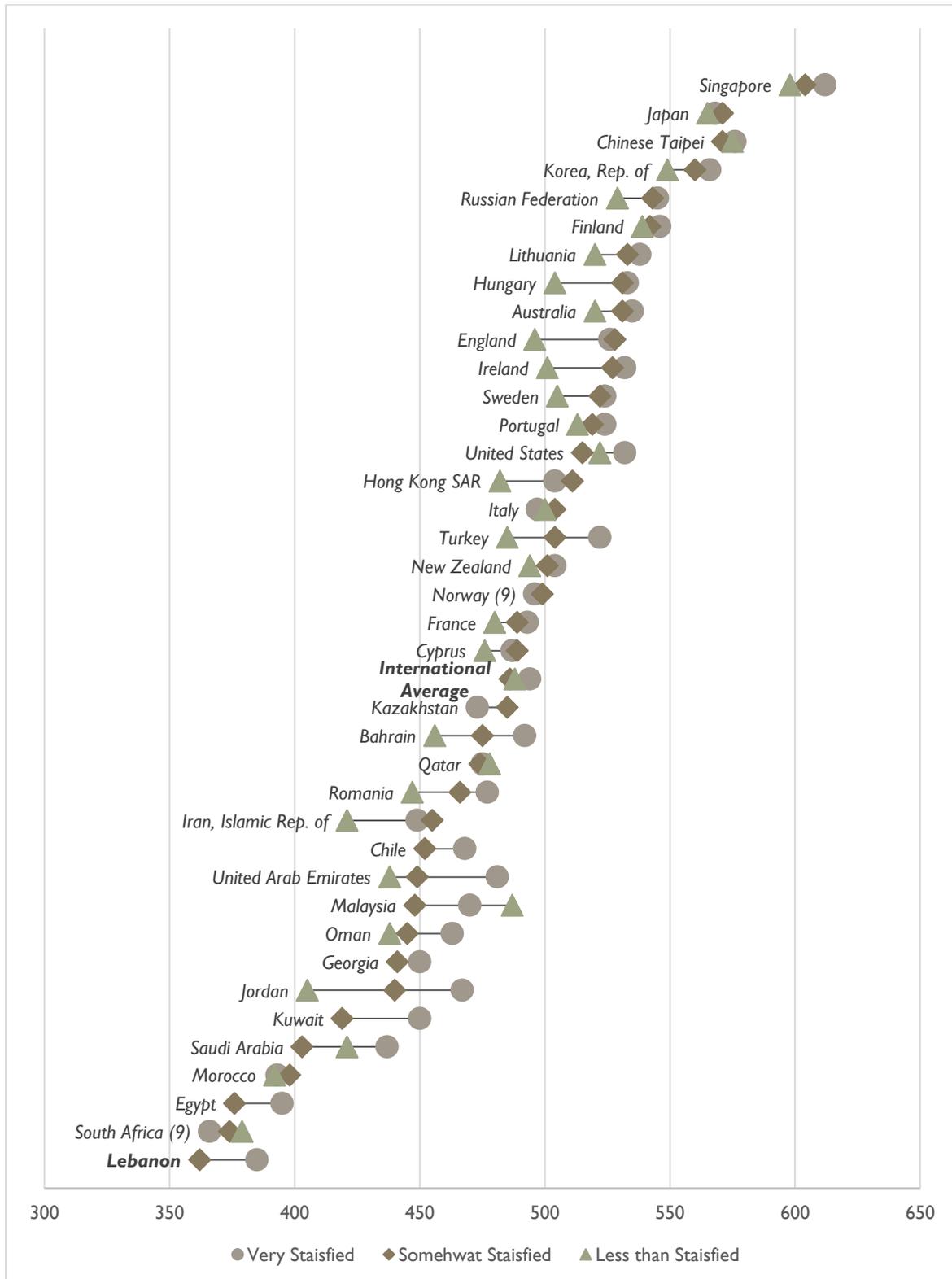
Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

From the mathematics teachers' perspective, fewer Lebanese science teachers were classified as very satisfied. Yet, far more teachers were still very satisfied with their employment compared to the international average. Moreover, in the case of science, job satisfaction seems to affect student learning outcomes more intensively.

In order to examine whether the job satisfaction of teachers can affect the performance of students in science, distribution analysis of the results in individual countries were presented in Figure 7.10.

In most countries, the highest scores have been achieved by students taught by the most satisfied teachers, though it should be noted that the differences between the categories are minor on average. Unlike mathematics, in Lebanon significant differences in science achievements between the categories concerning the high and median level of job satisfaction of teachers were found.

Figure 7.10. Average achievements in science depending on the job satisfaction of science teachers among participating countries.



Source: Exhibit 9.25: Teachers' Job Satisfaction. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Chapter 8. Challenges to teaching and learning

This chapter discusses insights on the **main barriers to teaching and learning**, such as absenteeism, feeling tired or hungry, and readiness for instruction, which play a significant negative role in achieving educational goals.

8.1. Absenteeism

Before the COVID-19 pandemic, education mostly took place in person. In the classrooms, students were introduced to the teaching material, but some skipped school due to illness, school truancy, reluctance to participate in classes, or the obligation to help at home. As the number of absences increases the difficulties with learning, the results of these students may remain a problem.

The structure of absences should be analyzed in each country's context and the real problems faced by eighth-graders, such as low sense of school belonging or commuting issues. Figure 8.1. presents the structure of **school absences** of eighth-graders in the countries participating in the TIMSS 2019 assessment.

Students were divided into five subgroups according to the frequency of their absences: Never or Almost never, Once every two months, Once a month, Once every two weeks, Once a week. While 55% of eighth-graders never or almost never missed a class on international average, the differences between countries are relatively vast. The range varies between South Korea, where 94% of students never or almost never missed school, to Georgia, where only 25% of students did so. In Lebanon, 62% of eighth-graders never or almost never missed a class, but at the same time, 9% of students skipped class once a week.

Figure 8.1. Distribution of the frequency of absenteeism of eighth graders in the countries participating in the test.



Source: Exhibit 10.3: Frequency of Student Absences. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Table 8.1. presents the data concerning the average results in mathematics depending on the frequency of absenteeism.

Table 8.1. Average score obtained in G8 TIMSS Mathematics assessment 2019 with respect to the level of absenteeism.

Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Never or Almost Never	62% (1.3)	438 (3.6)	55% (0.2)	502 (0.6)	50%	445
Once Every Two Months	15% (0.7)	436 (4.5)	16% (0.1)	495 (0.8)	14%	436
Once a Month	11% (0.6)	422 (5.3)	14% (0.1)	475 (0.9)	14%	419
Once Every Two Weeks	4% (0.3)	413 (6.5)	7% (0.1)	452 (1.1)	8%	405
Once a Week	9% (0.7)	384 (4.3)	8% (0.1)	412 (1.3)	14%	377

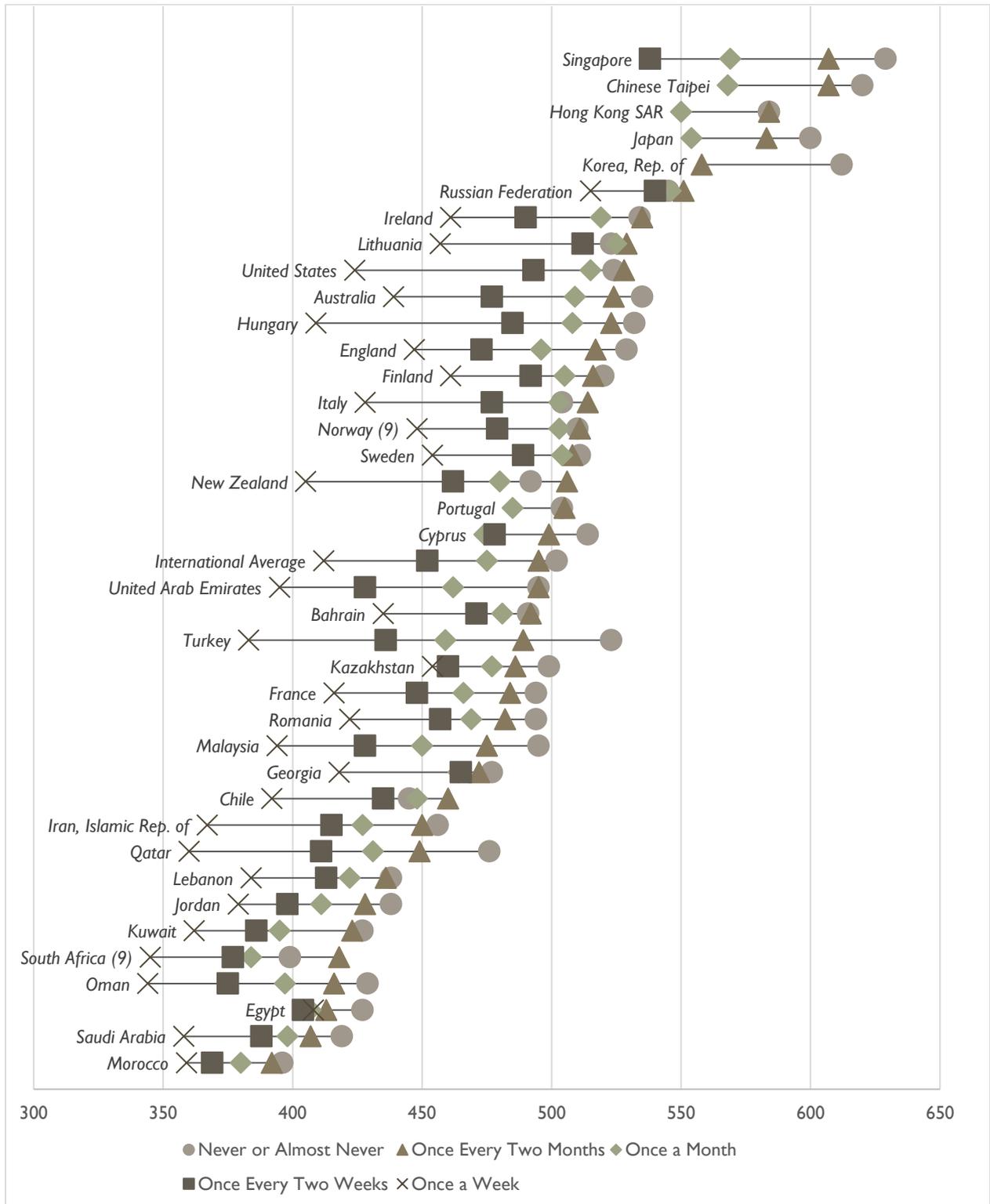
Source: Exhibit 10.3: Frequency of Student Absences. TIMSS 2019 International Results in Mathematics and Science.

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Unsurprisingly, the best mathematics results were achieved by students who were the least likely to be absent. However, there are minor differences between students who never or almost never leave class and students who miss class every two months in all the geographical areas considered.

Figure 8.2. presents the average achievements in the countries participating in the mathematics assessment with respect to the observed level of absenteeism among eighth-graders.

Figure 8.2. Average achievements in G8 TIMSS mathematics assessment with respect to the frequency of absenteeism of eighth graders in countries participating in the assessment.



Source: Exhibit 8.2: Frequency of Student Absences. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirils.bc.edu/timss2019/international-results/>

In the majority of the countries, the highest achievements in mathematics are found among students who never or almost never missed their classes, and similarly the lowest results are received by students who miss classes the most. In Lebanon, the range of observed differences in the scores in the assessment in mathematics is moderate. The influence of absenteeism might be essential when it comes to students' achievements.

Since the support of teachers can play a crucial role in providing a better understanding of science, the relation of school absenteeism and students' performance in science is presented in Table 8.2.

Table 8.2. Average score obtained in G8 TIMSS Science assessment 2019 with respect to the level of absenteeism.

Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Never or Almost Never	62% (1.3)	389 (5.4)	55% (0.2)	504 (0.6)	50%	459
Once Every Two Months	15% (0.7)	385 (7.4)	16% (0.1)	497 (0.8)	14%	449
Once a Month	11% (0.6)	365 (8.2)	14% (0.1)	479 (0.9)	14%	429
Once Every Two Weeks	4% (0.3)	361 (11.1)	7% (0.1)	457 (1.2)	8%	414
Once a Week	9% (0.7)	317 (7.0)	8% (0.1)	413 (1.4)	14%	378

Source: Exhibit 10.4: Frequency of Student Absences. TIMSS 2019 International Results in Mathematics and Science.

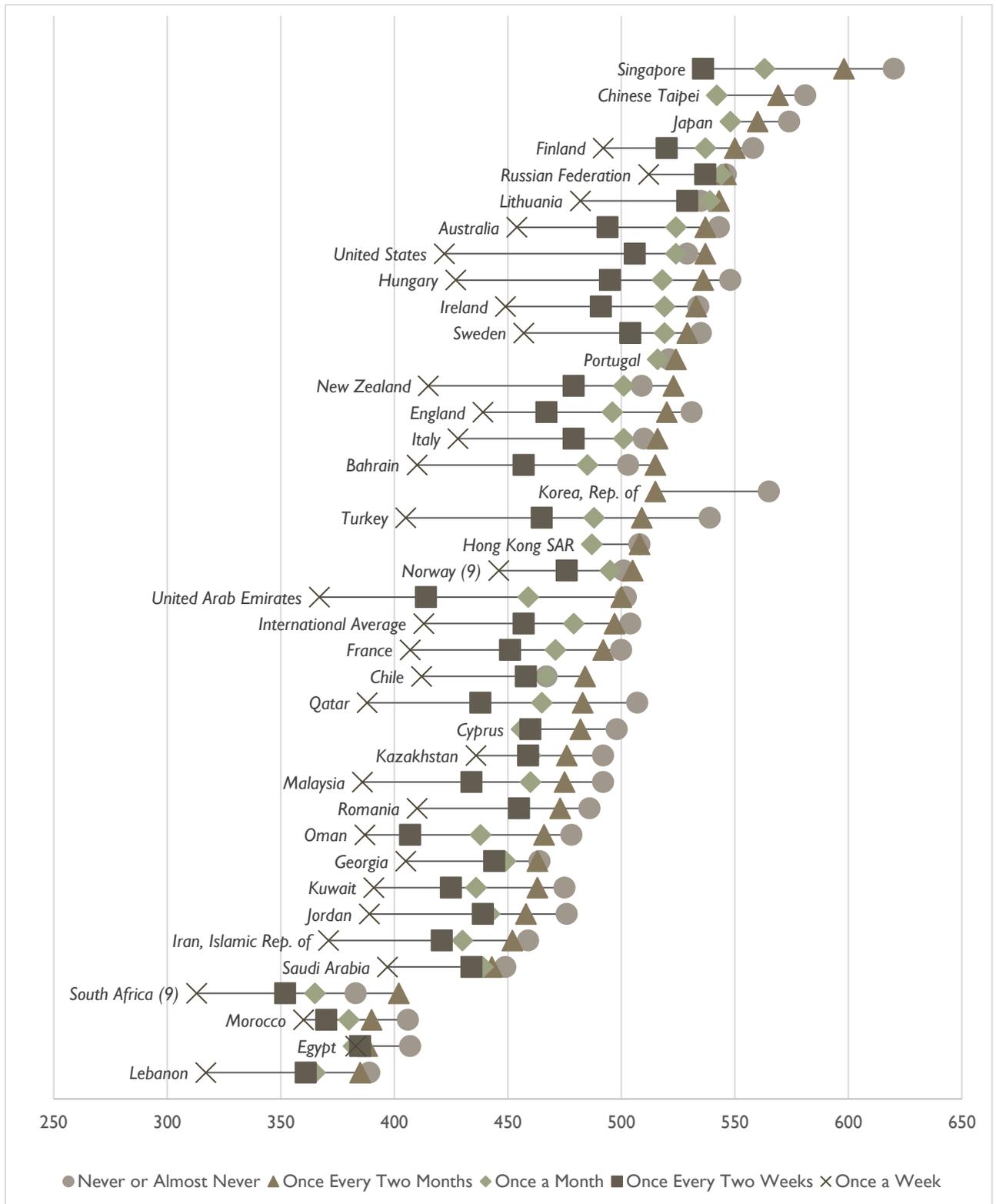
Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-r>

Just like in the case of mathematics, the best results in science are achieved by students who are the least likely to miss school. The impact of absenteeism on the results of Lebanese eighth graders is also visible since the difference between the least absent and most absent groups is equal to as much as 72 score points.

To fully understand the problem of absenteeism among eighth-graders across countries, students' results in science distribution depending on how often they miss classes were presented in Figure 8.3.

In case of science, the observed achievement gaps are slightly greater than in the case of mathematics, although similarly to mathematics, the students who rarely miss their classes scored on average higher than those students who were often absent. Therefore, while designing educational policies, decision-makers should approach lowering truancy among students.

Figure 8.3. Average achievements in G8 TIMSS science assessment with respect to the frequency of absenteeism of eighth graders in countries participating in the assessment.

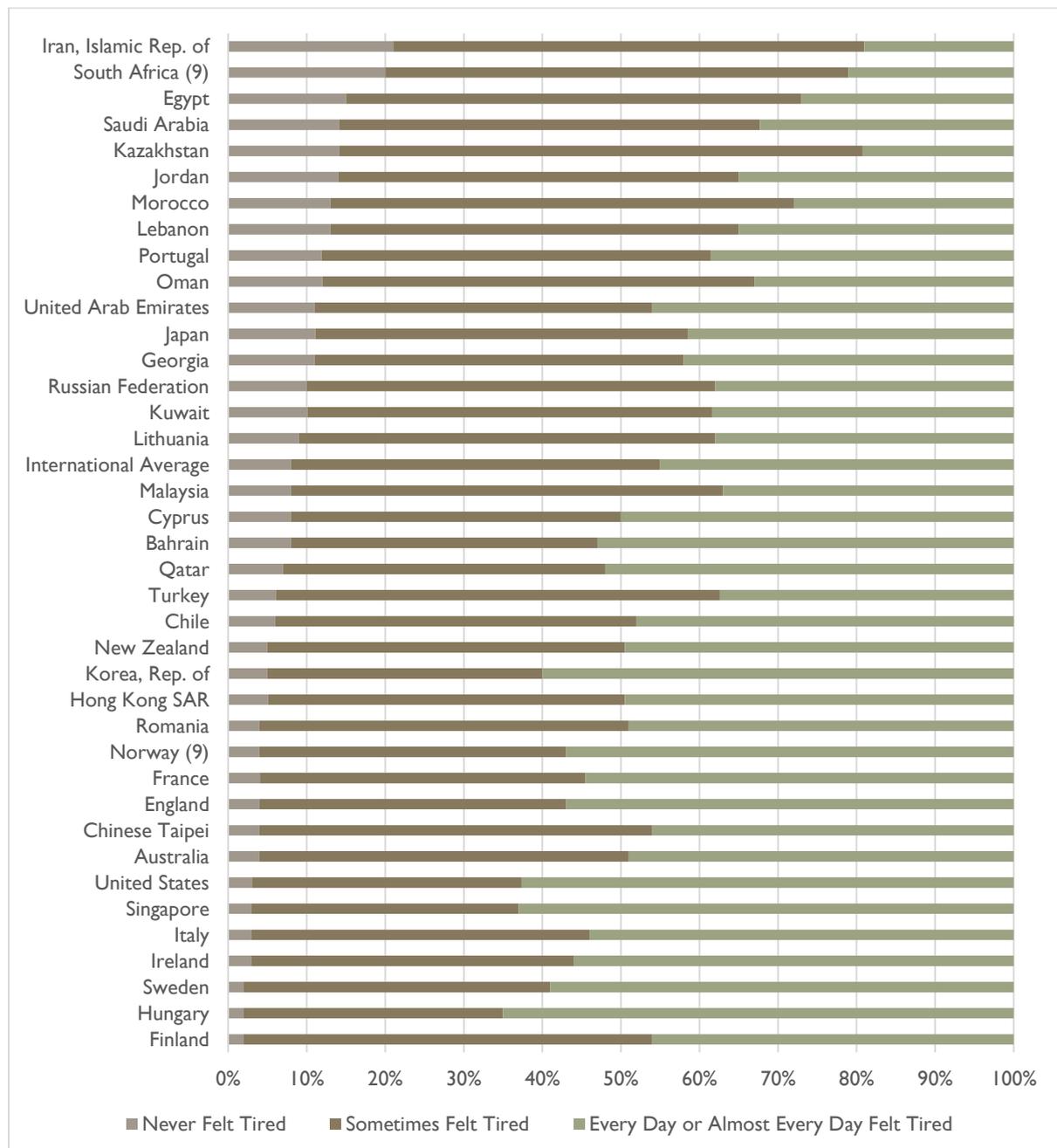


Source: Exhibit 10.4: Frequency of Student Absences. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-r>

8.2. Feeling tired at school

Students may feel tired due to being overwhelmed, which may harm students' abilities and mental health. Accounting for the frequency of students being tired allows understanding the relationship between the declared level of tiredness and average results in mathematics and science.

Figure 8.4. Distribution of students with respect to the declared frequency of feeling tired at school.



Source: Exhibit 10.7: Students Report Arriving at School Feeling Tired or Hungry. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In the TIMSS student questionnaires, students were asked how often they felt tired at school, with the possible answers being Never, Sometimes, and Every day or almost every day. Based on the results, it is possible to see the distribution of the **frequency of tiredness among students** from different countries, presented in Figure 8.4.

In the majority of countries, students declared that they sometimes felt tired at school. However, when it comes to Lebanon, one of the highest shares of students who never felt tired was observed, and at the same time, a moderate share of students felt exhausted every day or almost every day.

To analyze the relation of feeling tired at school, it is worth investigating whether the declared tiredness feeling is correlated with students' achievements. Table 8.3. shows data about the average achievements in mathematics concerning the reported frequency of feeling tired at school.

Table 8.3. Average score obtained in G8 TIMSS Mathematics assessment 2019 with respect to frequency of feeling tired.

Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Never or Almost Never Felt Tired	13% (1.0)	420 (5.7)	8% (0.1)	488 (1.3)	13%	435
Sometimes Felt Tired	52% (1.3)	429 (3.6)	47% (0.2)	493 (0.6)	51%	433
Every day or Almost Every Day Felt Tired	35% (1.2)	437 (3.5)	45% (0.2)	487 (0.6)	36%	422

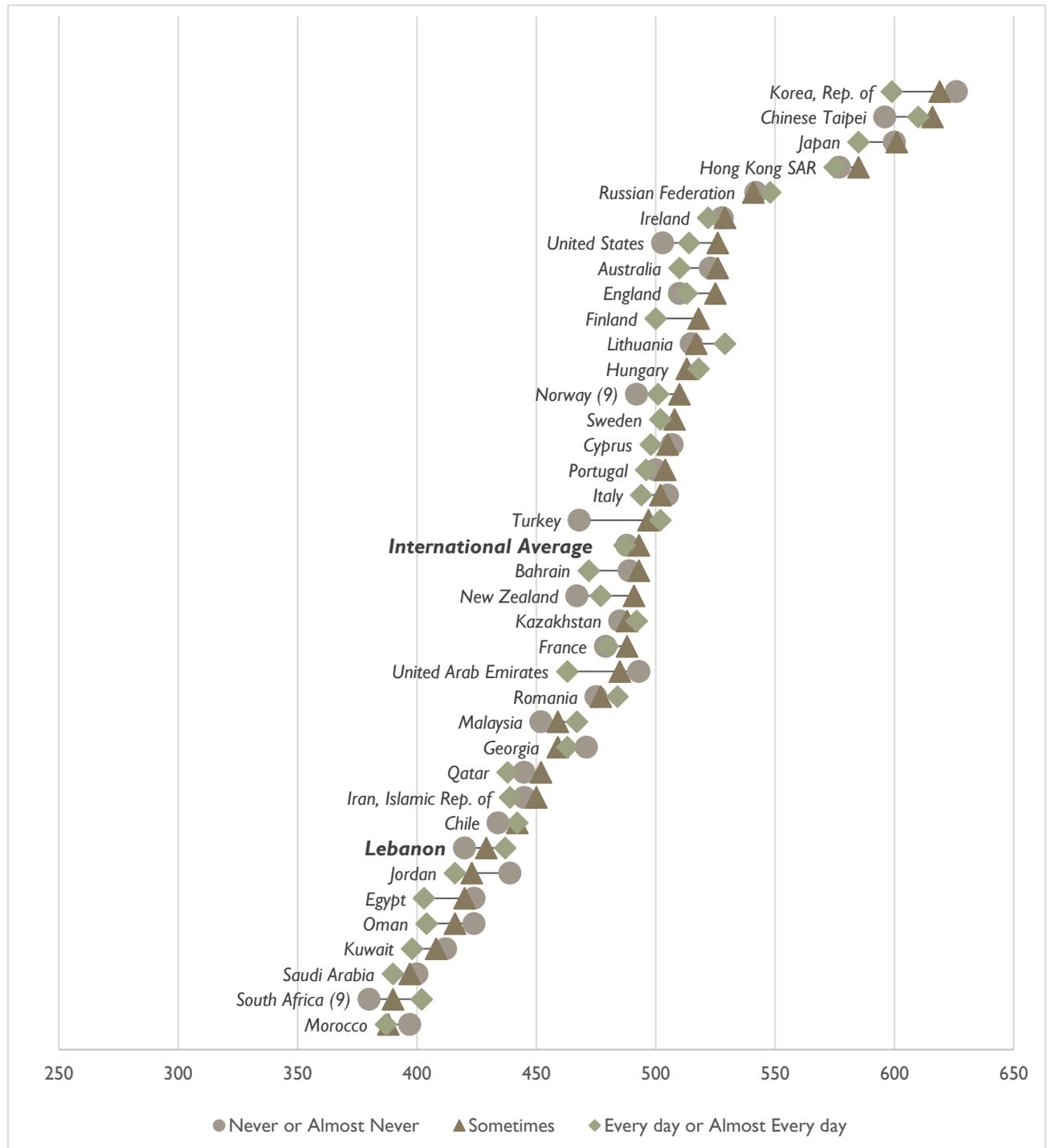
Source: Exhibit 10.7: Students Report Arriving at School Feeling Tired or Hungry. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirils.bc.edu/timss2019/international-results/>

Surprisingly, In Lebanon, the best results in mathematics were obtained by students who felt tired every day or almost every day. In the MENA countries, eighth-graders who never or almost never felt tired were the best at mathematics. On international average, students who sometimes felt tired were

reported to have the best performance in mathematics. Therefore, no clear pattern can be drawn about the relationship between feeling tired at school and the average score in mathematics.

As no patterns were found, it is worth analysing the distributions of the results in countries participating in the assessment. Figure 8.5 shows such distributions.

Figure 8.5. Average achievements in G8 TIMSS mathematics assessment with respect to the frequency of feeling tired of eighth graders in countries participating in the assessment.



Source: Exhibit 10.7: Students Report Arriving at School Feeling Tired or Hungry. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirils.bc.edu/timss2019/international-results/>

Small differences can be found in most countries, with the worst results being obtained by students who were tired most of their time at school. Yet, again, no general patterns can be found in the case of feeling tired at school. As in the case of mathematics, the analysis of the results in Science with respect to the frequency of feeling tired has been conducted, with the results being presented in table 8.4.

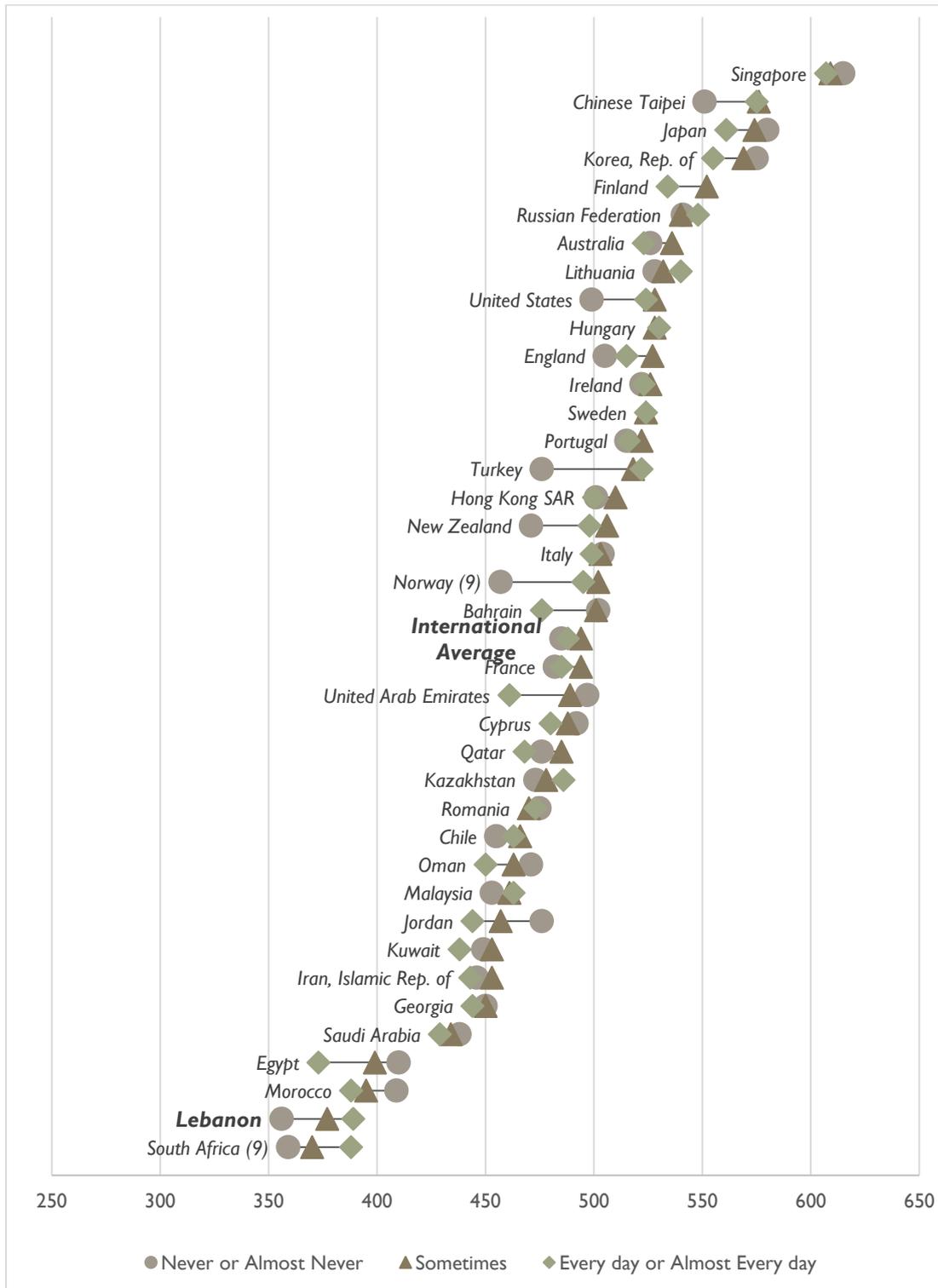
Table 8.4. Average score obtained in G8 TIMSS Science assessment 2019 with respect to frequency of feeling tired.

Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Never or Almost Never Felt Tired	13% (1.0)	356 (9.0)	8% (0.1)	485 (1.4)	13%	448
Sometimes Felt Tired	52% (1.3)	377 (5.2)	47% (0.2)	494 (0.6)	51%	446
Every day or Almost Every Day Felt Tired	35% (1.2)	389 (5.9)	45% (0.2)	488 (0.7)	36%	433

Source: Exhibit 10.8: Students Report Arriving at School Feeling Tired or Hungry. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirils.bc.edu/timss2019/international-results/>

The distribution of the results is quite similar to the case of mathematics. The country-level statistics are presented in figure 8.5.

Figure 8.5. Average achievements in G8 TIMSS science assessment with respect to the frequency of feeling tired of eighth graders in countries participating in the assessment.



Source: Exhibit 10.8: Students Report Arriving at School Feeling Tired or Hungry. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Relatively small differences between feeling-tired categories are observed. In the majority of the countries, the worst results are obtained by students who never felt tired at school. In Lebanon, the differences are moderate in comparison to other countries.

8.3. Feeling hungry at school

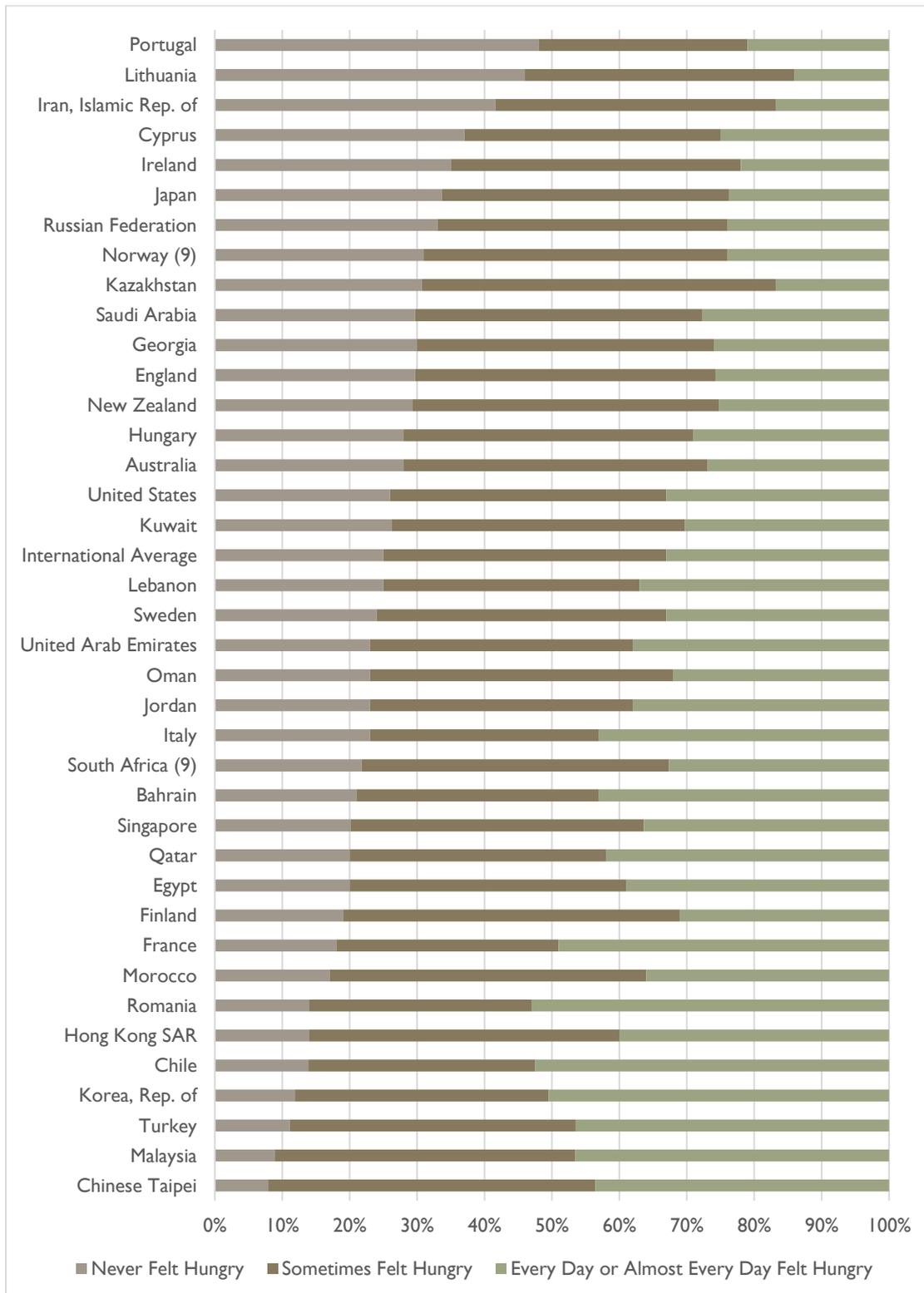
Feeling hungry is another example of a learning challenge. Hunger might be connected to a poor socioeconomic situation and influence students' achievements in mathematics and science.

Figure 8.6. presents the distribution of the frequency of students **feeling hungry** in countries participating in the TIMSS assessment, depending on the answers provided in the supplementary questionnaires.

In all the analysed countries some students felt hungry every day, ranging from 14% of eighth-graders in Lithuania to 53% of eighth-graders in Chile. In Lebanon, more than one-third of students have experienced hunger every day, while one-fourth of students from Lebanon never felt hungry at school. While several policies concerning the provision of food (e.g., fresh fruit and vegetables) were conducted worldwide, it seems that much attention still needs to be paid to minimize the influence of hunger on students' mental and physical health.

It can be expected that the least often students are hungry at school, the better results they achieve. Table 8.5. presents data concerning students' performance in mathematics with respect to their frequency of feeling hungry at school.

Figure 8.6. Distribution of students with respect to the declared frequency of feeling hungry at school.



Source: Exhibit 10.7: Students Report Arriving at School Feeling Tired or Hungry. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Table 8.5. Average score obtained in G8 TIMSS Mathematics assessment 2019 with respect to the level of feeling hungry.

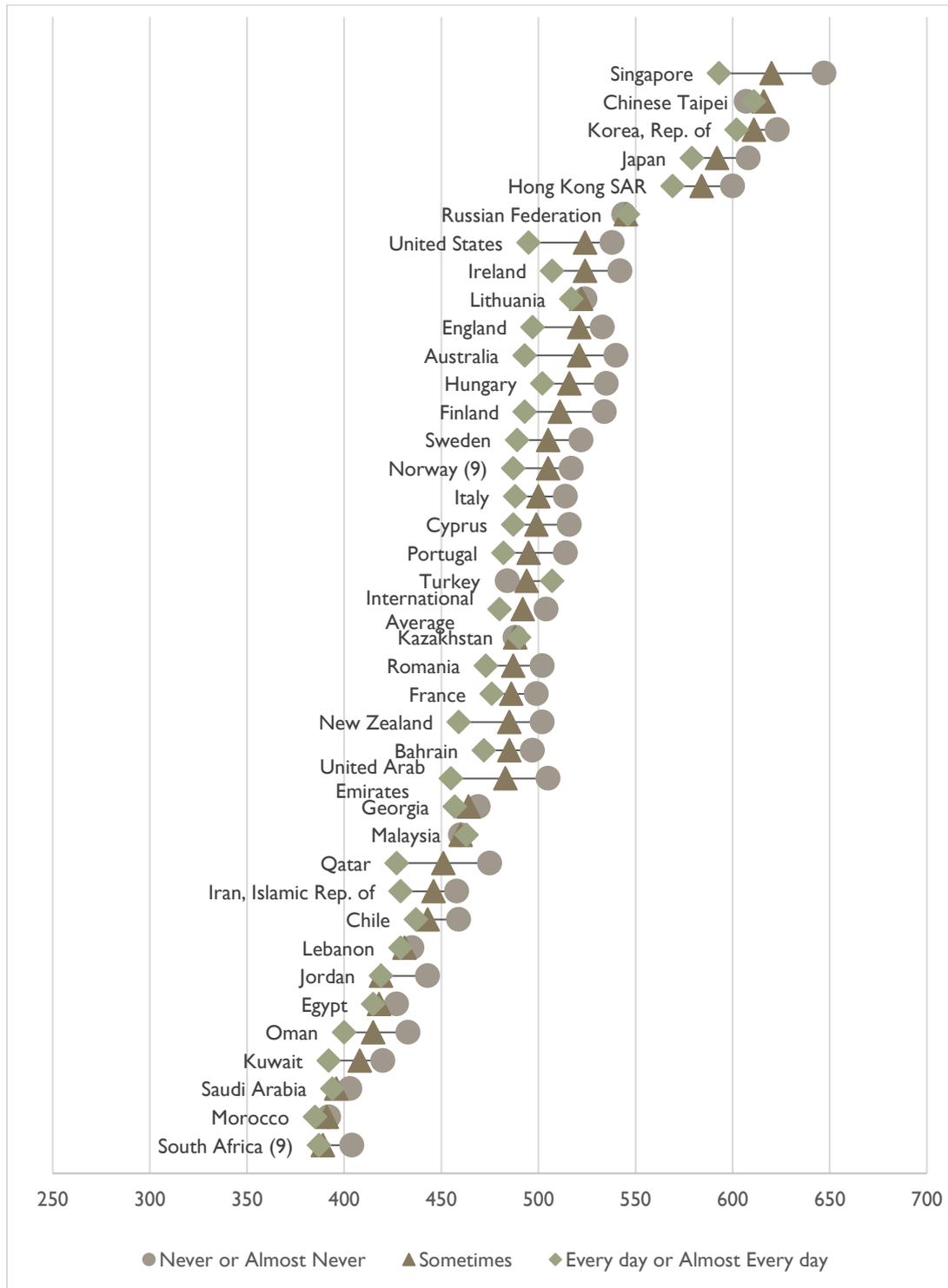
Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Never or Almost Never Felt Hungry	25% (1.1)	435 (4.3)	25% (0.1)	504 (0.8)	25%	444
Sometimes Felt Hungry	38% (0.9)	431 (3.9)	42% (0.1)	492 (0.6)	41%	431
Every day or Almost Every Day Felt Hungry	37% (1.2)	429 (3.6)	33% (0.2)	480 (0.7)	35%	420

Source: Exhibit 10.7: Students Report Arriving at School Feeling Tired or Hungry. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In all the areas considered, the highest scores in mathematics were obtained by students who did not experience feeling hungry at school. However, in the case of Lebanon, the difference in results between categories is not significant, contrary to the benchmarks.

Figure 8.7. shows the average results in the mathematics assessment with respect to the frequency of feeling hungry.

Figure 8.7. Average achievements in G8 TIMSS mathematics assessment with respect to the frequency of feeling hungry of eighth graders in countries participating in the assessment.



Source: Exhibit 10.7: Students Report Arriving at School Feeling Tired or Hungry. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In the vast majority of the countries, the least often the student were hungry, the better results were obtained. In Lebanon, one of the smallest inequalities between students was found in this respect. The analysis of the results of achievement in science with respect to the frequency of feeling hungry has been conducted; the results are shown in Table 8.6.

Table 8.6. Average score obtained in G8 TIMSS Science assessment 2019 with respect to the level of feeling hungry.

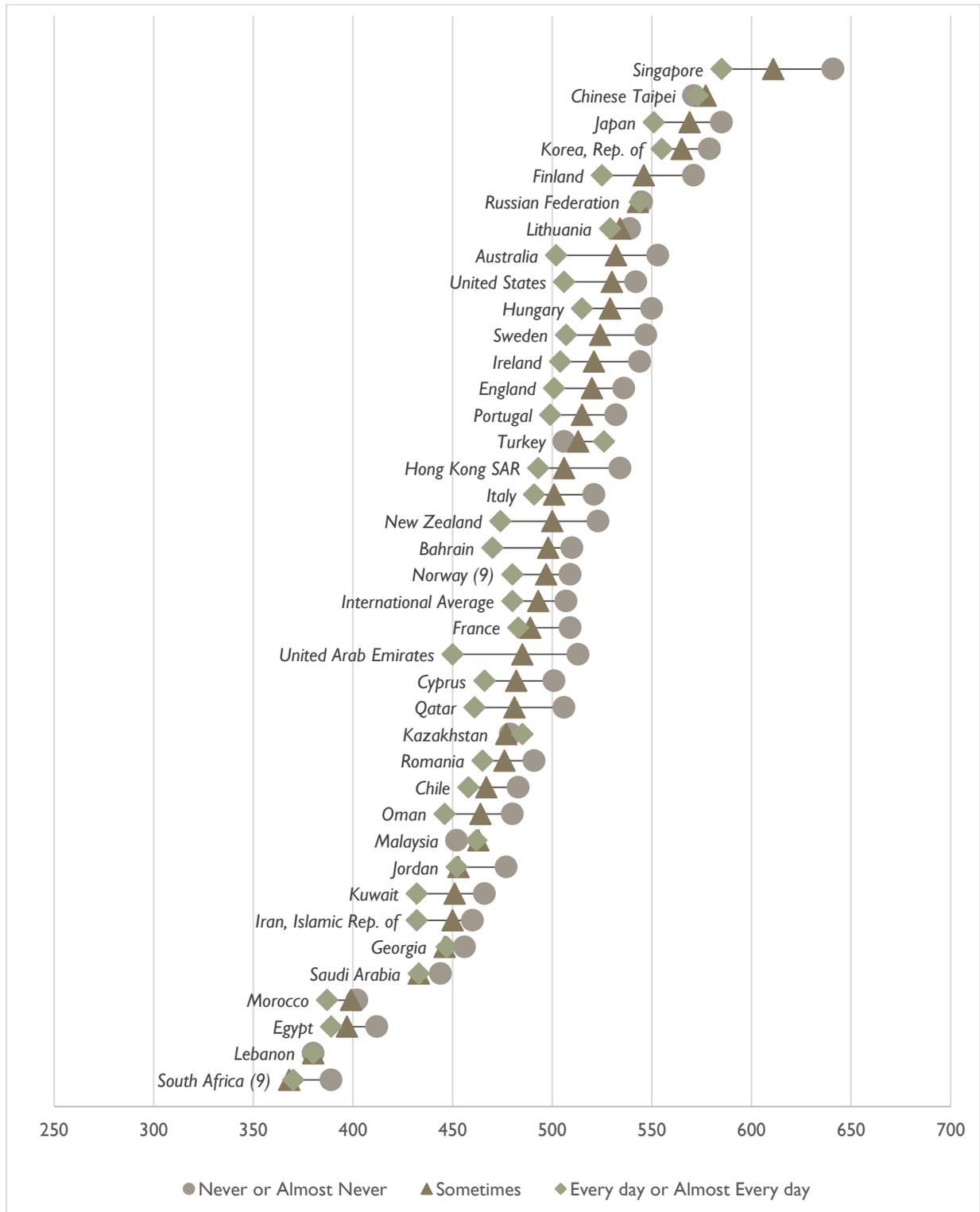
Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Never or Almost Never Felt Hungry	25% (1.1)	380 (6.3)	25% (0.1)	504 (0.8)	25%	444
Sometimes Felt Hungry	38% (0.9)	380 (6.4)	42% (0.1)	492 (0.6)	41%	431
Every day or Almost Every Day Felt Hungry	37% (1.2)	380 (5.0)	33% (0.2)	480 (0.7)	35%	420

Source: Exhibit 10.8: Students Report Arriving at School Feeling Tired or Hungry. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In Lebanon, the scores obtained in the assessment in Science do not appear to depend on the frequency of feeling hungry at school, contrary to the other geographical areas where the best results were obtained by the least often hungry students and the worst achievements by the students who are hungry more often.

Country-level analysis, which results are shown in figure 8.8, was run to account for national differences in the relationship between the frequency of feeling hungry and the achievements in science.

Figure 8.8. Average achievements in G8 TIMSS science assessment with respect to the frequency of feeling hungry of eighth graders in countries participating in the assessment.



Source: Exhibit 10.8: Students Report Arriving at School Feeling Tired or Hungry. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

As in the case of mathematics, almost in all countries listed above, the best results in science were obtained by students who declared being hungry at school the least often. While the differences between students are not vast, the issue of feeling hungry at school is important from the humanitarian point of view. Policies concerning the provision of fresh food to schools are extremely important to strengthen students' mental and physical health.

Chapter 9. Students' Attitudes towards subjects

This chapter analyses the extent to which students like the disciplines they study since there is a positive relationship between students enjoying learning and achievement. Moreover, this chapter will also analyze a scale of the confidence of students and attitude-related indices.

9.1. Students like learning

Maintaining the quality of teaching is the primary task of schools, but also creating passion among students is crucial when it comes to successful results as students motivated to learn can achieve better results. In the TIMSS assessment, the students were asked questions about their attitudes towards mathematics. Based on the responses, **students like learning mathematics index** was created. The index categories are presented in figure 9.1.

Figure 9.1. Scale description of Students like learning mathematics index



Source: Exhibit 11.1: Students Like Learning Mathematics. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

The index values have been divided so that students were classified into three categories: Very much like, Somewhat like, and Do not Like. As a positive attitude towards mathematics is expected to influence students' performance strongly, table 9.1 shows the respective percentage of eighth-graders in each category and their corresponding average score in the TIMSS assessment.

Table 9.1. Average score obtained in G8 TIMSS Mathematics assessment 2019 with respect to the declared level of liking mathematics.

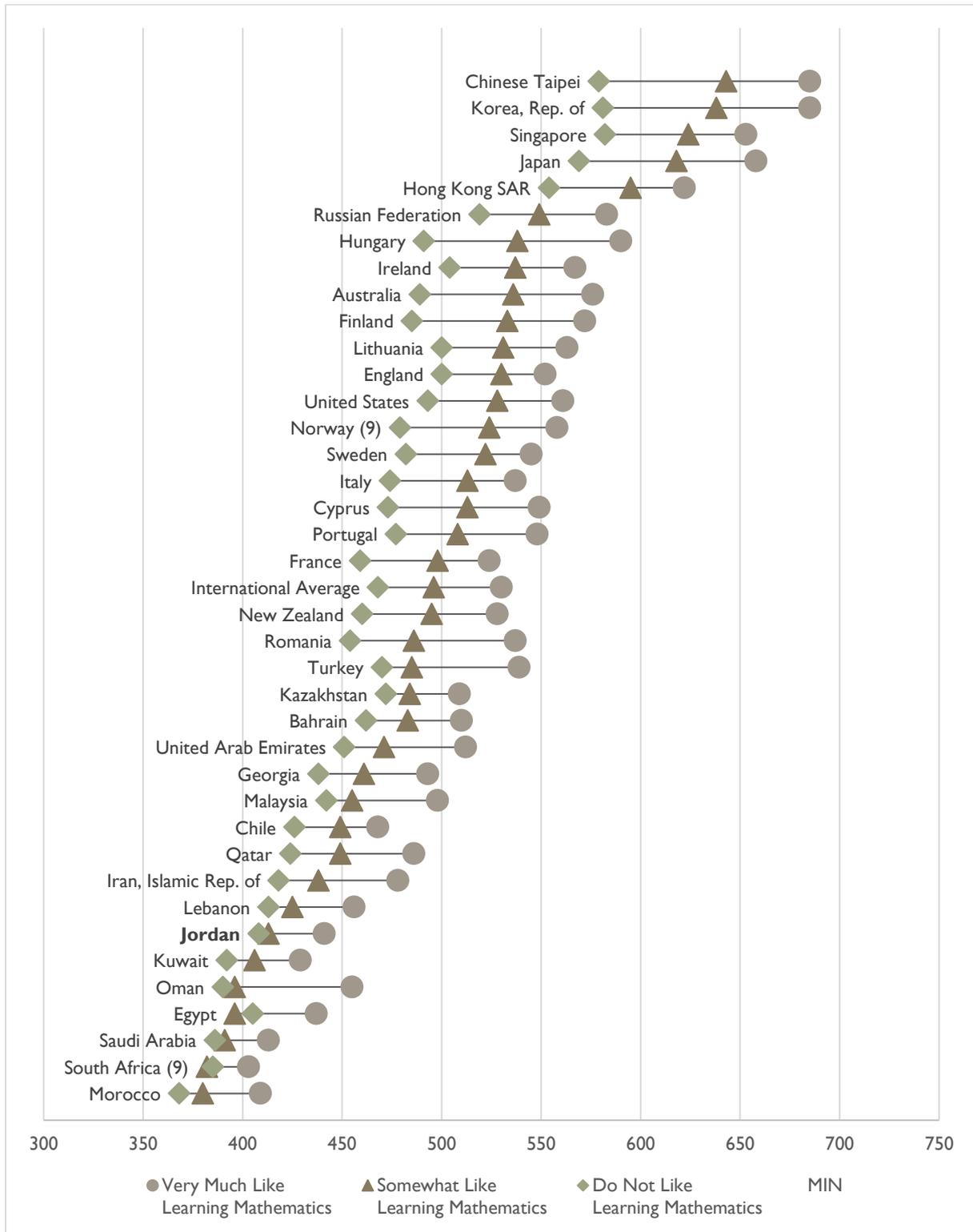
Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Very Much Like	28% (1.3)	456 (3.6)	20% (0.1)	530 (0.8)	29%	457
Somewhat Like	44% (1.1)	425 (3.9)	39% (0.1)	496 (0.7)	40%	423
Do not Like	28% (1.1)	413 (3.7)	41% (0.2)	468 (0.6)	31%	411

Source: Exhibit 11.1: Students Like Learning Mathematics. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Students in Lebanon and the MENA countries enjoy learning mathematics more than the international average. At the same time, relatively fewer Lebanese students declared a low interest in learning mathematics compared to the MENA countries and the global average. Therefore, the higher the level of liking learning mathematics, the higher the average results in this subject.

Figure 9.2. presents the distribution of results in mathematics, depending on the declared level of liking mathematics among the countries participating in the TIMSS assessment.

Figure 9.2. Average scores obtained in G8 TIMSS Mathematics assessment in Participating countries with respect to the level of liking for mathematics among students

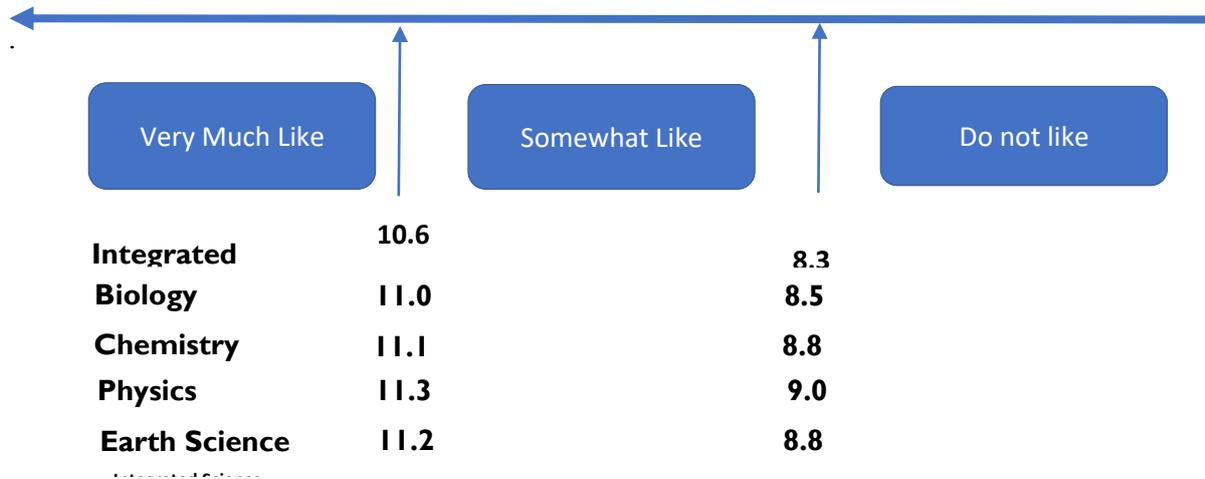


Source: Exhibit 11.1: Students Like Learning Mathematics. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

The highest scores in mathematics were achieved by students declaring that they very much enjoy learning math. In Lebanon, the distribution of results resembles the ones observed in the other MENA countries. Since the extent to which students like a subject strongly correspond to their performance, reforms aimed at popularizing mathematics learning may result in educational achievements.

In order to determine whether liking learning science has any impact on the achievements in science, the **students like learning science index** have been developed and presented in Figure 9.3.

Figure 9.3. Scale description of Students like learning science index



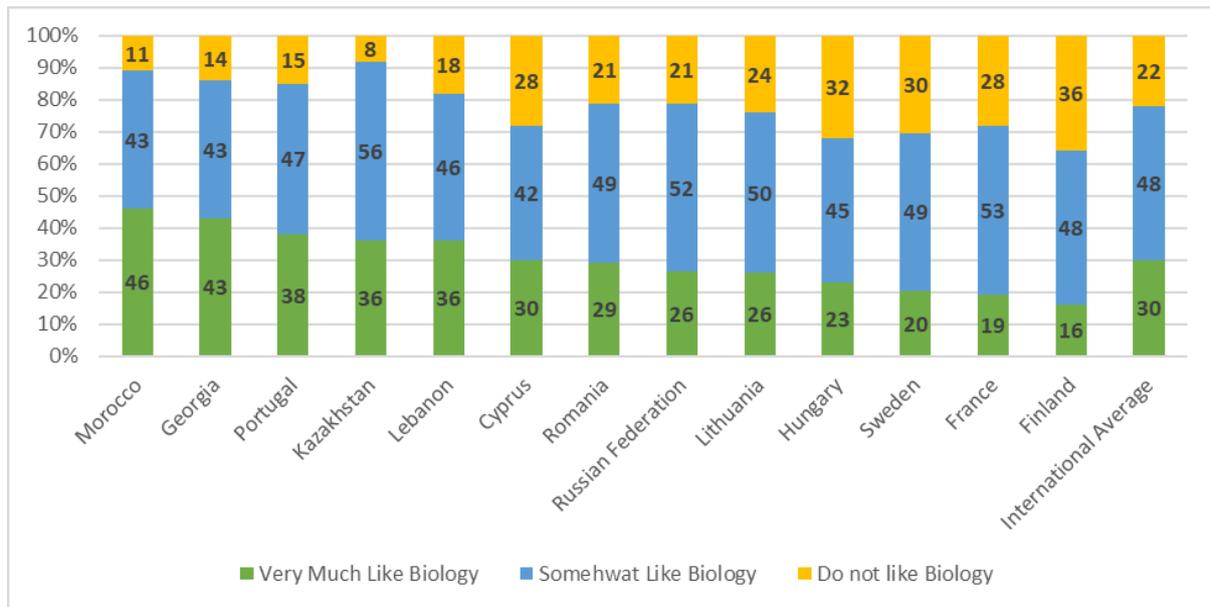
Source: Exhibit 11.6: Students Like Learning Science. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

The values of the indicator have been divided into three categories, similar to the index for mathematics. For Lebanese students, the results of this indicator are available only for subdomains of Biology, Chemistry and Physics.

Figures 9.4., 9.5. and 9.6. presents the shares of students belonging to each category, respectively for Biology, Chemistry and Physics.

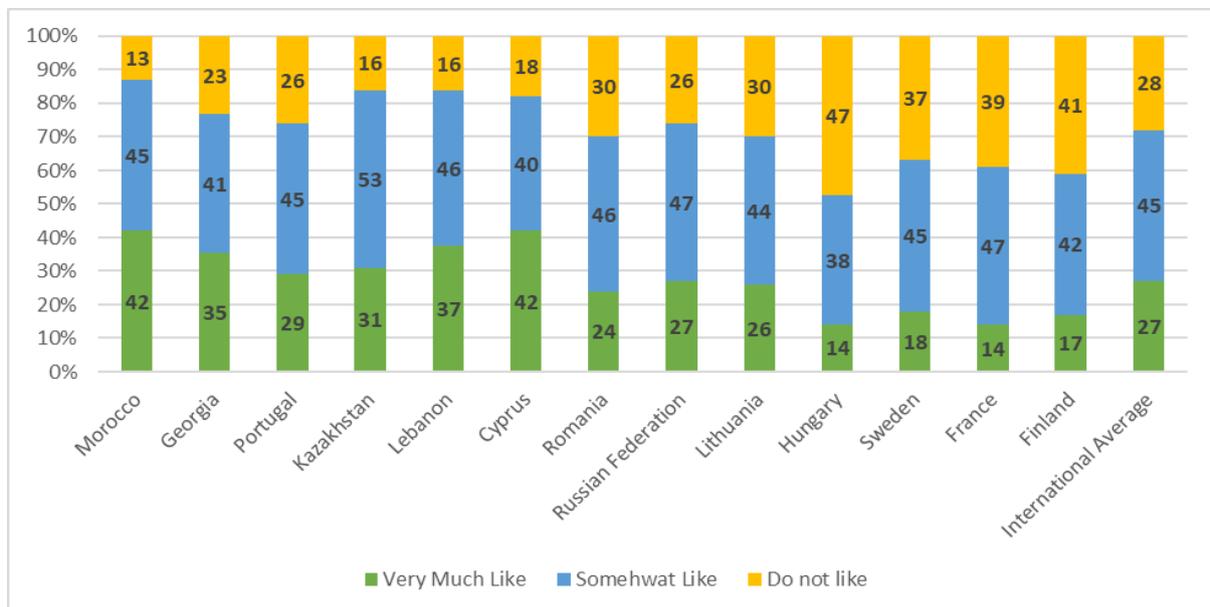
Figure 9.4. Percentage distribution of eighth-graders liking learning biology.



Source: Exhibit 11.6: Students Like Learning Science. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirils.bc.edu/timss2019/international-results/>

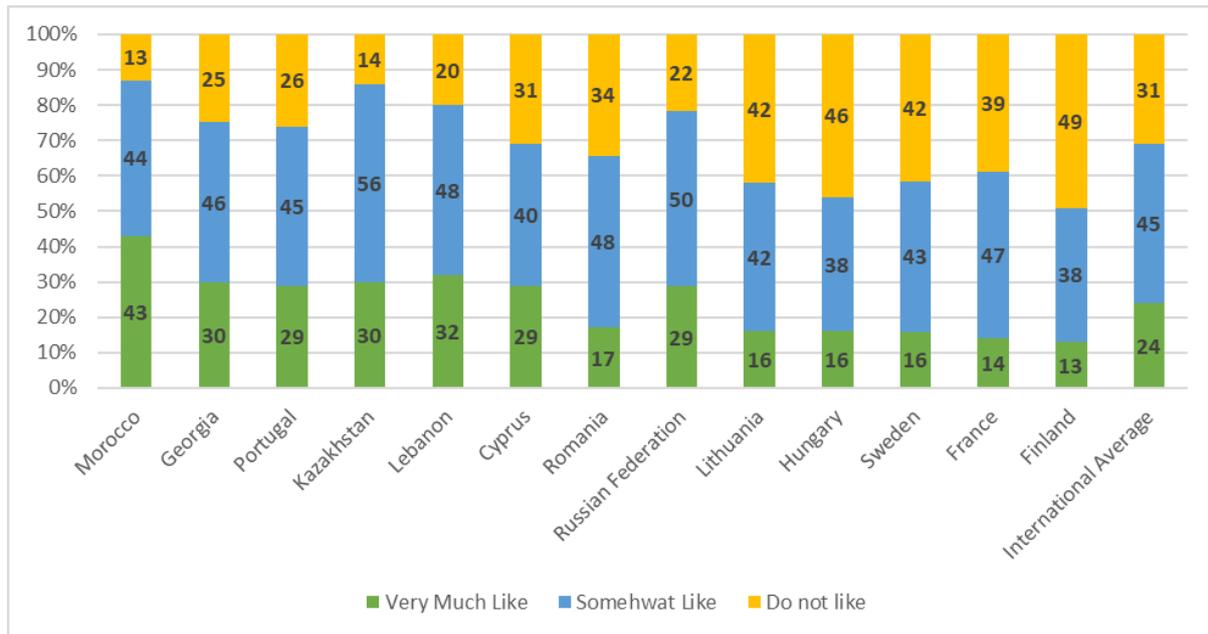
Figure 9.5. Percentage distribution of eighth-graders liking learning chemistry.



Source: Exhibit 11.6: Students Like Learning Science. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirils.bc.edu/timss2019/international-results/>

Figure 9.6. Percentage distribution of eighth graders liking learning physics.



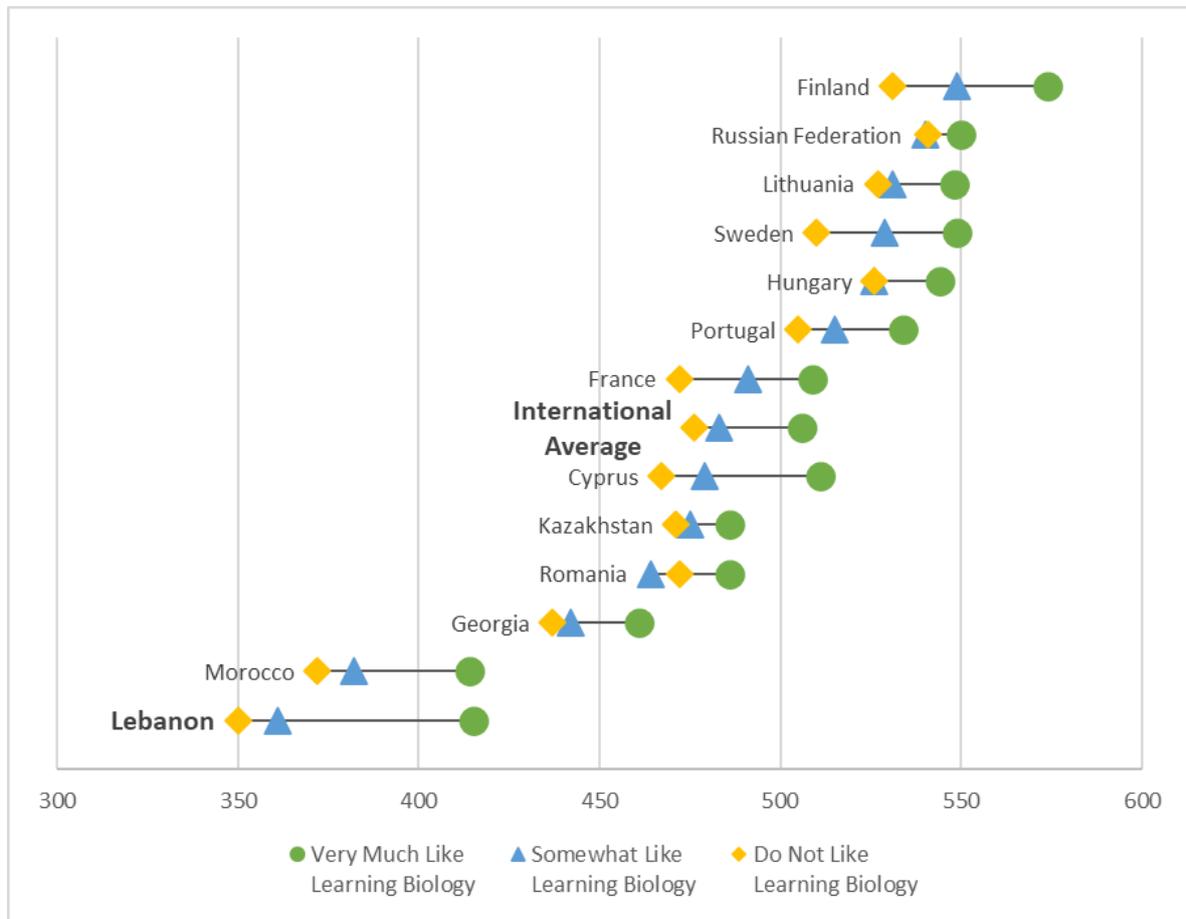
Source: Exhibit 11.6: Students Like Learning Science. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Students in Lebanon appear to enjoy learning science more than the international average for all the disciplines considered. Therefore, it is worth examining whether this interest corresponds to better achievements in Biology, Chemistry, and Physics. Figures 9.7., 9.8, and 9.9 present the average scores obtained during the assessment in science with respect to the declared level of liking learning each of the disciplines.

In each science group, the highest scores were obtained by the students who like learning these subjects the most, with the largest differences observed in the case of the interest in Physics and lowest in the case of Biology. Therefore, the data shows that popularizing science teaching among students can positively impact their performance.

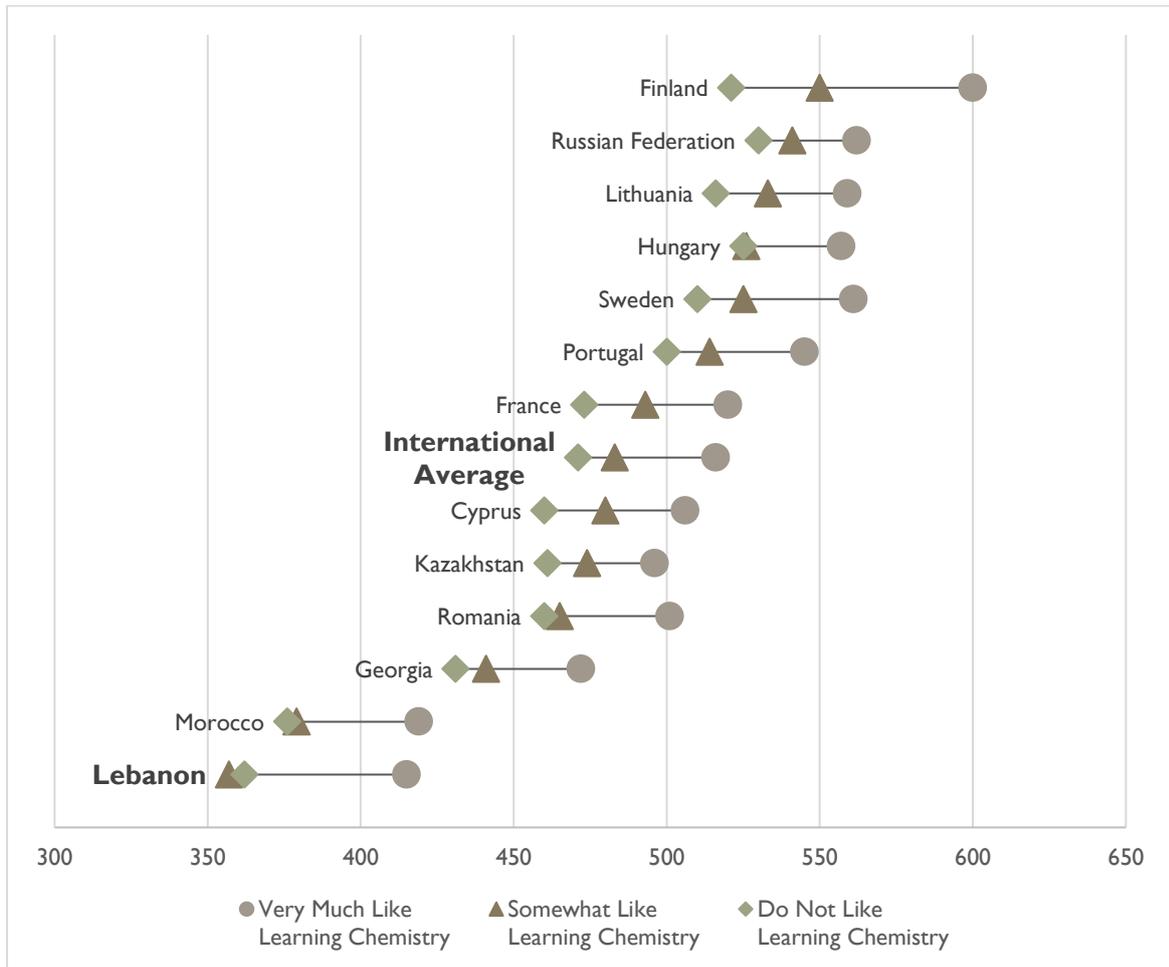
Figure 9.7. Distribution of the scores obtained in G8 TIMSS science assessment with respect to the level of liking learning biology.



Source: Exhibit 11.6: Students Like Learning Science. TIMSS 2019 International Results in Mathematics and Science.

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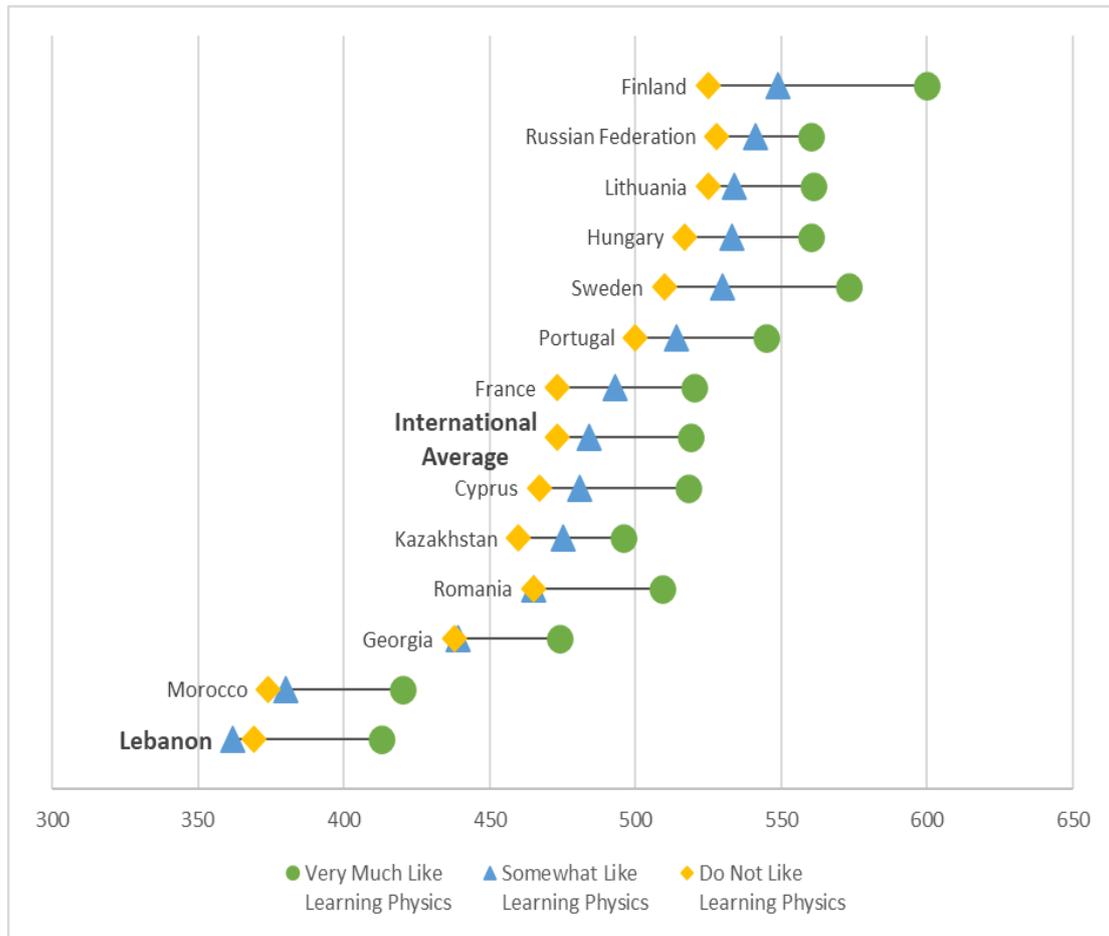
Figure 9.8. Distribution of the scores obtained in G8 TIMSS science assessment with respect to the level of liking learning chemistry.



Source: Exhibit 11.6: Students Like Learning Science. TIMSS 2019 International Results in Mathematics and Science.

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Figure 9.9. Distribution of the scores obtained in G8 TIMSS science assessment with respect to the level of liking learning physics.



Source: Exhibit 11.6: Students Like Learning Science. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

9.2. Students' confidence in learning

Making students aware of their abilities is related to how students will perceive themselves and their capacity to operate in the future world. Therefore, teachers should provide well-managed learning conditions to motivate students and strengthen their belief about the possibility of achieving success. To examine whether **confidence in learning mathematics** has any impact on the achievements, the TIMSS assessment developed an indicator describing whether the student is Very confident, Somewhat confident or Not confident at all in learning mathematics. This indicator was calculated based on the answers to questions concerning issues such as the perceived difficulties in mathematics, feelings connected to mathematics, or self-evaluation opinion about mathematics achievements. The scale and description are shown in Figure 9.10.

Figure 9.10. Scale description of Students confidence in learning mathematics index



Source: Exhibit 11.7: Students Confident in Mathematics. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Table 9.2. presents the average achievement in mathematics with respect to the declared confidence in learning mathematics.

Table 9.2. Average score obtained in G8 TIMSS Mathematics assessment 2019 with respect to the declared level of confidence in learning mathematics.

Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Very Confident	21% (1.0)	479 (4.2)	20% (0.1)	530 (0.8)	18%	487
Somewhat Like	45% (1.1)	429 (3.0)	39% (0.1)	496 (0.6)	46%	430
Not Confident	34% (1.3)	405 (4.0)	41% (0.2)	468 (0.6)	36%	400

Exhibit 11.9: Students Confident in Mathematics. . TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

The results are consistent across geographical areas. Lebanese students declared to not be confident less often than it is observed on the international average, and the impact of confidence in learning on the performance in mathematics amounts to 75 points.

Figure 9.11. Distribution of scores obtained in G8 TIMSS Mathematics assessment 2019 with respect to the declared level of confidence in learning mathematics in participating countries .

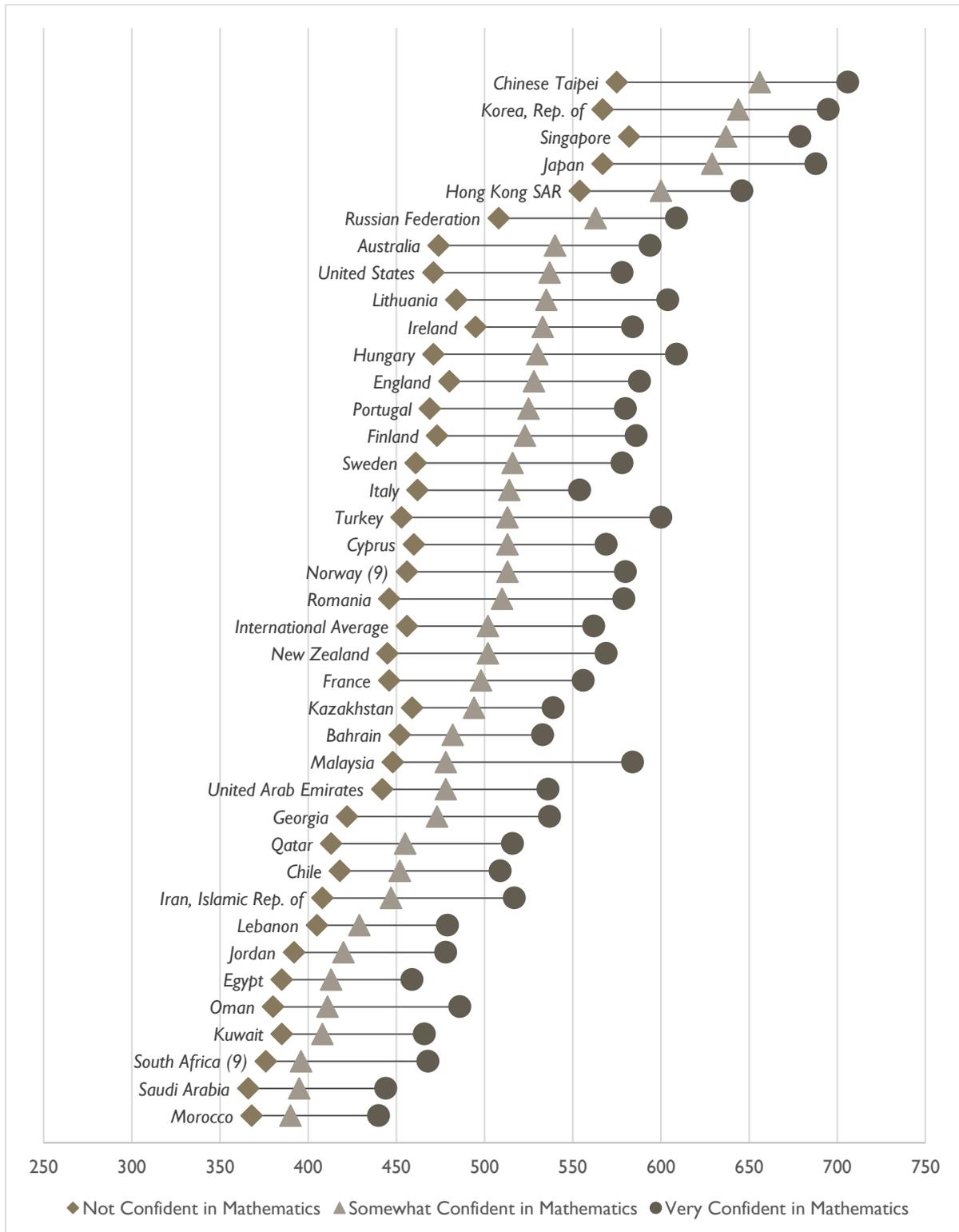


Exhibit 11.9: Students Confident in Mathematics. . TIMSS 2019 International Results in Mathematics and Science.

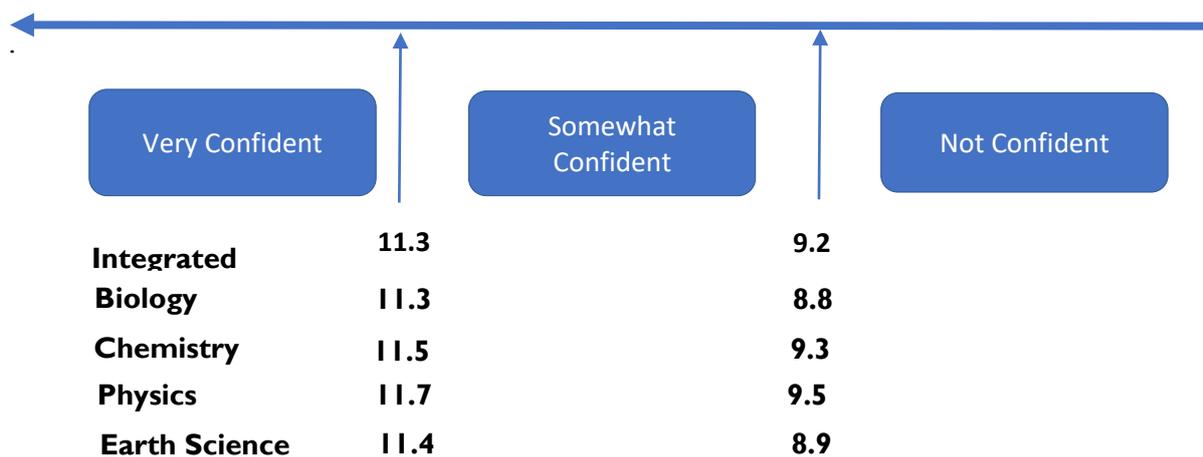
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The country-level analysis of the distribution of the results with respect to the level of confidence in mathematics is presented in the figure 9.11.

The highest results were achieved, on average, by the most confident students, while the worst students were the ones who were not confident in mathematics. In Lebanon, the difference between the students who are not confident and somewhat confident is minor.

As in the case of mathematics, confidence has a significant influence when it comes to science performance; therefore, in the additional questionnaires, students were asked about the extent to which they are **confident in science**, namely Biology, Chemistry, Physics, and Earth Sciences. On this basis, the index describing their confidence in these subjects is introduced and presented in figure 9.12.

Figure 9.12. Scale description of Students' confidence in science index

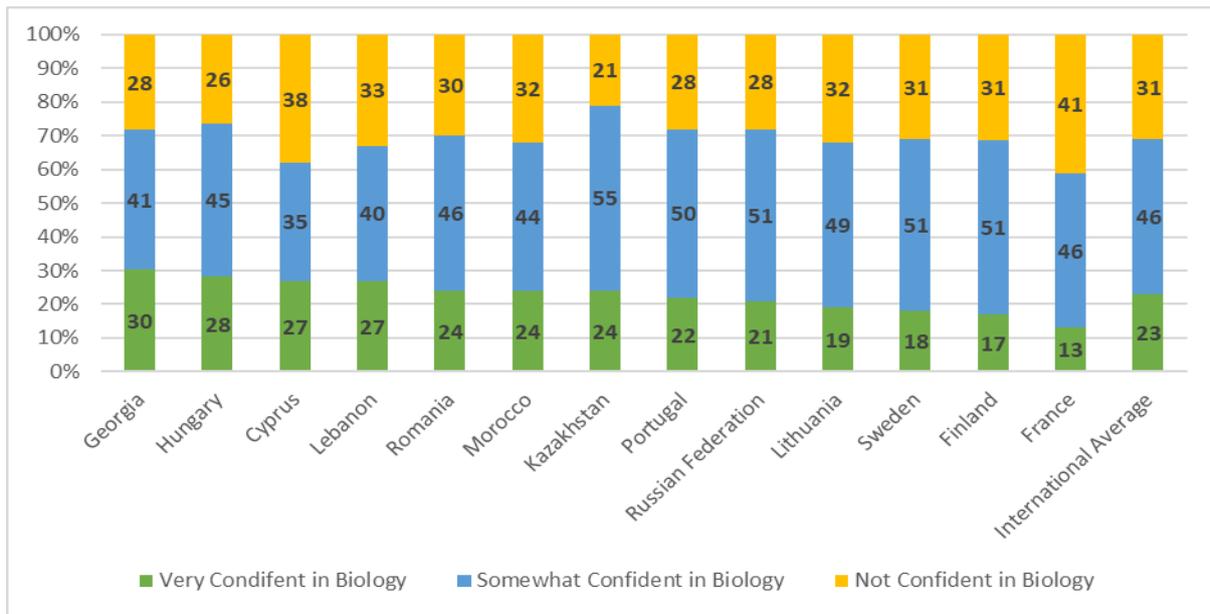


Source: Exhibit 11.10: Students Confident in Science. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

For Lebanon, there is no data about the confidence index for Earth Sciences and the integrated science index. The percentage distributions of confidence in Biology, Chemistry and Physics are presented in figures 9.13., 9.14. and 9.15, respectively.

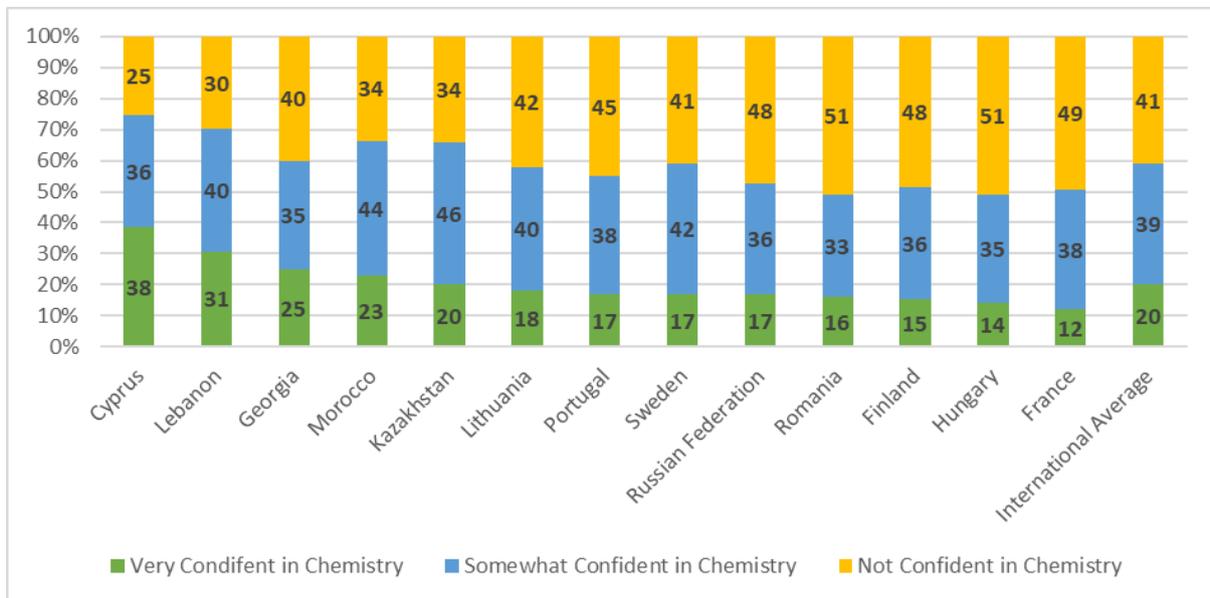
Figure 9.13. Percentage distribution of eighth-graders with respect to confidence in biology.



Source: Exhibit 11.12: Students Confident in Science. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

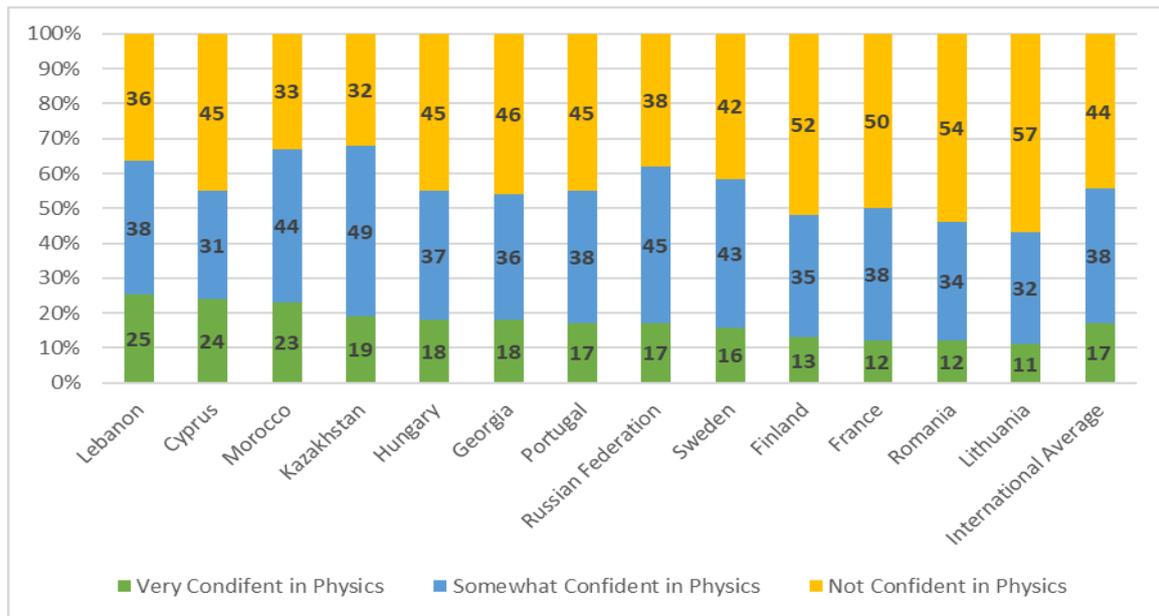
Figure 9.14. Percentage distribution of eighth-graders with respect to confidence in chemistry.



Source: Exhibit 11.12: Students Confident in Science. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Figure 9.15. Percentage distribution of eighth graders with respect to confidence in physics.



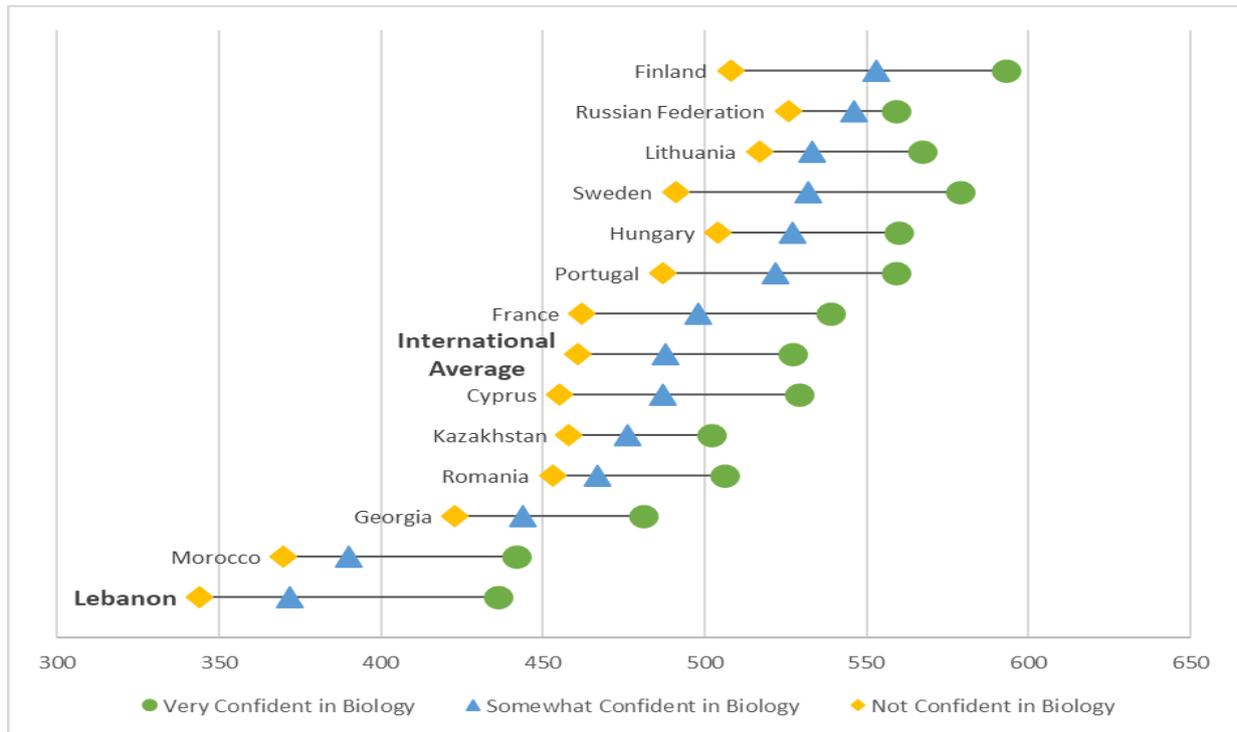
Source: Exhibit 11.12: Students Confident in Science. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Lebanese eighth-graders are characterized by high confidence in learning science sub-disciplines, even though this does not result in better achievements in the TIMSS assessment in science itself. The country-level analysis of the relationship between students' confidence and their achievements in Biology, Chemistry, and Physics is shown in figures 9.16., 9.17. and 9.18.

There is a positive effect of confidence in every presented country on achievements, with very large differences in results between students. **It can be concluded that there is a positive correlation between confidence and the performance of students. However, the endogeneity problem occurs. One cannot be sure if achievement causes confidence or confidence causes achievement– most probably, the relation is mutual.**

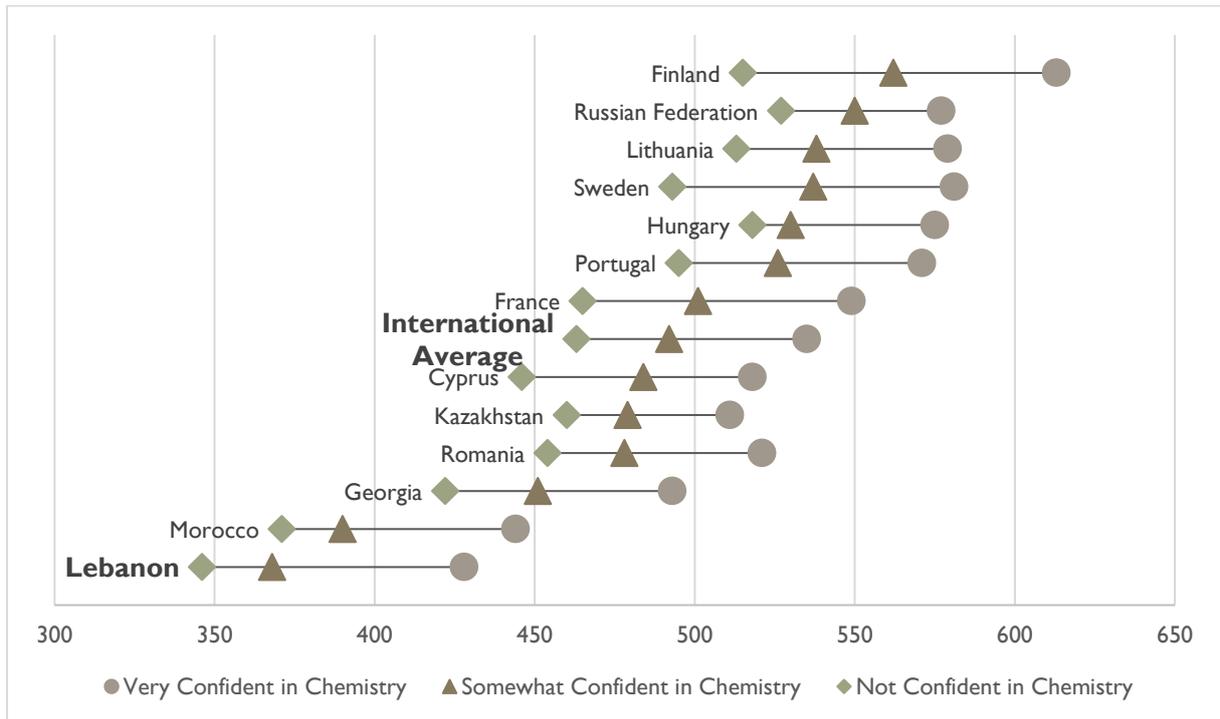
Figure 9.16. Distribution of the scores obtained in G8 TIMSS science assessment with respect to the confidence in learning biology.



Source: Exhibit 11.12: Students Confident in Science. TIMSS 2019 International Results in Mathematics and Science.

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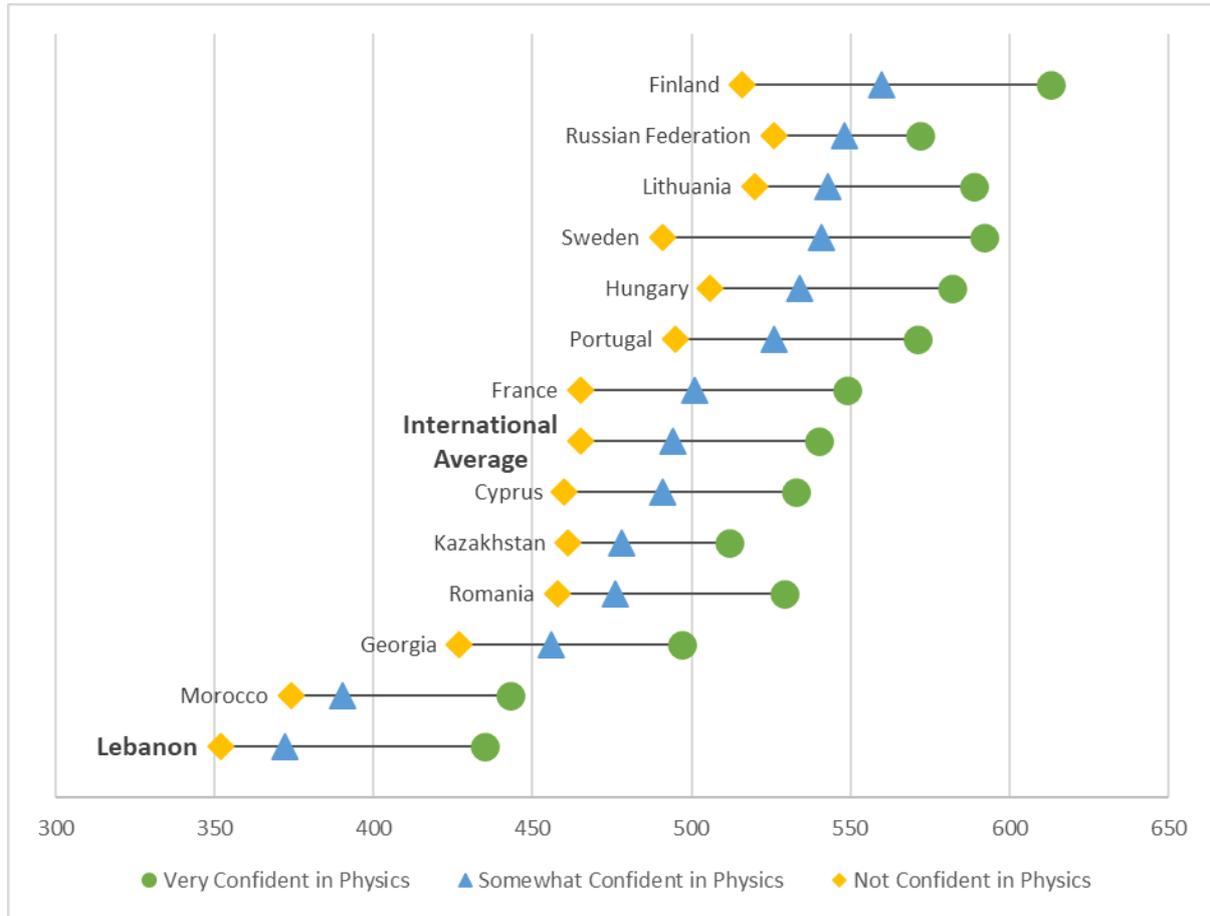
Figure 9.17. Distribution of the scores obtained in G8 TIMSS science assessment with respect to the confidence in learning chemistry.



Source: Exhibit 11.12: Students Confident in Science. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Figure 9.18. Distribution of the scores obtained in G8 TIMSS science assessment with respect to the confidence in learning physics.



Source: Exhibit 11.12: Students Confident in Science. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

9.3. Students value Mathematics and Science

Students may put more or less effort into learning depending on whether they perceive what they study as useful, which can in turn influence their educational outcomes. In order to understand the impact of the subjective opinion of students on the value of mathematics on performance, the respective indicator was introduced. Eighth-graders were asked questions concerning the usefulness of mathematics in everyday life, its value during application to university, or their parents' opinions about learning mathematics. Based on the responses, students were classified into three categories concerning their opinion, creating the **students value mathematics index**, shown in figure 9.19.

Figure 9.19. Scale description of Students value mathematics index



Source: Exhibit 11.13: Students Value Mathematics. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

The categories indicate whether students Strongly value mathematics, Somewhat value mathematics, or Do not value mathematics. Table 9.3. presents the average scores obtained in mathematics with respect to the extent to which students value mathematics. Figure 9.20 presents the results of the country-level analysis of the relationship between the value given to mathematics and the results. in this discipline.

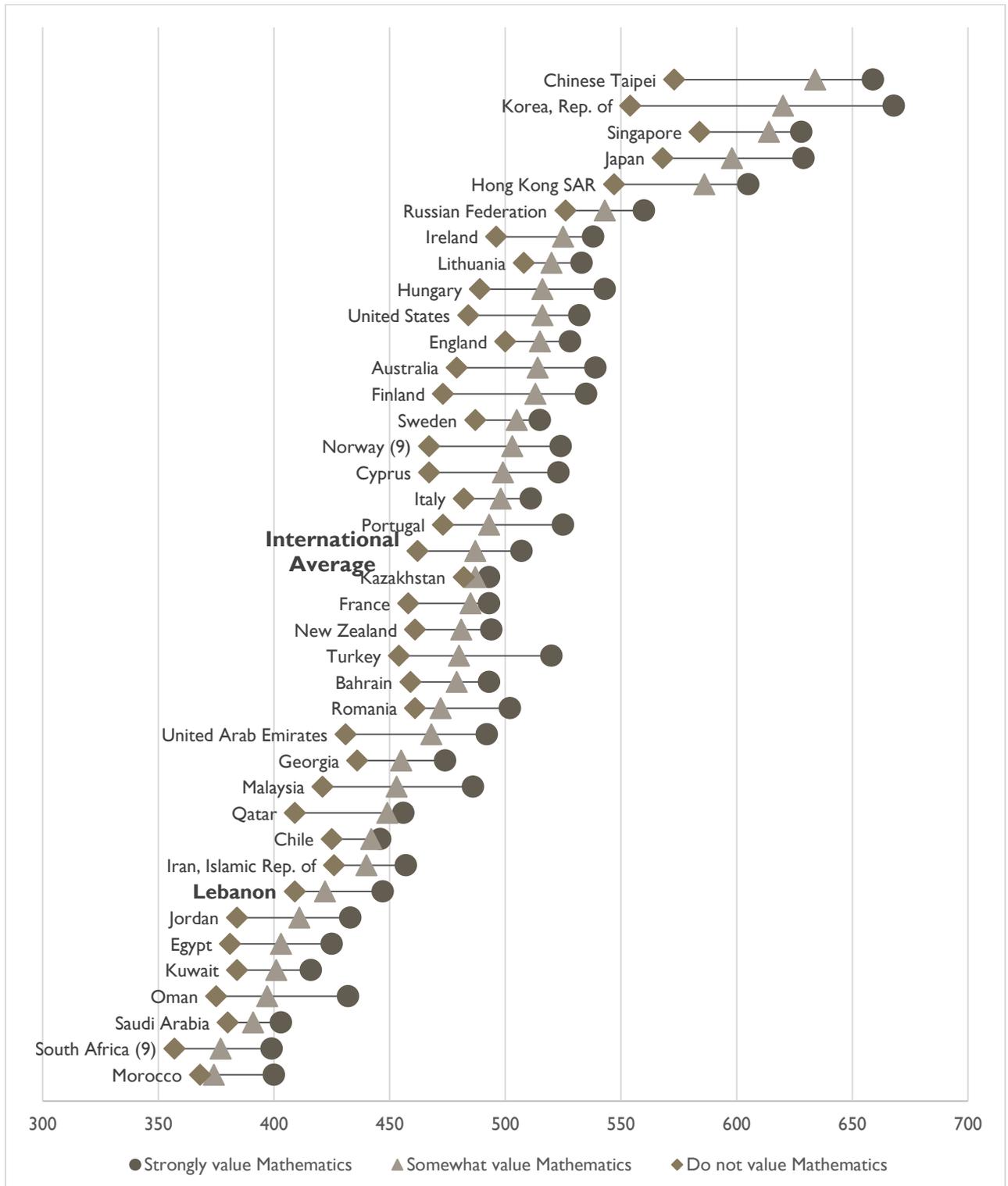
Table 9.3. Average score obtained in G8 TIMSS Mathematics assessment 2019 with respect to the students value mathematics category. .

Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Strongly value	45% (1.3)	447 (3.0)	37% (0.2)	507 (0.7)	49%	441
Somewhat value	43% (1.0)	422 (4.0)	47% (0.1)	487 (0.6)	39%	421
Do not value	12% (0.8)	409 (5.5)	16% (0.1)	462 (0.8)	11%	401

Source: Exhibit 11.14: Students Value Mathematics. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Figure 9.20. Average scores obtained in G8 TIMSS Mathematics assessment in participating countries with respect to the value assigned to mathematics



Source: Exhibit 11.14: Students Value Mathematics. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In Lebanon and the MENA countries, almost half of the students strongly value mathematics. This is much more than it observed on the international average, where only 37% of eighth-graders strongly value the subject. The correlation of the declared value of mathematics on the results is evident since students who appreciate mathematics the most obtain the best results. The difference in performance between students who strongly value mathematics and students who do not value it at all is similar in all the areas and equal to around 40 points. In Lebanon, there were moderate differences between students depending on the value assigned to mathematics when compared to other countries.

A similar indicator was created to describe the subjective opinion about the value of science. Students were asked to answer questions about the usefulness of learning science in their future jobs, the usefulness of science in learning other subjects, or their parents' opinion about learning science. Based on their answers, the **students' value learning science index** was created, whose scale and categories are shown in Figure 9.21.

Figure 9.21. Scale description of Students value learning science index



Source: Exhibit 11.15: Students Value Science. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Table 9.4. presents the average scores obtained in the assessment in science with respect to the extent to which students value science.

Table 9.4. Average score obtained in G8 TIMSS Mathematics assessment 2019 with respect to the declared level of value assigned to science.

Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Strongly value	49% (1.1)	404 (5.3)	36% (0.2)	511 (0.7)	55%	458
Somewhat value	39% (0.9)	360 (5.0)	42% (0.1)	487 (0.6)	34%	426
Do not value	12% (0.6)	350 (9.2)	22% (0.1)	467 (0.8)	11%	407

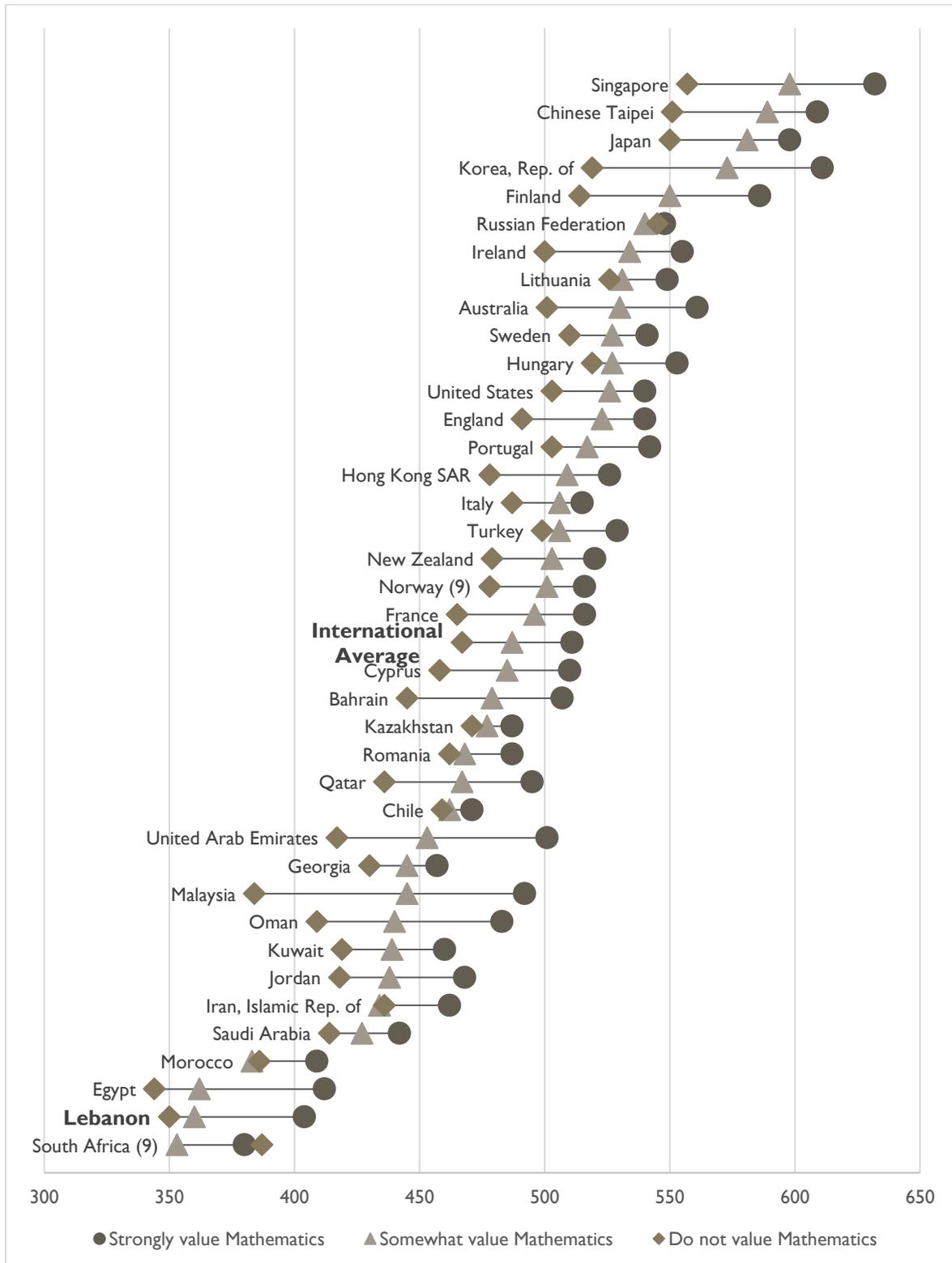
Source Exhibit 11.16: Students Value Science. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In Lebanon and MENA countries, relatively many eighth-graders strongly value science (49% and 55% of the students, respectively) –more than on the international average. The best results were achieved by those students who value science the most. The value assigned to science more strongly correlates with average results in science compared to the case of mathematics.

The country-level analysis of the relationship between the value assigned to science and the achievements in its assessment is shown in figure 9.22.

Figure 9.22. Average scores obtained in G8 TIMSS Science assessment in participating countries with respect to the value assigned to science



Source Exhibit 11.16: Students Value Science. TIMSS 2019 International Results in Mathematics and Science.

Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In the majority of the countries, including Lebanon, the highest scores in science are achieved by the students who strongly value its learning, while the lowest results are achieved by students who consider science as worthless. Also, in the case of science, the importance of the value assigned to the discipline should be considered when designing new educational policies.

Chapter 10. Technology, Curriculum and Instruction

In the 21st century, technological tools have become a worldwide need for education, and the COVID-related crisis has raised the importance of the role of the digital world in providing education. This chapter discusses the main factors that define technology access in schools:

- access to computers,
- the usage of computer activities to support learning,
- tests, and
- assessments.

This chapter discusses the relationship between technological access and educational achievements, with a focus on instructional time.

10.1. Application of technology during classroom activities

The use of technology in schools is increasing all over the world, ranging from a more extensive use of computers to interactive whiteboards and graphic tablets. Yet, such use is still not available for all the students in the same way due to different possibilities of access to technology itself. Therefore, it is worth analyzing whether having access to computers correlates with higher average results in mathematics and science.

In the supplementary TIMSS questionnaires, mathematics teachers were asked about the **accessibility of computers** during lessons, both at the individual and the class level.

Significantly fewer students have access to computers in Lebanon than in other countries since only 2% of Lebanese eighth-graders have their own computers that they can use during mathematics lessons. Moreover, only 14% of students in Lebanon have computers in their class which they can sometimes use – this is notably less than in MENA countries and on an international average. This became a severe problem when it came to the introduction of distance learning, and thus it was relatively difficult for Lebanese students to adjust to this during the COVID-19 pandemic. What is more, it is expected that modern economies will require ICT knowledge, which is strongly limited due to the lack of proper equipment. As the pandemic problem is still observable, the inequalities connected to the lack of proper equipment might increase over time.

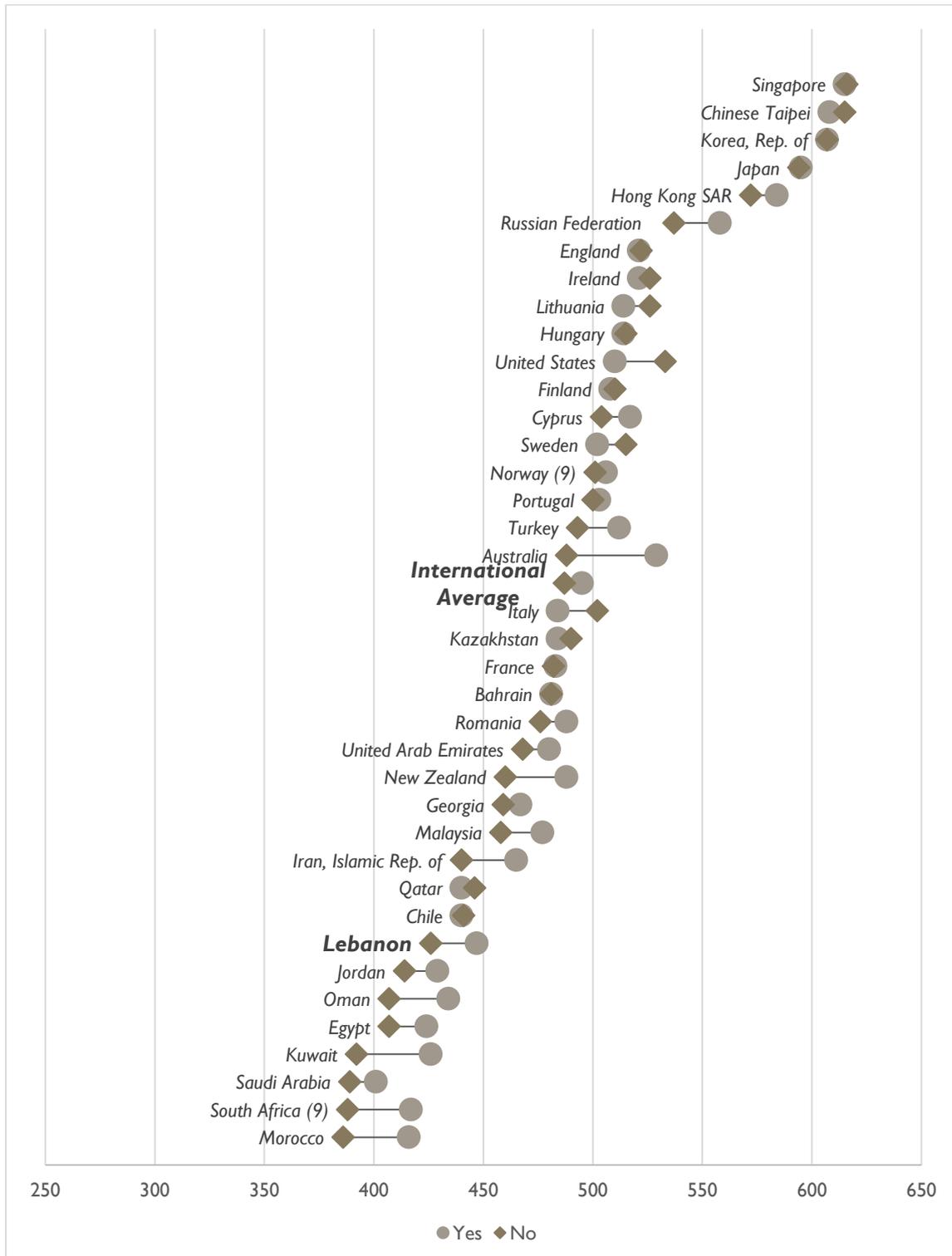
Table 10.1. Percentage of students with respect to the accessibility of the computers during mathematics lessons.

Category	Lebanon	International Average	MENA countries
	Percentage of students	Percentage of students	Percentage of students
Each Student has a Computer	2% (1.0)	17% (0.4)	7%
The Class has Computers that Students can Share	6% (2.1)	11% (0.4)	9%
The School has Computers that the Class can Sometimes Use	14% (3.3)	28% (0.5)	26%

Source: Exhibit 14.3: Access to Computers for Mathematics Lessons. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

A country-level analysis of the relationship between the availability of technology and achievements is presented in figure 10.1, showing that higher achievements in mathematics were scored by students who had access to computers during mathematics instruction. However, some countries have the opposite pattern, which can be explained by the fact that using too much technology might also distract students. Based on the rule of thumb, the hypothesis about the differences between groups was tested. It turned out that in 5 out of 39 countries and economies, the difference between students was significant. (i.e., Kuwait, Malaysia, Oman, Morocco).

Figure 10.1. Average results in G8 TIMSS mathematics assessment with respect to the accessibility of the computers during mathematics instruction.



Source: Exhibit 14.3: Access to Computers for Mathematics Lessons. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Also, for the domain of science, technological support can be relevant in achieving educational goals—an analysis of the availability of computers is presented in table 10.2.

Table 10.2. Percentage of students with respect to the accessibility of the computers during science lessons

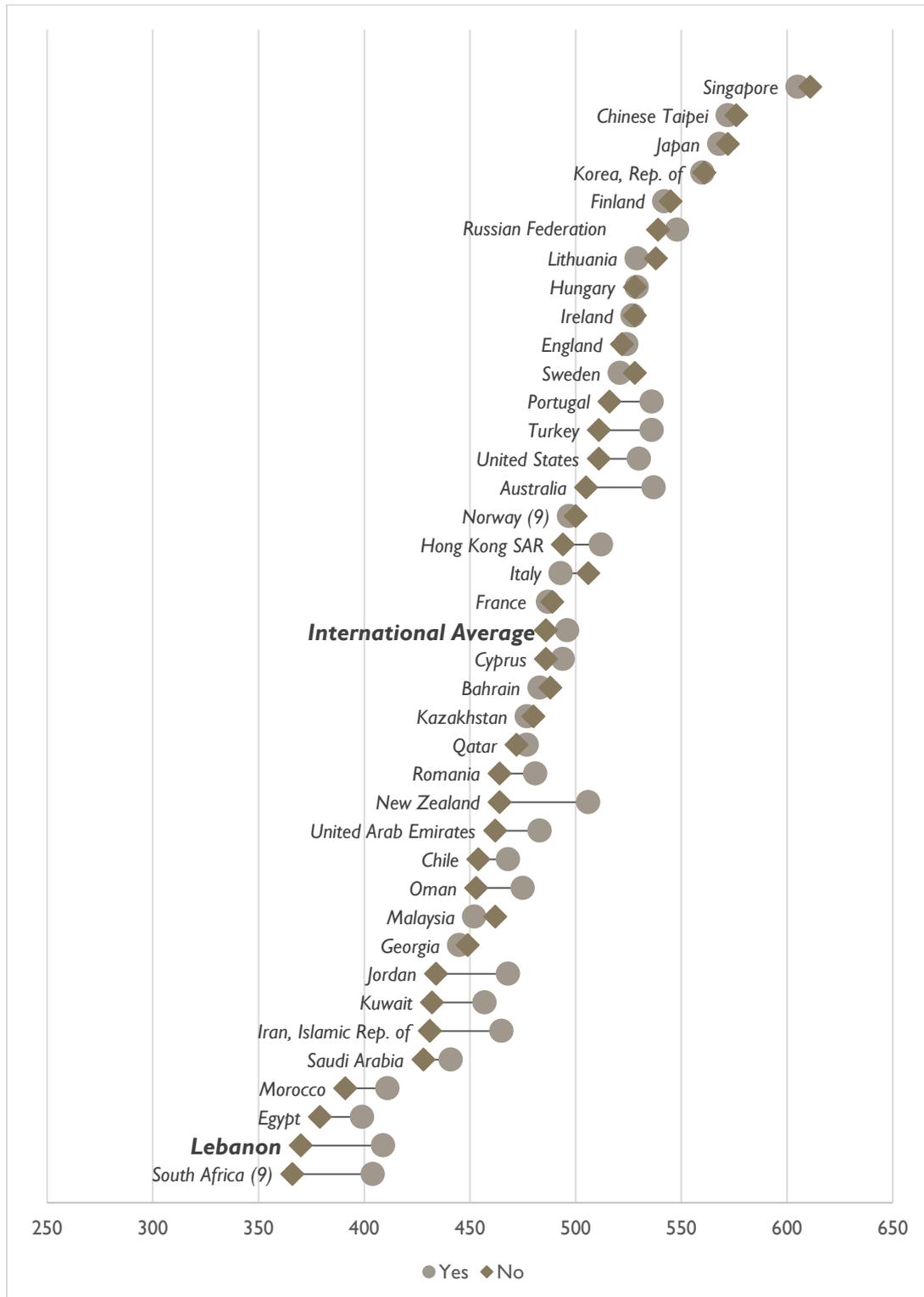
Category	Lebanon	International Average	MENA countries
	Percentage of students	Percentage of students	Percentage of students
Each Student has a Computer	1% (0.7)	19% (0.4)	9%
The Class has Computers that Students can Share	6% (1.9)	17% (0.4)	12%
The School has Computers that the Class can Sometimes Use	14% (2.3)	39% (0.5)	36%

Source: Exhibit 14.4: Access to Computers for Science Lessons. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In Lebanon, a similar share of students has access to computers during science as in mathematics, while the access to technology is broader among students from MENA countries and on an international average. On international average and in MENA countries, respectively 39% and 36% of students have a computer in class which they can use.

Figure 10.2 shows the results of the country-level analysis of the relationship between the accessibility of computers and achievements in science.

Figure 10.2. Average results in G8 TIMSS science assessment with respect to the accessibility of the computers during mathematics instruction.



Source: Exhibit 14.4: Access to Computers for Science Lessons. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In most countries, students who had access to the computers during instructions achieved better results in science, with differences between students' performance being sometimes larger than in the case of mathematics. This is particularly visible for Lebanon, where students who had access to computers scored on average 39 points more than the ones who could not.

Supporting the instruction, however, does not only depend on the availability of computers, since the frequency of their use is also important. Figure 10.3 shows the **frequency of use of digital devices** during the instruction of mathematics.

While in most countries, digital activities are never applied during mathematics lessons, in some countries, such as Australia, New Zealand, United Arab Emirates, and the United States, around 20% of eighth-graders are used to such activities. In contrast, only 1% of students in Lebanon were used to such activities. More importantly, **almost 90% of Lebanese eighth-graders have never been introduced to such activities during the instruction**. Such patterns might be connected to the lack of proper training about digital learning among teachers. As shown in previous chapters, the interest in development courses concerning integrating ICT into instruction remained relatively low in Lebanon. These results emphasize the difficulty in providing quality distance learning in Lebanon.

Figure 10.3. Distribution of students with respect to the frequency of applying digital activities during mathematics instruction



Source: Exhibit 14.7: Teachers Do Computer Activities to Support Learning in Mathematics Lessons. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Table 10.3 presents the results of the frequency of use of digital devices in relationship to achievements in mathematics.

Table 10.3. Average score obtained in G8 TIMSS mathematics assessment with respect to the frequency of supporting the instruction with digital activities.

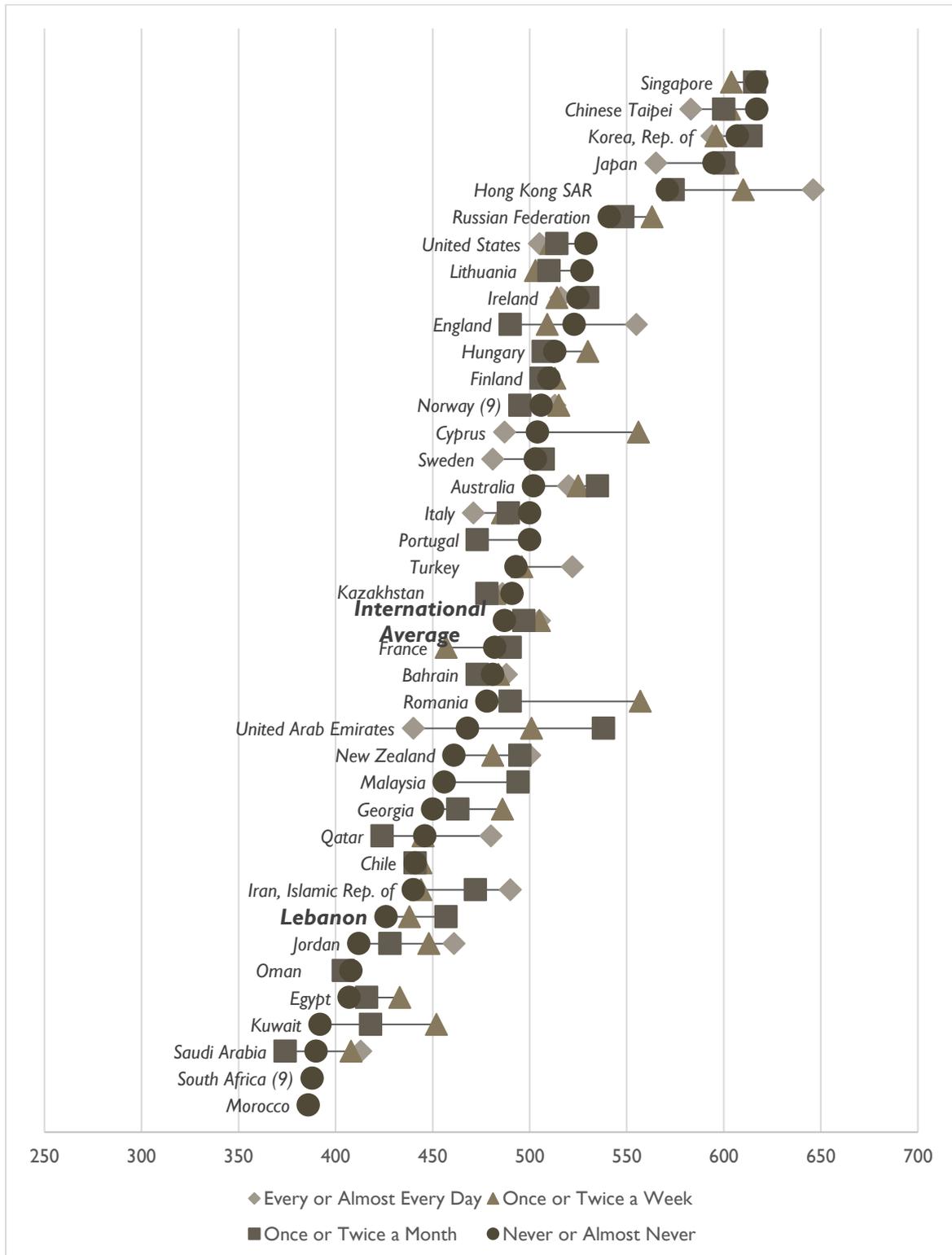
Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Every or Almost Every Day	1% (0.7)	NA	5% (0.3)	505 (3.2)	7%	451
Once or Twice a Week	5% (1.8)	438 (26.5)	10% (0.4)	505 (2.8)	10%	451
Once or Twice a Month	7% (2.4)	457 (13.3)	16% (0.4)	497 (2.0)	9%	442
Never or Almost Never	88% (3.0)	426 (3.1)	68% (0.5)	487 (0.9)	74%	424

Source: Exhibit 14.7: Teachers Do Computer Activities to Support Learning in Mathematics Lessons. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In Lebanon, the highest score in mathematics had students who used a computer once or twice a month. On the other hand, in MENA countries and on the international average, the best performance was found among students who most frequently used it, and consistently, the worst results were obtained by students who used digital devices the least frequently.

It should be noted that the frequency of use of computers might relate to the socioeconomic status of students. As students with better socioeconomic backgrounds usually obtain higher scores in the assessment on average, it is not surprising that higher achievements are observed in schools that are better equipped with digital devices. Figure 10.4 shows the country-level analysis of the relationship between the frequency of use of digital devices and achievements in mathematics.

Figure 10.4. Average results in G8 TIMSS Mathematics assessment with respect to the frequency of supporting mathematics instruction with computer activities.



Source: Exhibit 14.7: Teachers Do Computer Activities to Support Learning in Mathematics Lessons. TIMSS 2019 International Results in Mathematics and Science. Downloaded from:

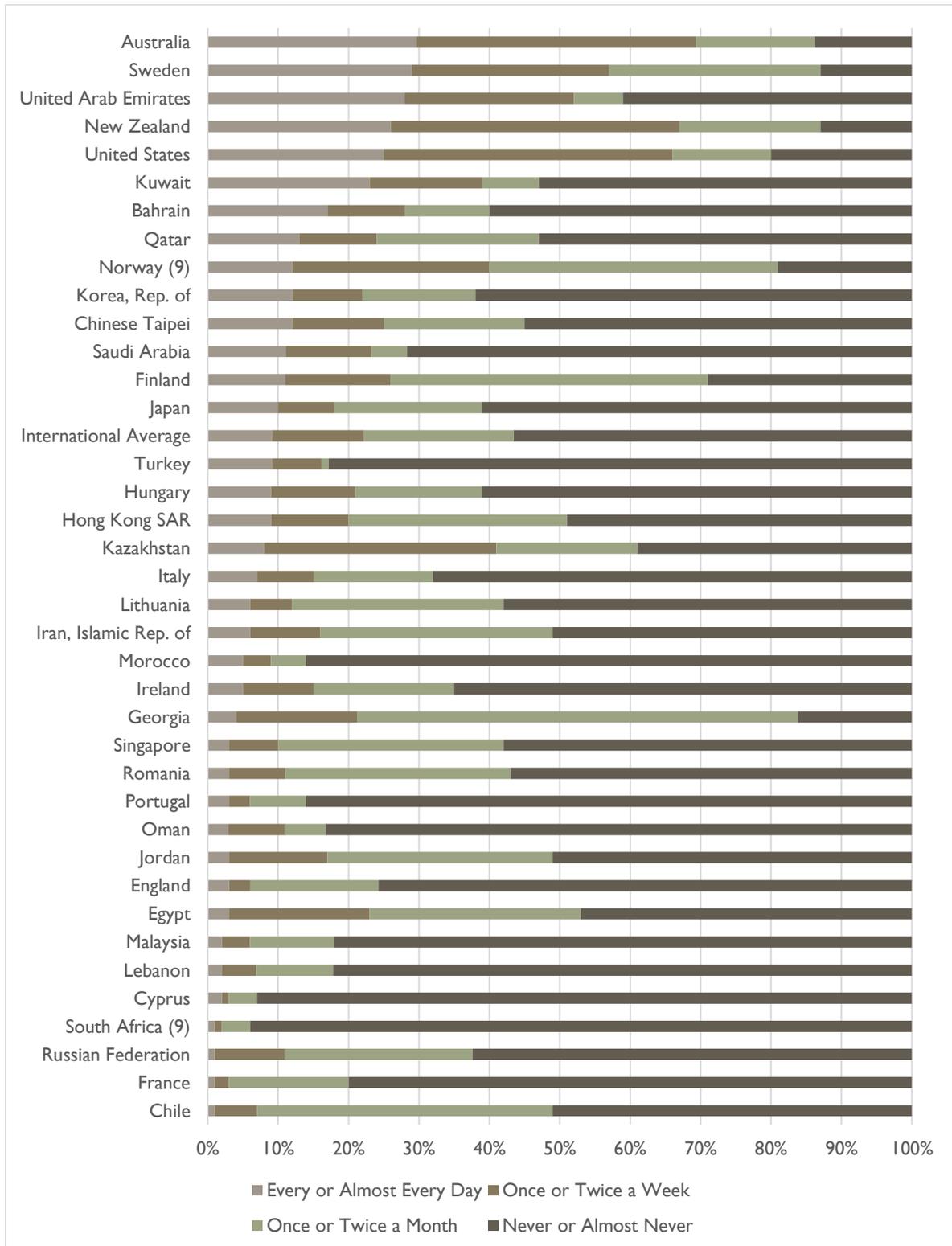
<https://timssandpirls.bc.edu/timss2019/international-results/>

In general, no specific pattern concerning the relationship between the frequency of use of digital devices during mathematics lessons and students' performance can be found.

Science instruction requires supporting the instruction with the use of computer activities more than mathematics since it might be easier and more time-effective to explain science phenomena. Figure 10.5 shows the distribution of students with respect to the frequency of use of digital devices.

In Lebanon, more than 80% of eighth-graders are not used to these activities at all. In consequence, when the instruction is not supported by applying digital activities, learning might be more difficult for Lebanese students, especially in the case of distance learning.

Figure 10.5. Distribution of students with respect to the frequency of applying digital activities during science instruction



Source: Exhibit 14.8: Teachers Do Computer Activities to Support Learning in Science Lessons. TIMSS 2019

International Results in Mathematics and Science. Downloaded from:

<https://timssandpirls.bc.edu/timss2019/international-results/>

Table 10.4 presents the results of the frequency of use of digital devices in relationship to achievements in science.

Table 10.4. Average score obtained in G8 TIMSS Science assessment with respect to the frequency of supporting the instruction with digital activities.

Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Every or Almost Every Day	2% (1.3)	NA	9% (0.3)	509 (2.4)	10%	463
Once or Twice a Week	5% (1.4)	389 (29.9)	13% (0.4)	495 (2.5)	12%	447
Once or Twice a Month	11% (2.0)	417 (14.4)	21% (0.4)	497 (1.7)	16%	457
Never or Almost Never	83% (2.6)	369 (5.1)	56% (0.5)	487 (1.0)	62%	431

Source: Exhibit 14.8: Teachers Do Computer Activities to Support Learning in Science Lessons. TIMSS 2019

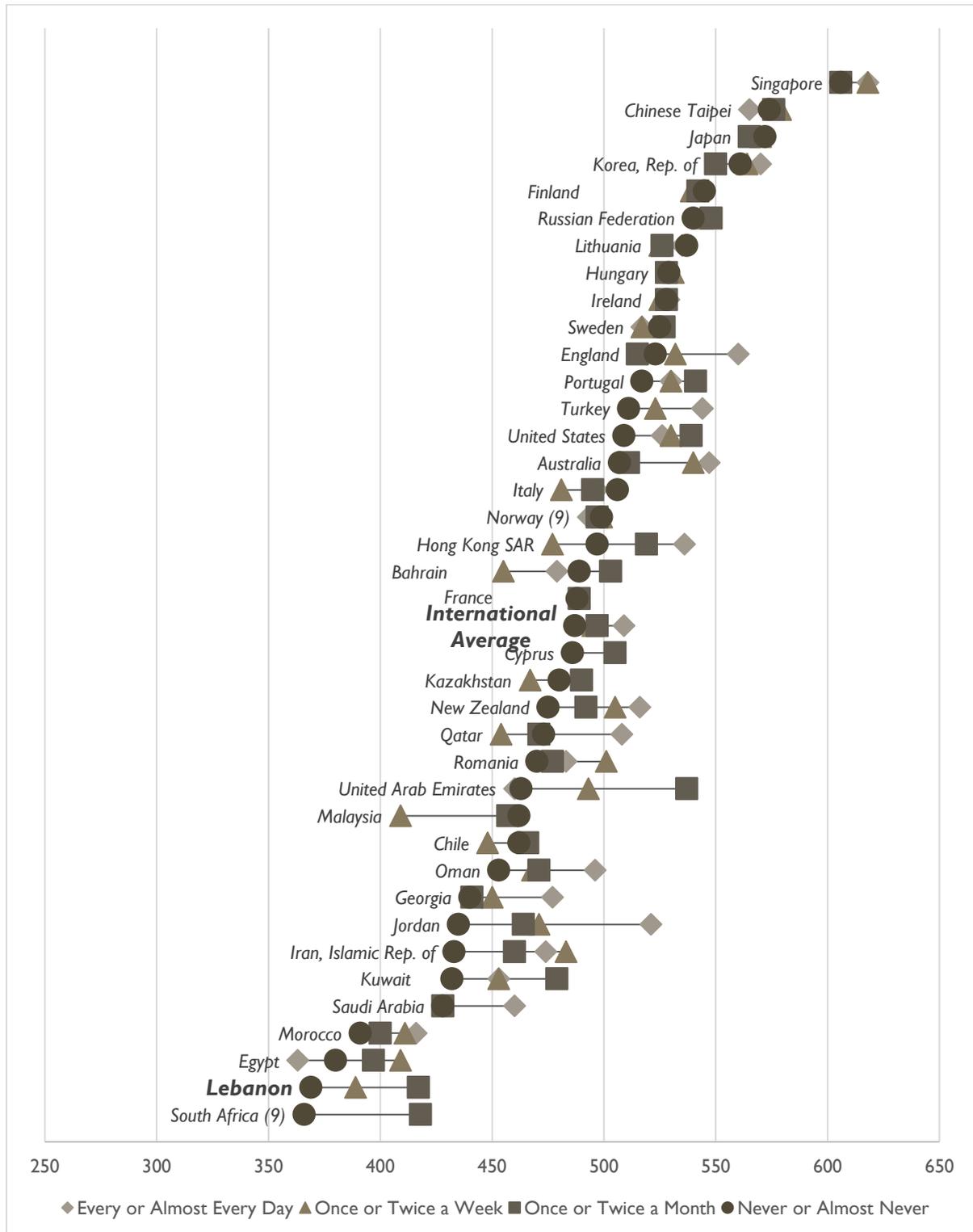
International Results in Mathematics and Science. Downloaded from:

<https://timssandpirls.bc.edu/timss2019/international-results/>

In the MENA Countries and on international average, the highest scores in science were obtained by students who used computers daily, contrary to Lebanon, where the best results were achieved by students using digital devices once or twice a month. Additionally, it can be noticed that only 2% of Lebanese students use digital devices almost every day. Lebanese science teachers might rarely use digital devices during the instruction, as they might not be trained in applying digital devices for teaching purposes. Also, the previous analysis has shown the lack of computers in Lebanese schools.

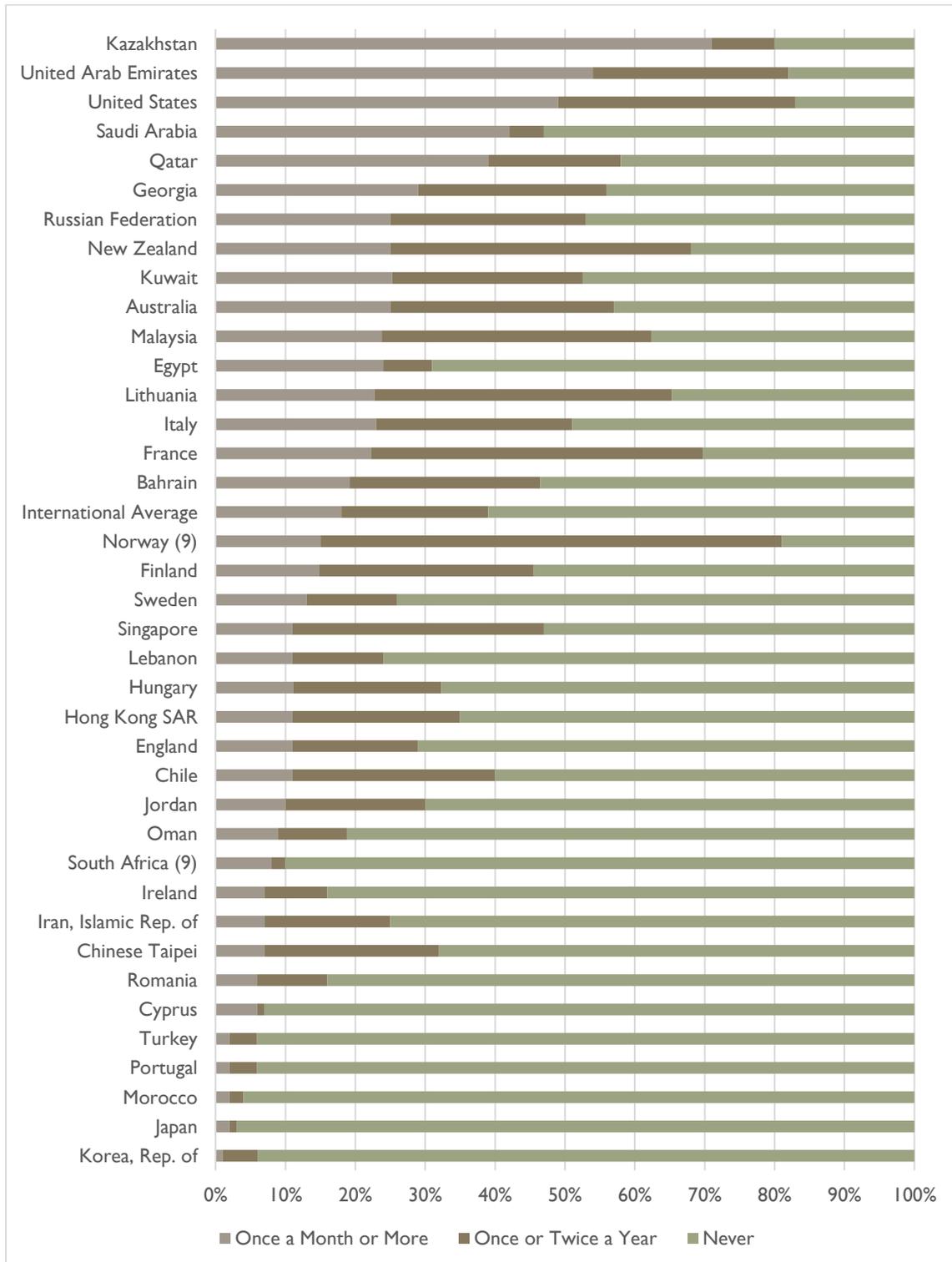
Figure 10.6 presents the results of the country-level analysis of the relationship between the frequency of use of computers and science achievement.

Figure 10.6. Average results in G8 TIMSS Science assessment with respect to the frequency of supporting science instruction with computer activities.



Source: Exhibit 14.8: Teachers Do Computer Activities to Support Learning in Science Lessons. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Figure 10.7. Distribution of students with respect to the frequency of applying digital assessment in mathematics.



Source: Exhibit 14.11: Students Take Mathematics Tests on Computers or Tablets. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Digital devices might be useful in assessing students' competencies. For example, electronic exams allow for quicker grading, but at the same time, can hardly include anything other than multiple-choice questions. Figure 10.7 shows the distribution of students on the **frequency of electronic exams**. In the majority of countries, students do not take part in electronic assessments with the use of digital devices. In Lebanon, very few eighth-graders are reported to take a computer assessment.

Figure 10.5 shows the results in the mathematics assessment with respect to the frequency of electronic exams.

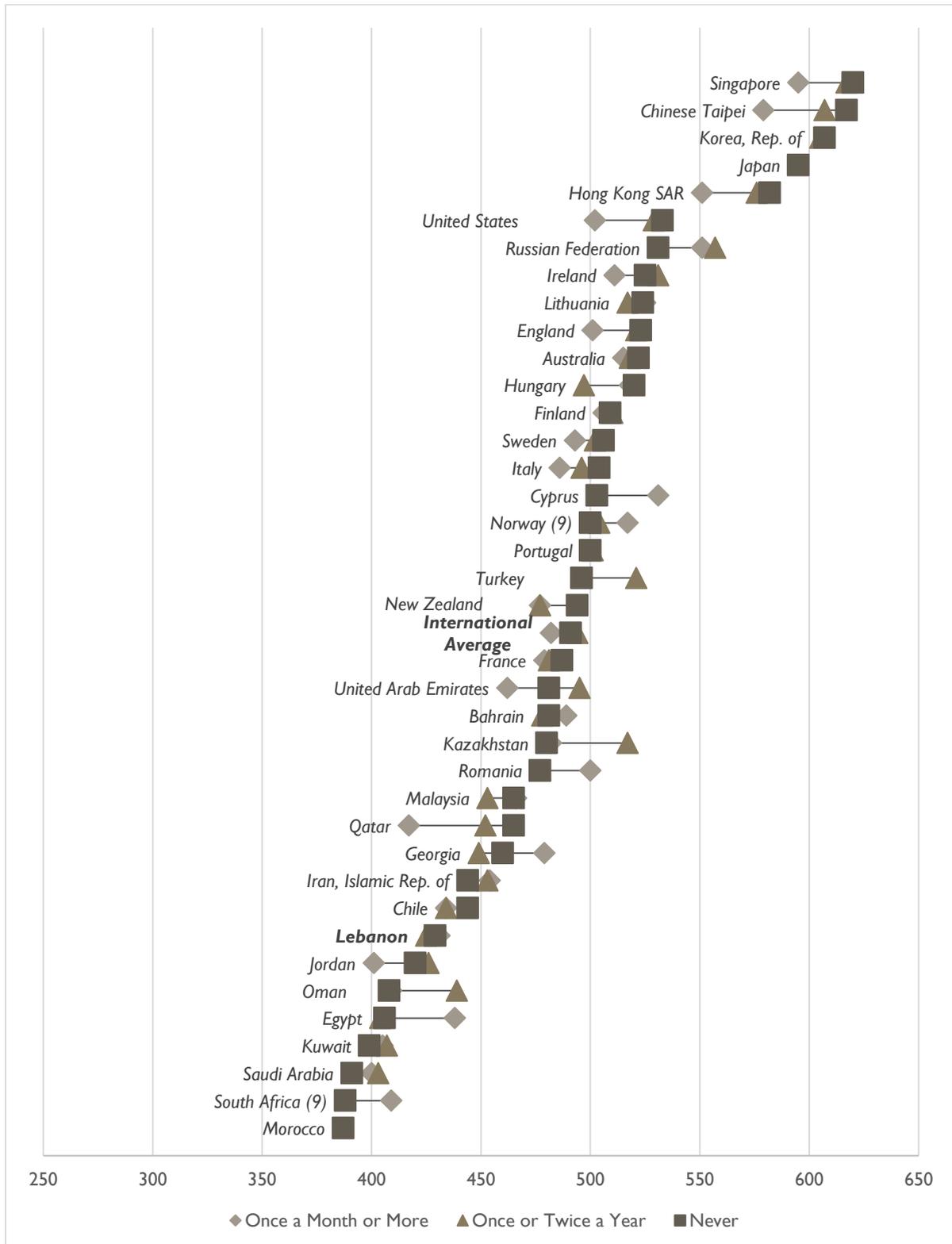
Table 10.5. Average score obtained in G8 TIMSS Mathematics assessment with respect to the frequency of conducting computer assessments.

Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Once a Month or More	11% (2.3)	431 (15.0)	18% (0.4)	482 (2.0)	23%	434
Once or Twice a Year	13% (2.9)	425 (10.6)	21% (0.5)	494 (2.1)	16%	440
Never	76% (3.4)	429 (3.7)	61% (0.5)	491 (0.9)	61%	429

Source: *Students Take Mathematics Tests on Computers or Tablets. TIMSS 2019 International Results in Mathematics and Science*. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

No significant differences in achievement can be found in any of the groups. Figure 10.8 shows the results from the country-level analysis on the relationship between the frequency of electronic exams and achievements. Only in top-performing countries, students who perform the best are the ones having electronic exams.

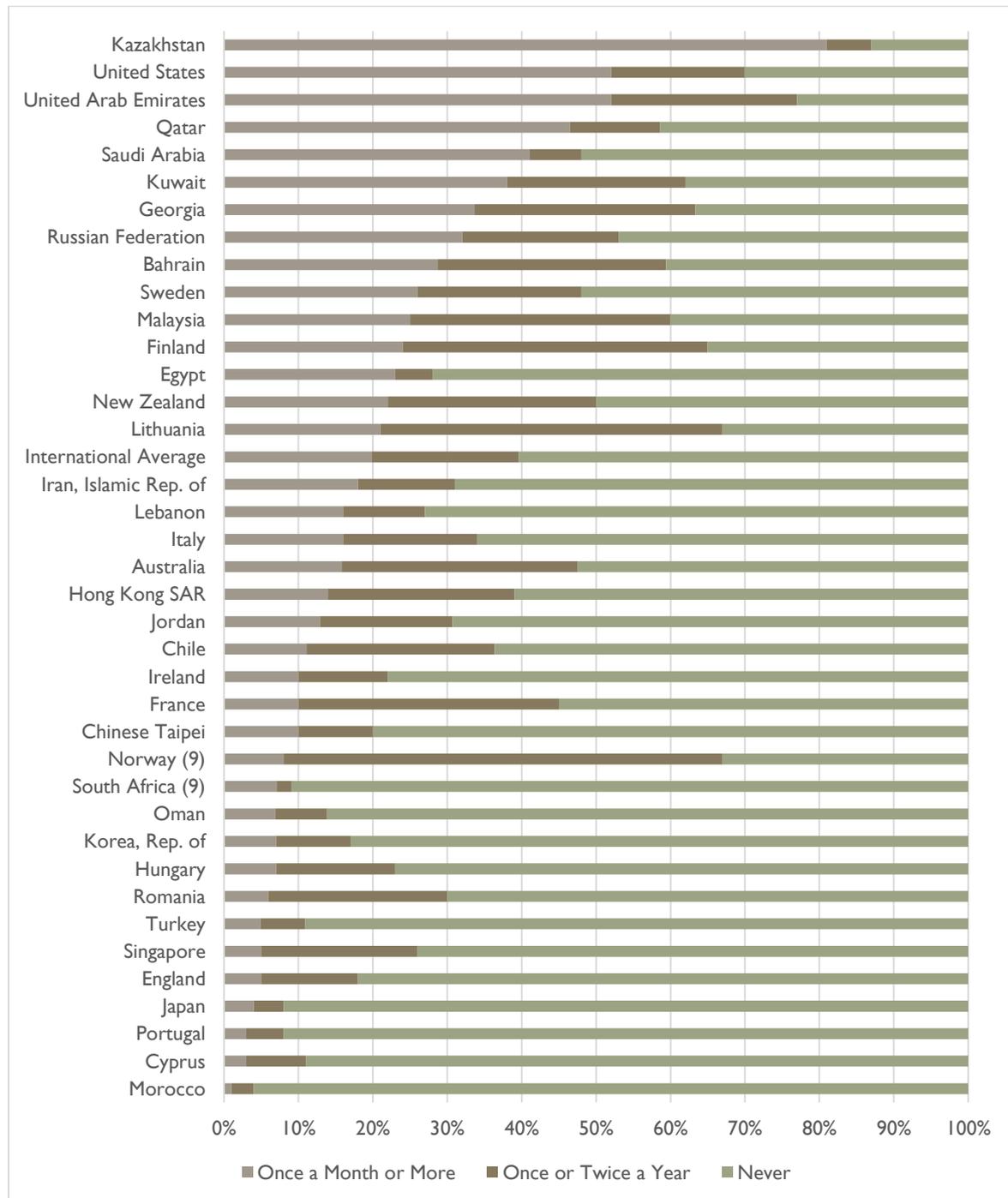
Figure 10.8. Average scores in G8 mathematics assessment, with respect to the frequency of conducting digital assessments.



Source: Students Take Mathematics Tests on Computers or Tablets. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

The same analysis was conducted in terms of science assessments. Figure 10.9 shows the distribution of students with respect to the frequency of electronic exams.

Figure 10.9. Distribution of students with respect to the frequency of applying digital assessment in science



Source: Exhibit 14.12: Students Take Science Tests on Computers or Tablets. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In Lebanon, less than 30% of students have ever taken part in a digital assessment in science. The majority of eighth-graders were not used to taking assessments in science on either computers or tablets, yet the percentage of students who take these assessments digitally at least once a month is relatively close to the share of students on an international average.

Table 10.6 shows the score obtained in the assessment in science with respect to the frequency of electronic exams.

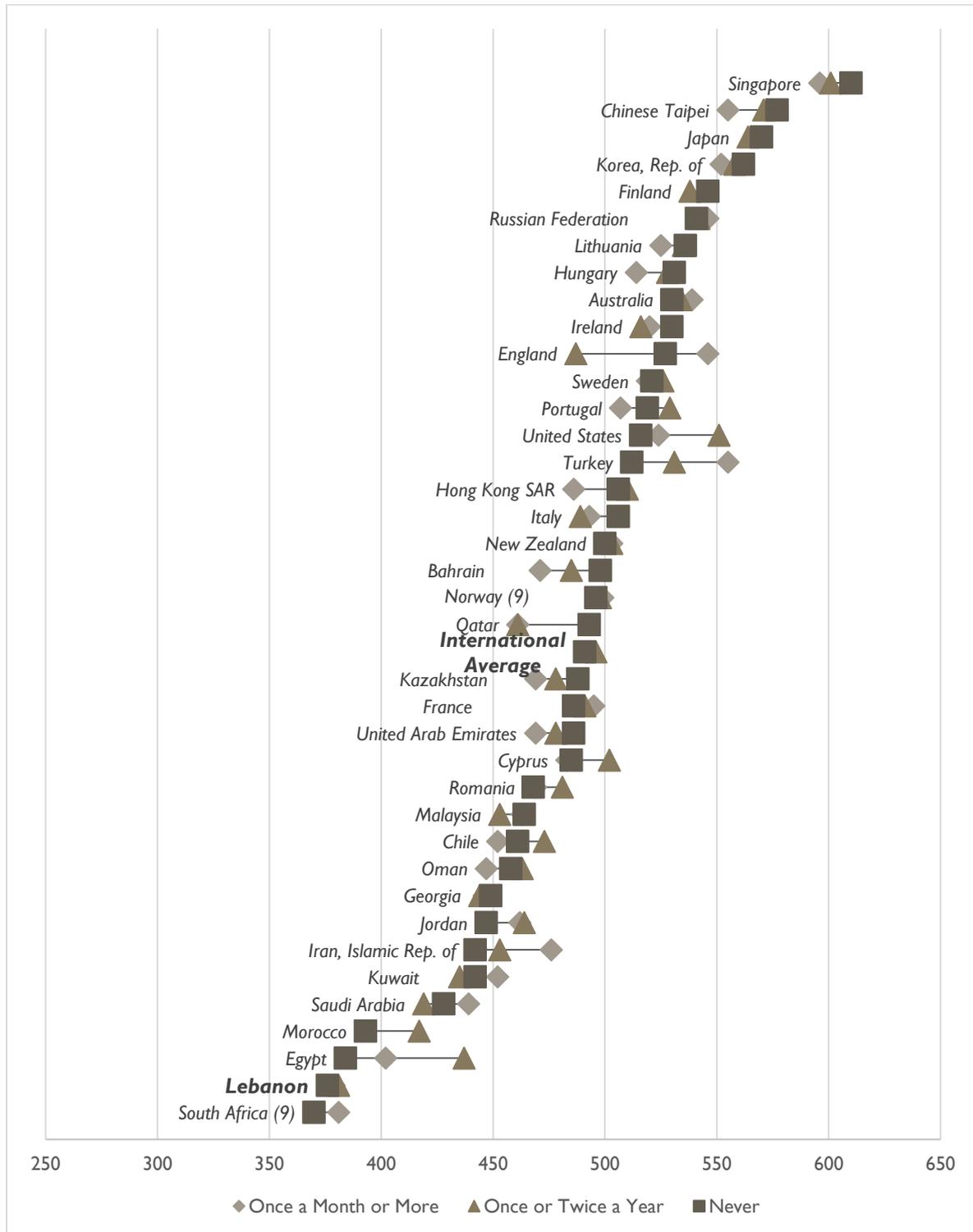
Table 10.6. Average score obtained in G8 TIMSS Science assessment with respect to the frequency of conducting computer assessments.

Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Once a Month or More	16% (2.1)	379 (10.1)	18% (0.4)	492 (1.8)	26%	446
Once or Twice a Year	11% (2.0)	381 (18.8)	21% (0.4)	496 (1.6)	14%	445
Never	73% (2.5)	376 (5.3)	61% (0.5)	491 (0.9)	60%	441

Source: Exhibit 14.12: Students Take Science Tests on Computers or Tablets. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

The table shows that the frequency of electronic exams does not seem to relate significantly to science assessment results. Figure 10.10 shows the country-level results.

Figure 10.10. Average scores in G8 science assessment, with respect to the frequency of conducting digital assessments.



Source: Exhibit 14.12: Students Take Science Tests on Computers or Tablets. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Since no significant differences in performance can be seen, it can be concluded that the influence of taking the test digitally is marginal when it comes to students' achievements.

10.2 Mathematics and science curriculum

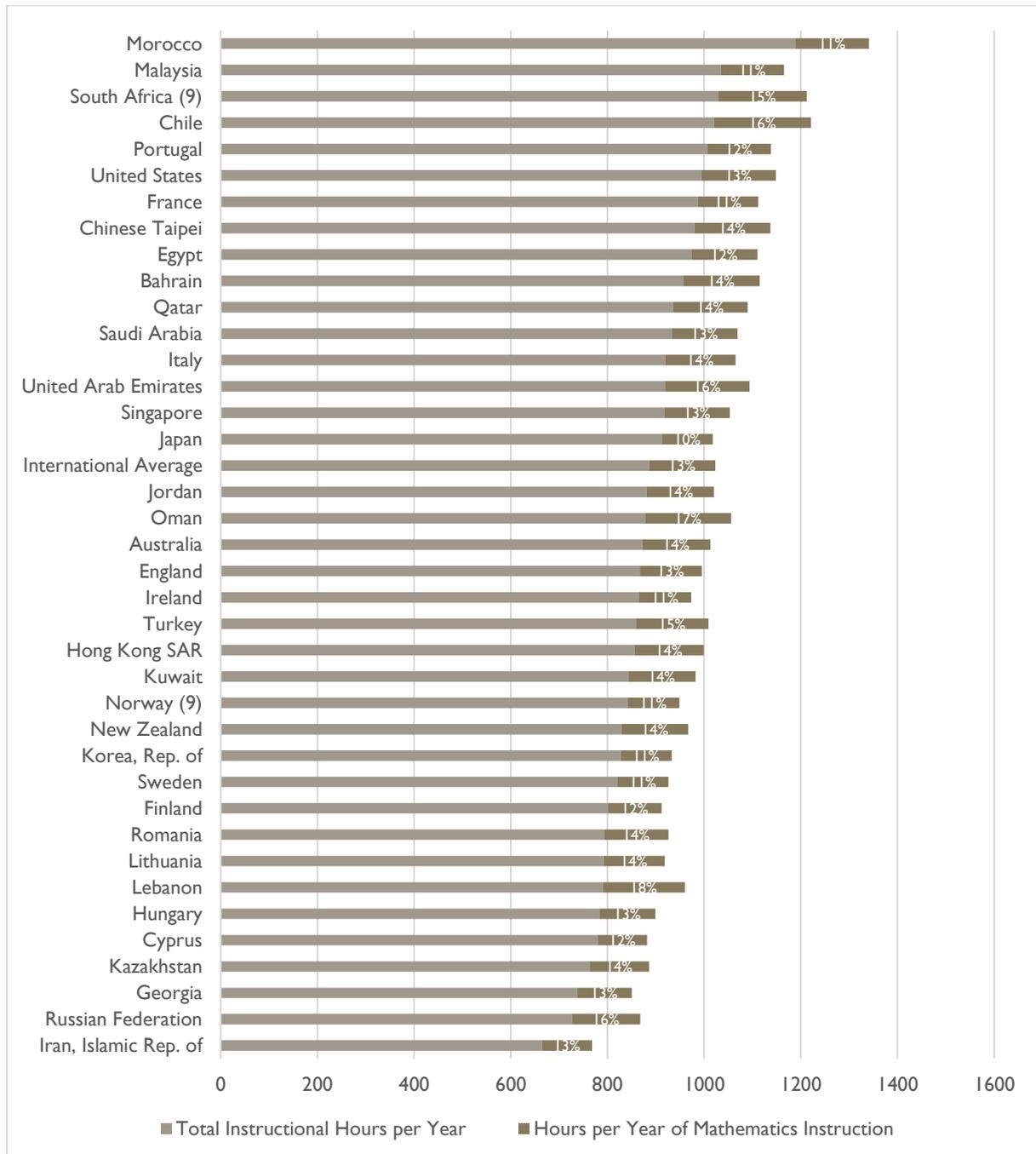
The TIMSS assessment is designed to consider the topics found in each country's school curricula, although in each school, the actual implementation of the curriculum may vary depending on the specific conditions faced by the class. The ideal curriculum in mathematics should include all of the important topics in mathematics while also leaving the appropriate time for the study of other subjects. Figure 10.11 presents the **share of instructional hours** devoted to mathematics in each country participating in the TIMSS assessment.

The total amount of instructional hours varies significantly between countries, though the share of hours devoted to mathematics is similar (ranging from 102 to 200 of the total instructional hours, or 10% to 18% in relative terms). **Lebanon presents one of the lowest numbers of total instructional hours among MENA countries while at the same time having the highest share of instruction devoted to mathematics (170 hours out of 960 total instructional hours).**

In the TIMSS assessment, teachers were asked what part of the assessment material had been covered in class. As mathematics assessment concerns four content domains – Numbers, Algebra, Geometry and Data and Probability, it is possible to determine to which extent the material was covered in each of these domains. The results are shown in table 10.7.

In Lebanon, eighth-graders exhibit a very low Percentage of mathematics material covered, which can explain their worse results.

Figure 10.11. Total instructional time and Percentage of instructional hours devoted to mathematics by country



Source: Exhibit 12.3: Instructional Time Spent on Mathematics. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

However, in countries such as Russia, Cyprus and Hungary, students had even fewer instructional hours but achieved much better results in mathematics than Lebanese students. Thus, a deep analysis of the curriculum might provide a better understanding of the coverage of the mathematics curriculum.

Table 10.7. Percentage of mathematics material covered before the assessment

Category	Lebanon	International Average	MENA countries
	Percentage of material covered	Percentage of material covered	Percentage of material covered
All mathematics topics	56% (1.1)	72% (0.2)	75%
Number	92% (1.0)	98% (0.1)	98%
Algebra	50% (1.4)	68% (0.2)	65%
Geometry	64% (1.3)	76% (0.2)	82%
Data and probability	39% (2.8)	60% (0.3)	70%

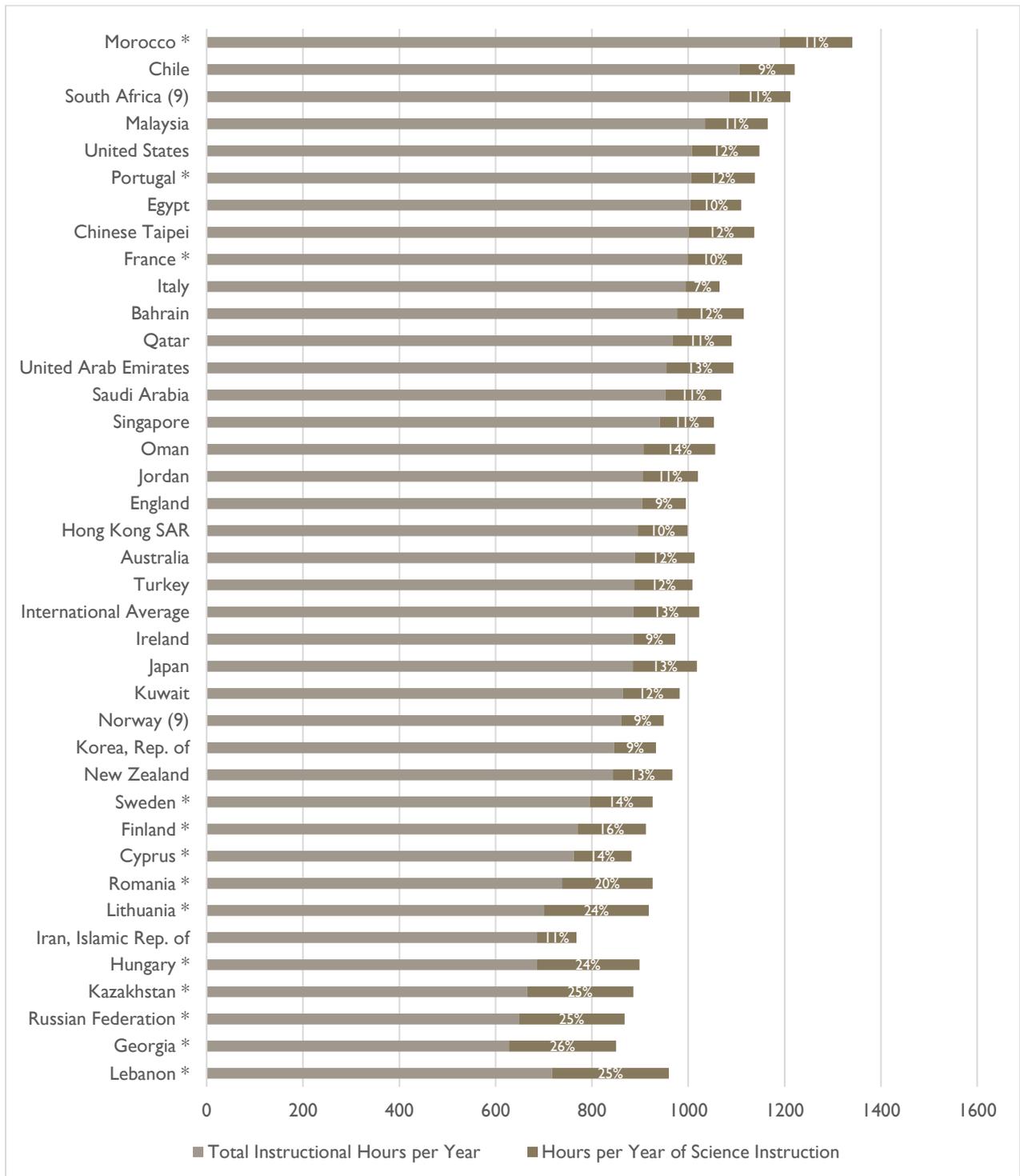
Source: Exhibit 12.7: Percentages of Students Taught the TIMSS Mathematics Topics. Downloaded from:

<https://timssandpirls.bc.edu/timss2019/international-results/>

The same analyses but concerning science were conducted. Figure 10.12 shows the percentage of instructional hours devoted to science as a share of the total instructional hours.

Larger differences in the time devoted to science can be found compared to the case of mathematics, ranging from 7% in Italy to 26% in Georgia (in absolute terms: from 70 up to 243 hours). In Lebanon, the second highest share of total instructional hours was devoted to science – 243 hours out of 970 total instructional hours (having in mind the overall low total instruction time). In sum, Lebanese eighth-graders spend more than 40% of their time learning mathematics and science at school.

Figure 10.12. Percentage of instructional hours devoted to science by country



⁷Source: Exhibit 13.3: Instructional Time Spent on Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

⁷ * For countries teaching science as separate subjects, hours per year for science instruction is based on total hours across subjects.

As in the case of mathematics, science teachers were asked to what extent they have covered the TIMSS material before the assessment. As Science assessment consists of four different content domains – Biology, Chemistry, Physics and Earth Science, the coverage of the material can be analysed independently for each domain. Table 10.8 shows the results of this inquiry.

Table 10.8. Percentage of science material covered before the assessment

Category	Lebanon	International Average	MENA countries
	Percentage of students	Percentage of students	Percentage of students
All science topics	76% (0.8)	72% (0.2)	78%
Biology	76% (1.9)	74% (0.2)	81%
Chemistry	80% (1.3)	74% (0.2)	75%
Physics	71% (1.5)	68% (0.2)	75%
Earth Science	NA	71% (0.3)	83%

Source: Exhibit 13.7: Percentages of Students Taught the TIMSS Science Topics. Downloaded from:

<https://timssandpirls.bc.edu/timss2019/international-results/>

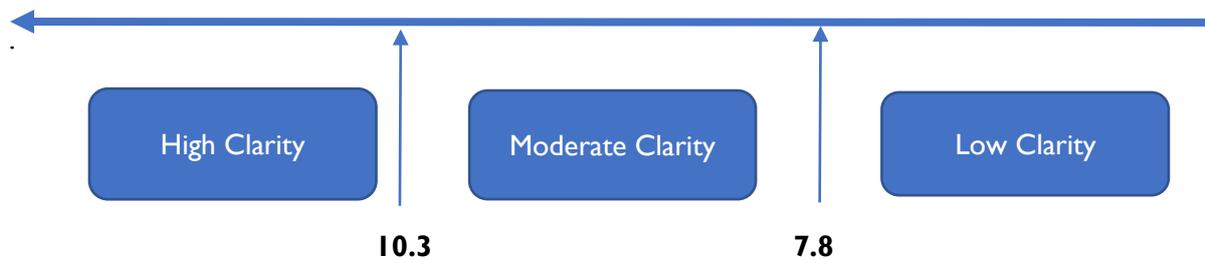
While Lebanese students performed worse than eighth-graders from other areas in the science assessment, the share of the material covered in class is relatively comparable to schools abroad. This can indicate that the influence of the share of total instructional hours devoted to science is not the most important factor in understanding Lebanese students' poor achievements.

10.3. Mathematics and science instruction

Even though many factors might influence the learning process, the clarity of the instruction and the observed level of disorderly behavior during the lessons are among the most significant. Without clarity and order, there is a higher chance that students will not be able to do so to understand the materials covered.

In a supplementary questionnaire, eighth-graders were asked questions concerning the clarity of instruction of their mathematics teachers. These questions were concerning issues such as whether teachers give clear answers, use various techniques to make the process of learning easier for students, and link the newly learned concepts to the ones learned before. Based on this, the **instructional clarity index** has been calculated and scaled and is shown in figure 10.13.

Figure 10.13. Scale description of mathematics instruction clarity index

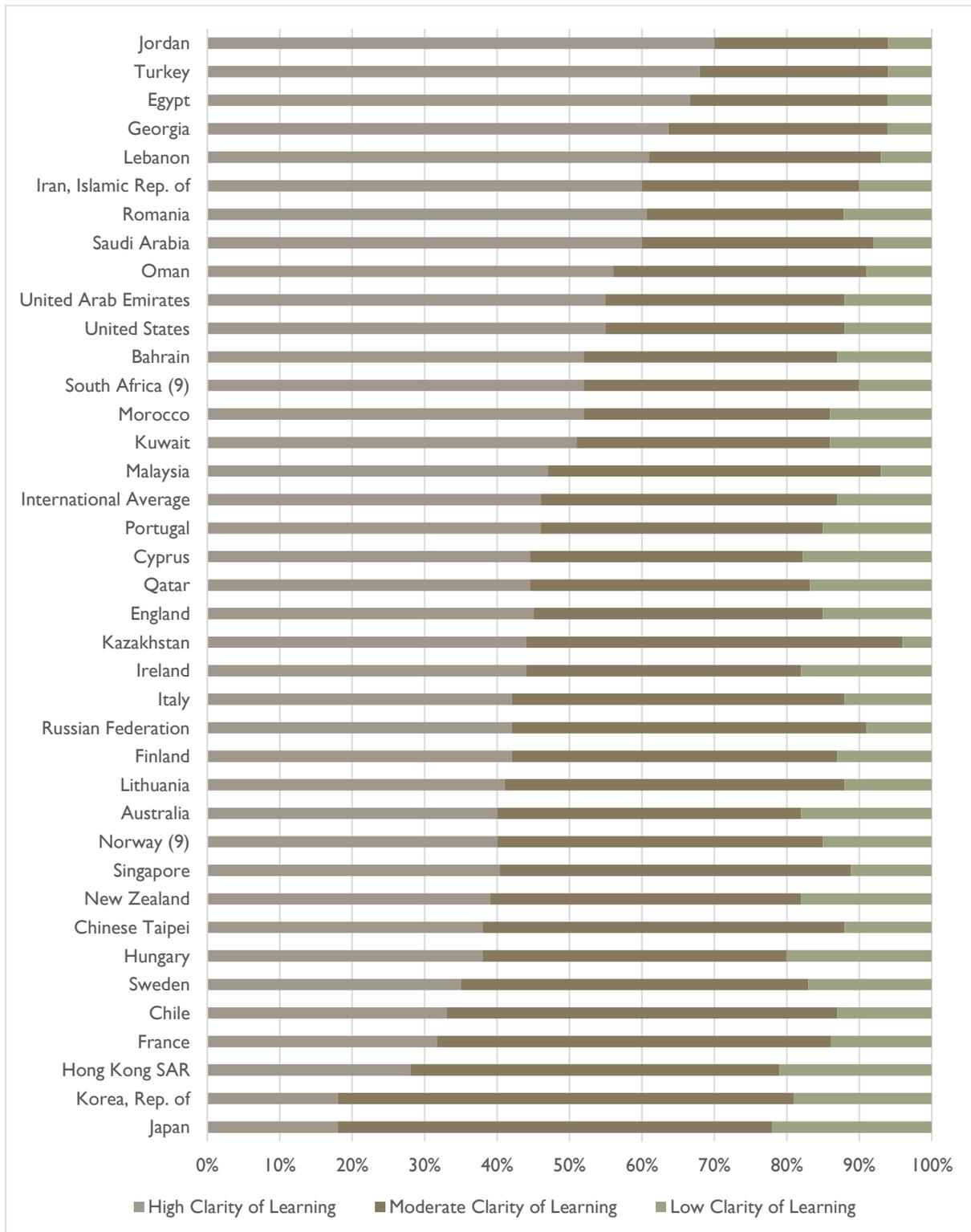


Source: Exhibit 12.8: Instructional Clarity in Mathematics Lessons – Students’ Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Three categories concerning the level of instructional clarity have been defined based on the answers given in the questionnaires. Figure 10.14 shows the distribution of students with respect to the level of instructional clarity in mathematics.

In more than half of the countries, the largest share of students found a high instructional clarity in learning mathematics. Surprisingly, students from countries where the best performances in mathematics are found (such as Japan, the Republic of Korea, and Hong Kong SR) declared the lowest levels of instructional clarity. In Lebanon, 61% of students claimed to have experienced high clarity of mathematics instruction. However, the performance of Lebanese eighth-graders was very low. This might be connected to the teaching styles adopted by teachers. Lack of problem-solving elements in the learning process might not fully develop pupils' competencies, even if the instruction is explained in a clear and easily understandable way.

Figure 10.14. Distribution of students with respect to the level of instructional clarity of learning mathematics



Source: Exhibit 12.10: Instructional Clarity in Mathematics Lessons – Students’ Reports TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Table 10.9 shows the average score obtained in the assessment in mathematics with respect to the level of instructional clarity.

Table 10.9. Average score obtained in G8 TIMSS mathematics assessment with respect to the level of instructional clarity of mathematics.

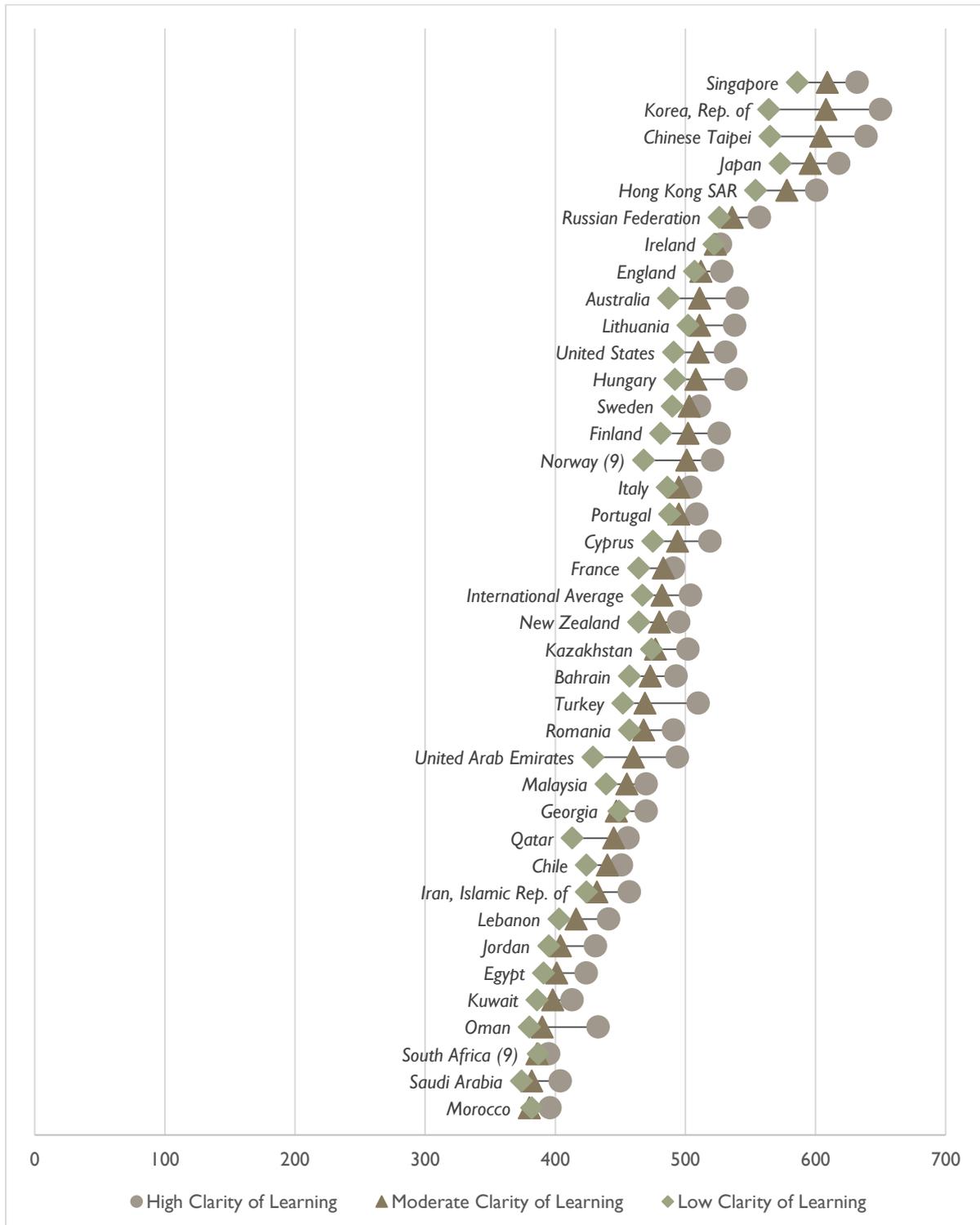
Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
High Clarity of Instruction	61% (1.9)	441 (3.2)	46% (0.2)	504 (0.6)	57%	440
Moderate Clarity of Instruction	32% (1.6)	416 (4.3)	41% (0.2)	482 (0.7)	32%	416
Low Clarity of Instruction	7% (0.6)	403 (6.4)	13% (0.2)	467 (1.0)	11%	403

Source: Exhibit 12.10: Instructional Clarity in Mathematics Lessons – Students’ Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

The higher clarity of mathematics instruction experienced eighth-graders, the better they performed in the assessment. However, the differences between students are more or less the same in Lebanon, the MENA countries, and on the international average. Figure 10.15 shows the results of the country-level analysis of the relationship between instructional clarity and achievements in mathematics.

In all the countries, the best performance in mathematics is found among students who experienced the highest level of instructional clarity in mathematics. At the same time, there are no significant differences between students' performances who experienced a low and a moderate clarity of instruction.

Figure 10.15. Average results in G8 TIMSS mathematics assessment with respect to the level of instructional clarity in mathematics.

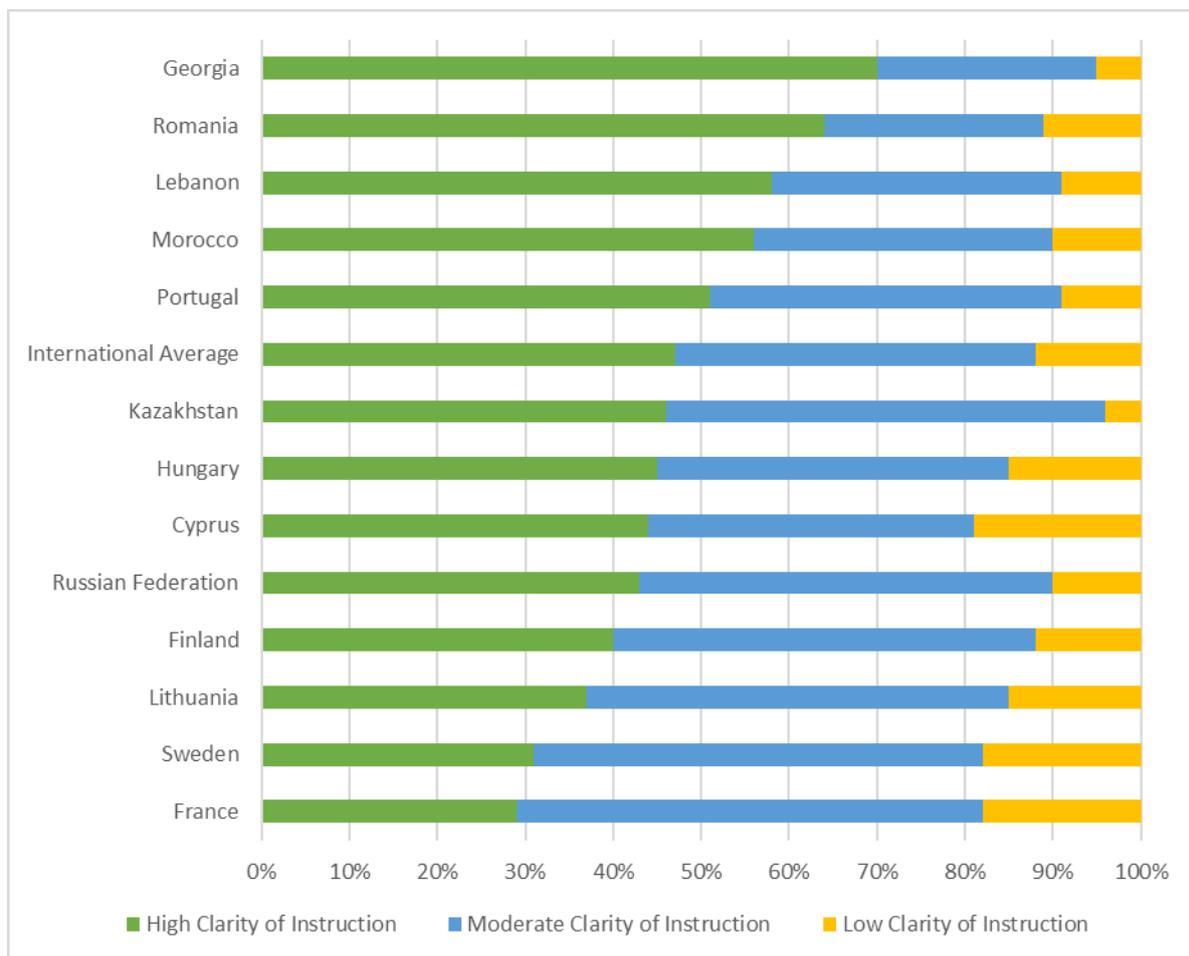


Source: Exhibit 12.10: Instructional Clarity in Mathematics Lessons – Students’ Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Since for science, the assessment is based on four different disciplines (Biology, Chemistry, Physics, Earth Science), questions about the clarity of instruction have been provided for each of them independently. Due to missing data from the Lebanese questionnaires, the analyses are conducted only for Biology, Chemistry, and Physics.

Figure 10.16 shows the distribution of students with respect to the experienced level of instructional clarity in learning Biology.

Figure 10.16. Distribution of students with respect to the level of instructional clarity of learning biology



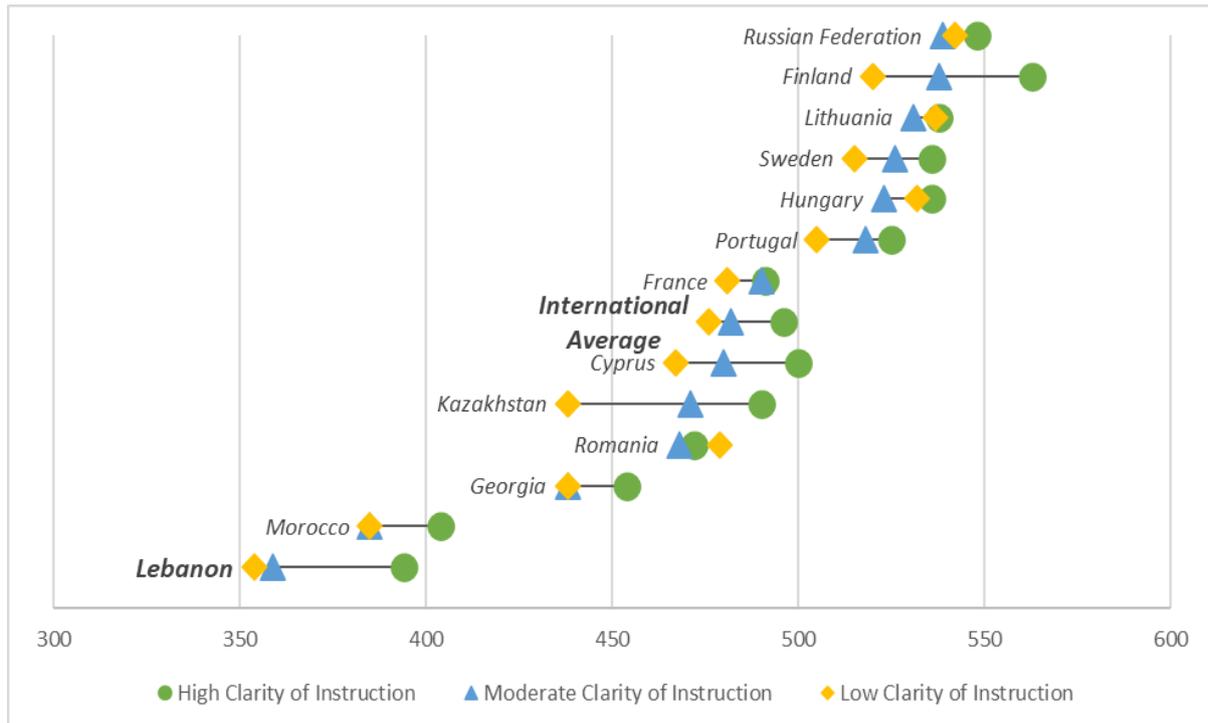
Source: Exhibit 13.10: Instructional Clarity in Science Lessons – Students’ Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

The majority of the eighth graders declared they experienced a high clarity of instruction in Biology. In Lebanon, over half of the students experienced a high clarity of instruction in this discipline. Yet, the average score obtained by Lebanese students in science was poor, even in comparison to the

countries where the level of instruction clarity was lower than in Lebanon. This might be resulting from ineffective approaches adopted by Lebanese teachers.

Figure 10.17 shows the results of the country-level analysis about the results obtained in the assessment with respect to the instructional clarity in Biology.

Figure 10.17. Average results in G8 TIMSS science assessment with respect to the level of instructional clarity in biology.



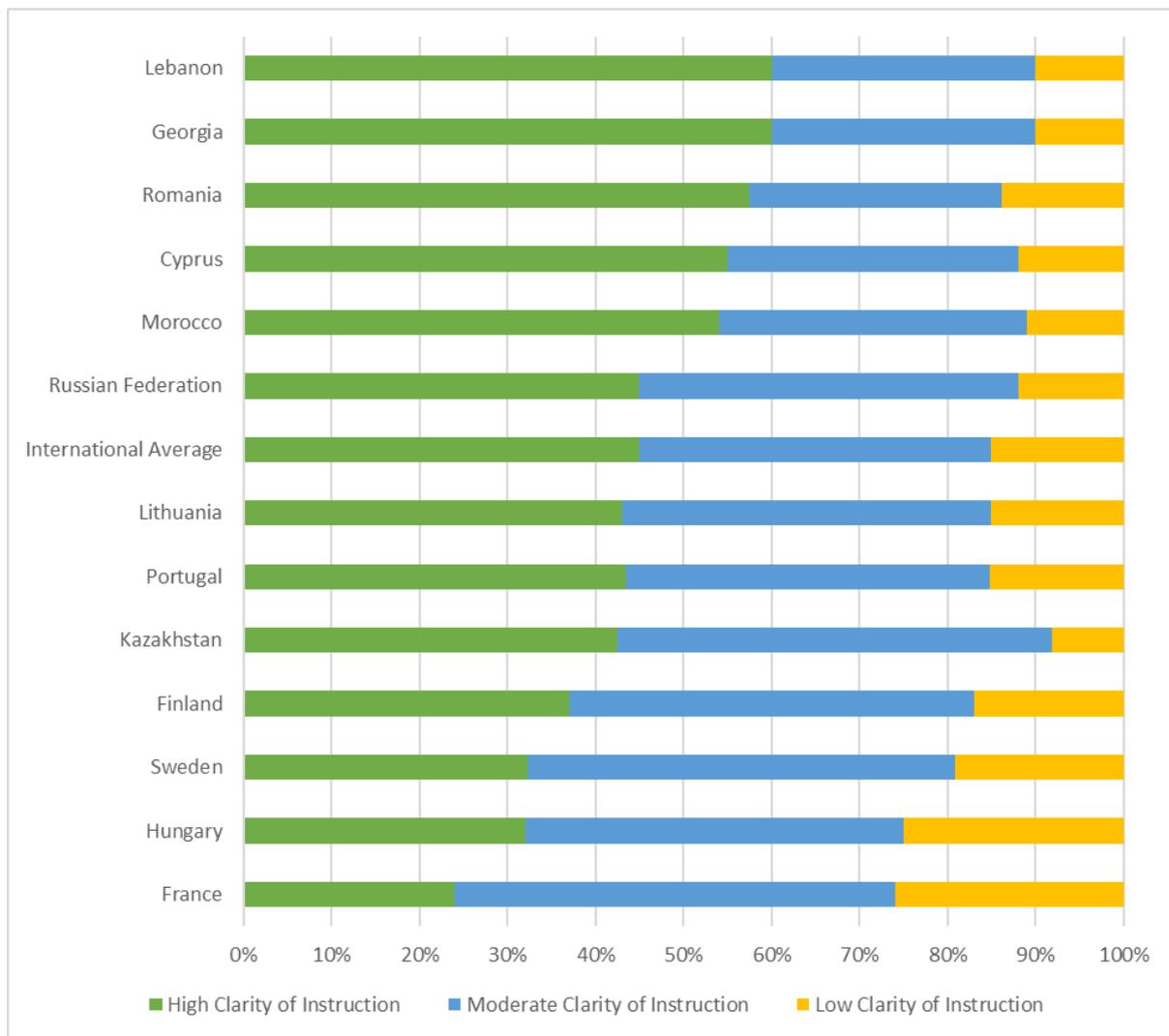
Source: Exhibit 13.10: Instructional Clarity in Science Lessons – Students’ Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In almost all the countries, the best performance in science was found among students that experienced a high clarity of instruction in Biology. Since large inequalities between Lebanese eighth-graders were found, providing a higher clarity of instruction in Biology might be crucial for reforming the Lebanese education system.

Figure 10.18 shows the distribution of students with respect to the experienced level of instructional clarity in learning Chemistry.

As for Biology, the majority of students declared they experienced a high clarity of instruction in Chemistry. In Lebanon, the highest reported level of instructional clarity in Chemistry can be observed, equal to 60%. Figure 10.19 shows the assessment results in Chemistry concerning the instructional clarity at the country level.

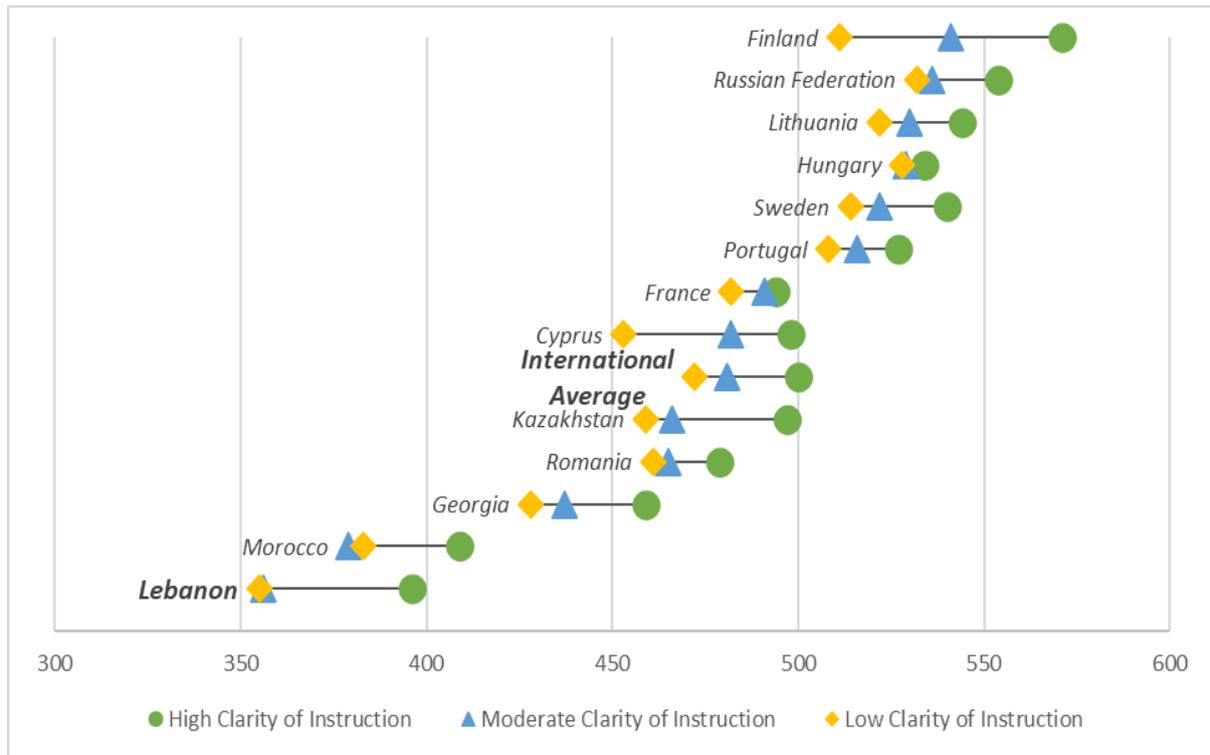
Figure 10.18. Distribution of students with respect to the level of instructional clarity of learning chemistry



Source: Exhibit 13.10: Instructional Clarity in Science Lessons – Students’ Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Differently than in case of Biology, considerably higher inequalities can be observed on the international average, although still in all the countries, the higher the clarity of instruction in Chemistry correlates with the better the student’s performance. Since the average results in Lebanon are highly dependant on instructional clarity, reforming the educational system to increase the average level of instructional clarity might be beneficial for students' achievements.

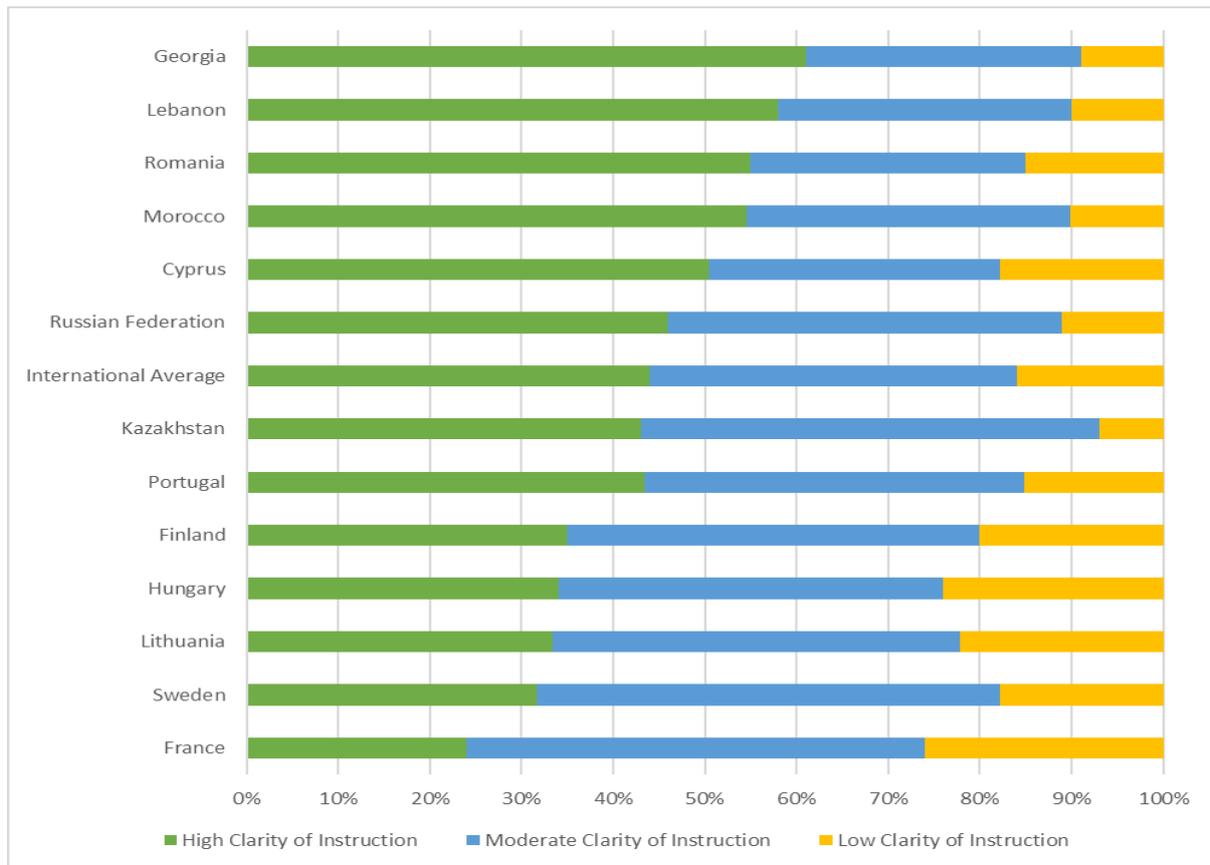
Figure 10.19. Average results in G8 TIMSS science assessment with respect to the level of instructional clarity in chemistry.



Source: Exhibit 13.10: Instructional Clarity in Science Lessons – Students’ Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Figure 10.20 shows the distribution of students with respect to the experienced level of instructional clarity in learning Physics. A considerably lower level of instructional clarity is observed, although still, a majority of eighth-graders declared they were highly satisfied with the clarity of learning. Again, in Lebanon, the highest percentage of students experienced a high clarity of instruction in Physics.

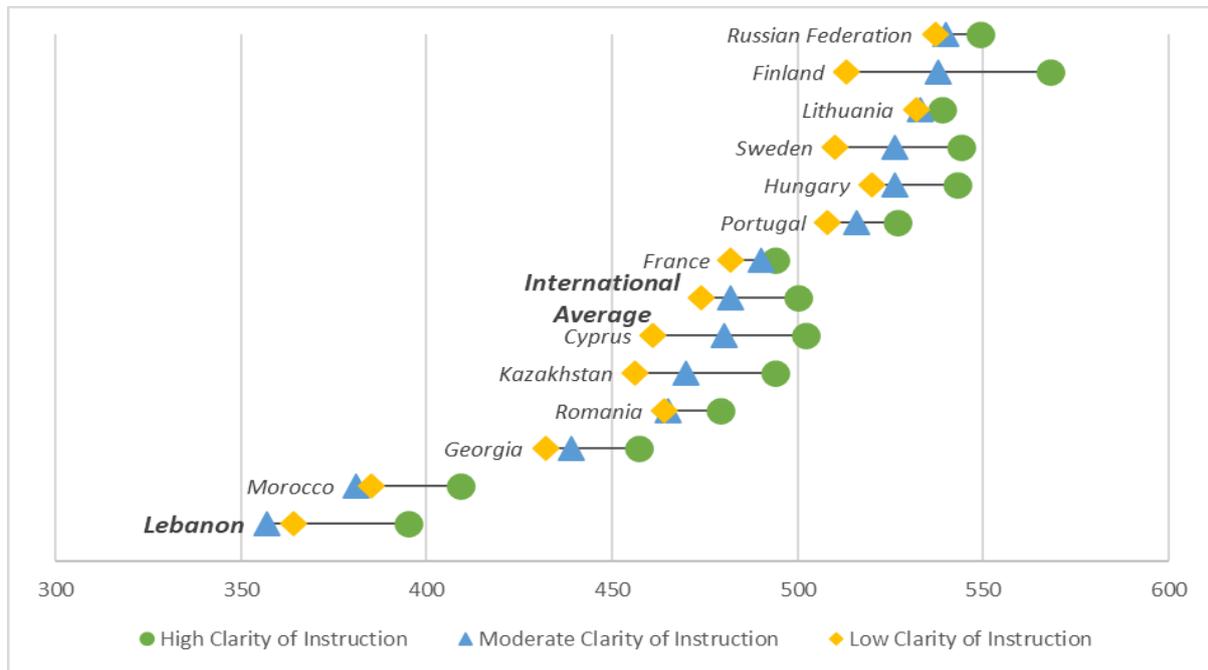
Figure 10.20. Distribution of students with respect to the level of instructional clarity of learning physics



Source: Exhibit 13.10: Instructional Clarity in Science Lessons – Students’ Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>.

Figure 10.21 shows the country-level analysis of the relationship between the achievements in Physics and its instructional clarity

Figure 10.21. Average results in G8 TIMSS science assessment with respect to the level of instructional clarity in physics in selected countries.



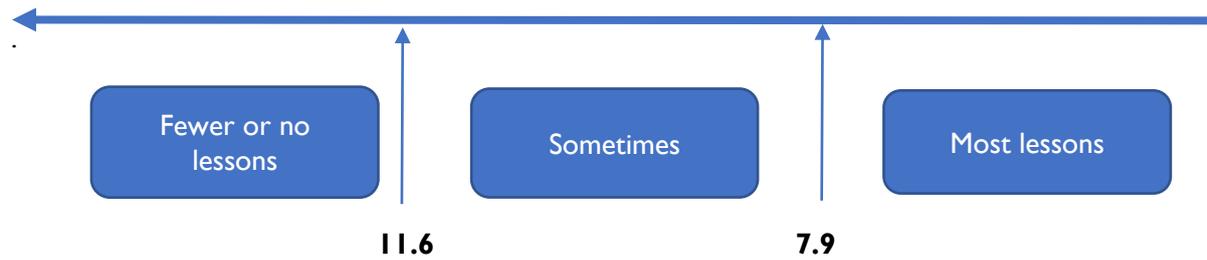
Source: Exhibit 13.10: Instructional Clarity in Science Lessons – Students’ Reports. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

The inequalities between students are quite vast, especially in Finland and Lebanon. However, in all the countries, the best performance in science was found among students who experienced the highest clarity of instruction in Physics.

In conclusion, the best results in mathematics and science are achieved by students who received the highest clarity of instruction, although, in the countries, where on average, the majority of the students experienced a high instructional clarity, lower scores are usually obtained in the assessment. Thus instructional clarity affects the achievement within, but not between countries.

Students' behavior during the lessons might also influence the process of learning. As disorderly behaviors might be hard to measure quantitatively, based on students' responses, TIMSS introduced the **disorderly instruction index**, presented in figure 10.22, which describes the frequency of disorderly behaviors during mathematics instruction.

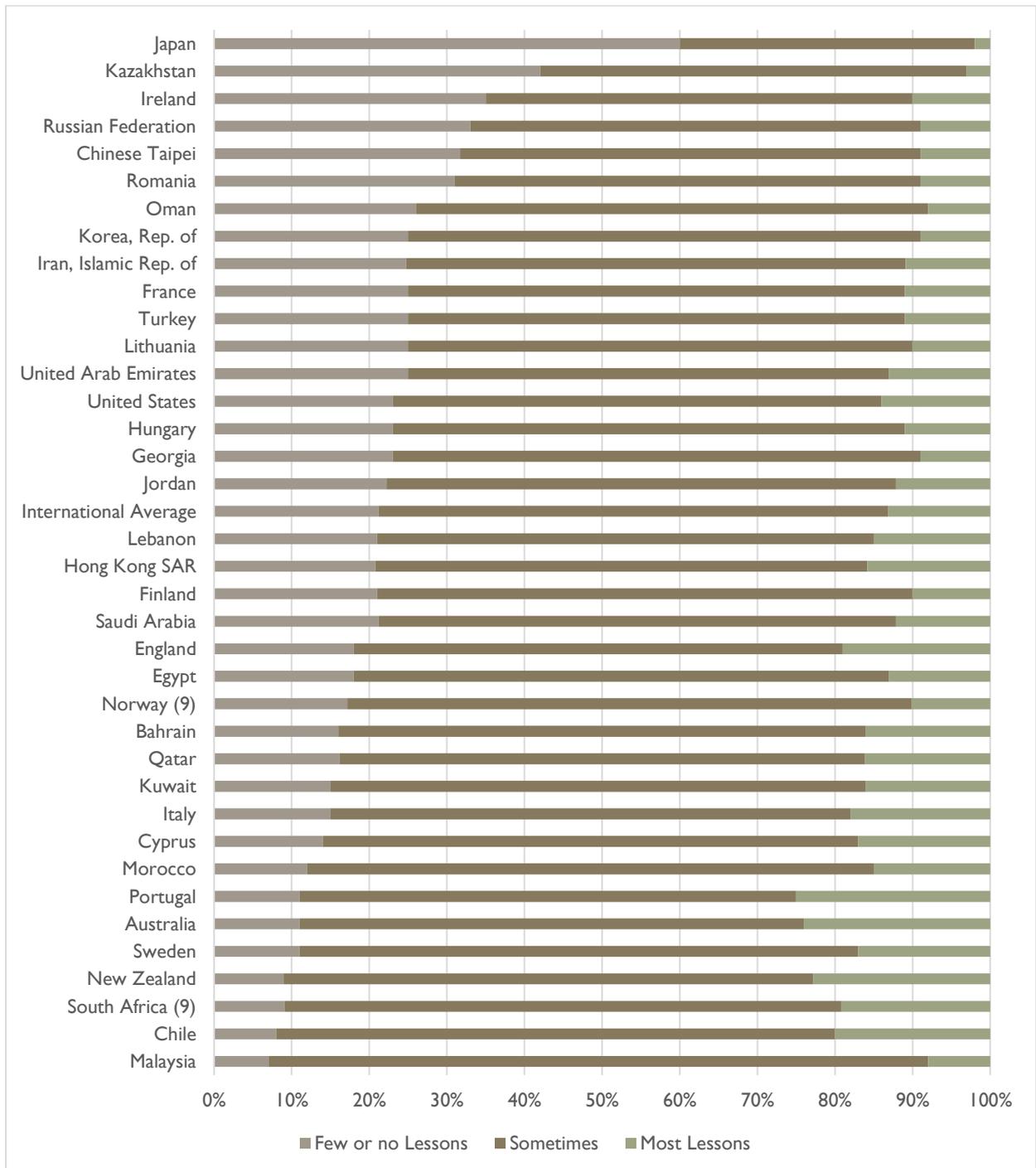
Figure 10.22. Disorderly instruction index scale



Source: Exhibit 12.11: Disorderly Behaviour During Mathematics Lessons. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Three categories concerning the frequency of disorderly behaviors during the lessons of mathematics are defined. Figure 10.23 presents the distribution of students depending on the disorderly behavior index.

Figure 10.23. Distribution of students with respect to the disorderly behaviours during mathematics instruction.



Source: Exhibit 12.13: Disorderly Behaviour During Mathematics Lessons. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In the majority of the countries participating in the assessment⁸, most students reported that disorderly behaviors are sometimes observed during mathematics instruction. Table 10.10 presents the mathematics assessment results in relation to the frequency of disorderly behavior.

Table 10.10. Average score obtained in G8 TIMSS Mathematics assessment with respect to the frequency of disorderly behaviors during mathematics instruction.

Category	Lebanon		International Average		MENA countries	
	Percentage of students	Average Score	Percentage of students	Average Score	Percentage of students	Average Score
Fewer or no lessons	21% (1.3)	438 (4.3)	21% (0.2)	502 (0.9)	20%	442
Sometimes	64% (1.4)	429 (3.2)	65% (0.2)	485 (0.6)	67%	429
Most lessons	15% (1.2)	426 (7.0)	13% (0.2)	466 (1.0)	14%	412

Source: Exhibit 12.13: Disorderly Behaviour During Mathematics Lessons. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

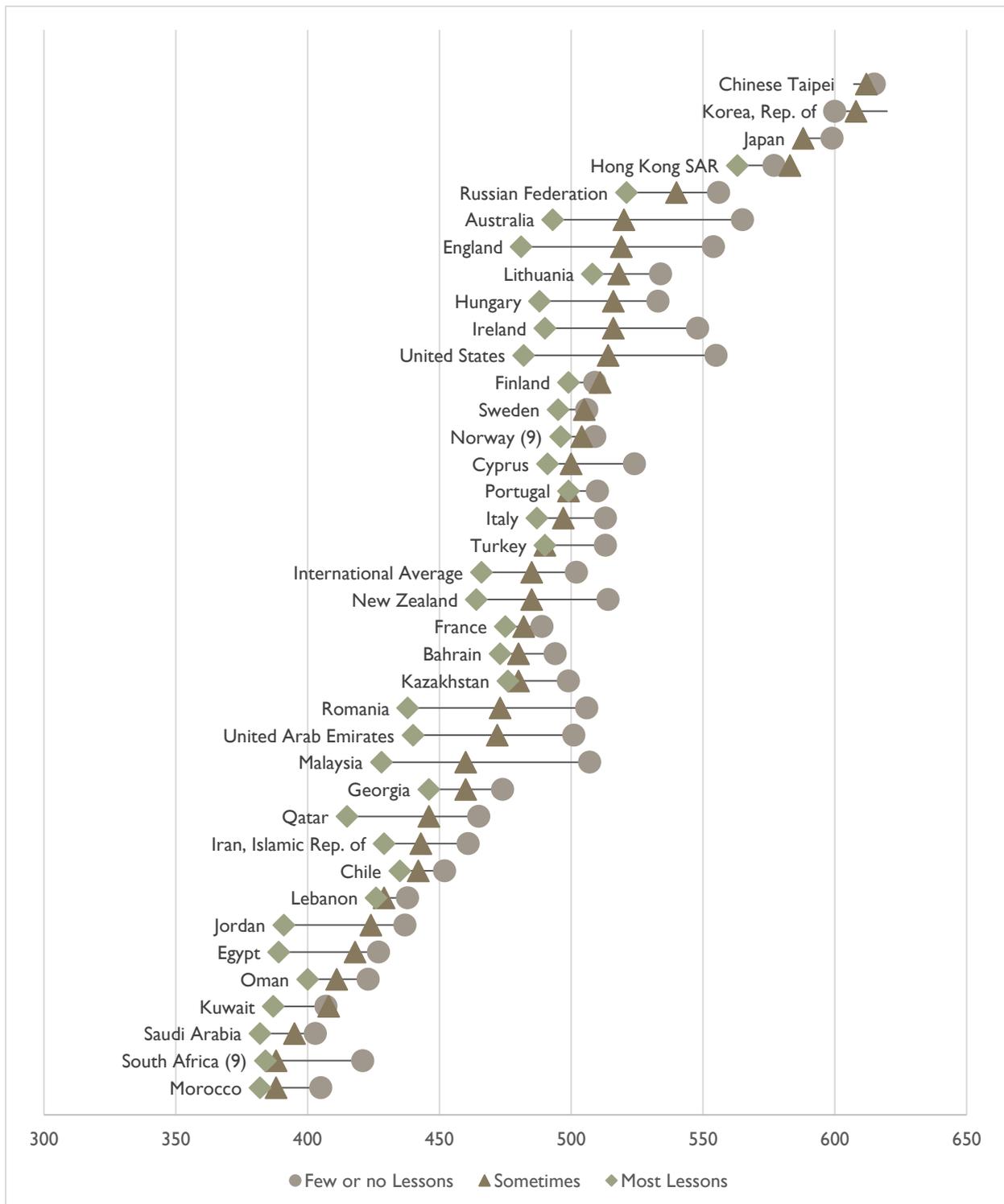
In Lebanon, there is no strong relationship between the presented variables; although the least often distracting behaviors are observed, the higher results are achieved. In the MENA countries and on international average, a positive relationship can be found instead.

Figure 10.24 presents the country-level analysis of the relationship between disorderly behavior and achievements in mathematics. In the majority of the individual states, the best performance in mathematics was found among students who did not experience disorderly behaviors during the instruction. In Lebanon, one of the lowest inequalities between students is observed.

⁸ Missing data concerning Singapore.

Since no data for science instruction is available, it is not possible to conduct the same analyses run for mathematics.

Figure 10.24. Average results in G8 TIMSS mathematics assessment with respect to the frequency of disorderly behaviours during mathematics instruction.

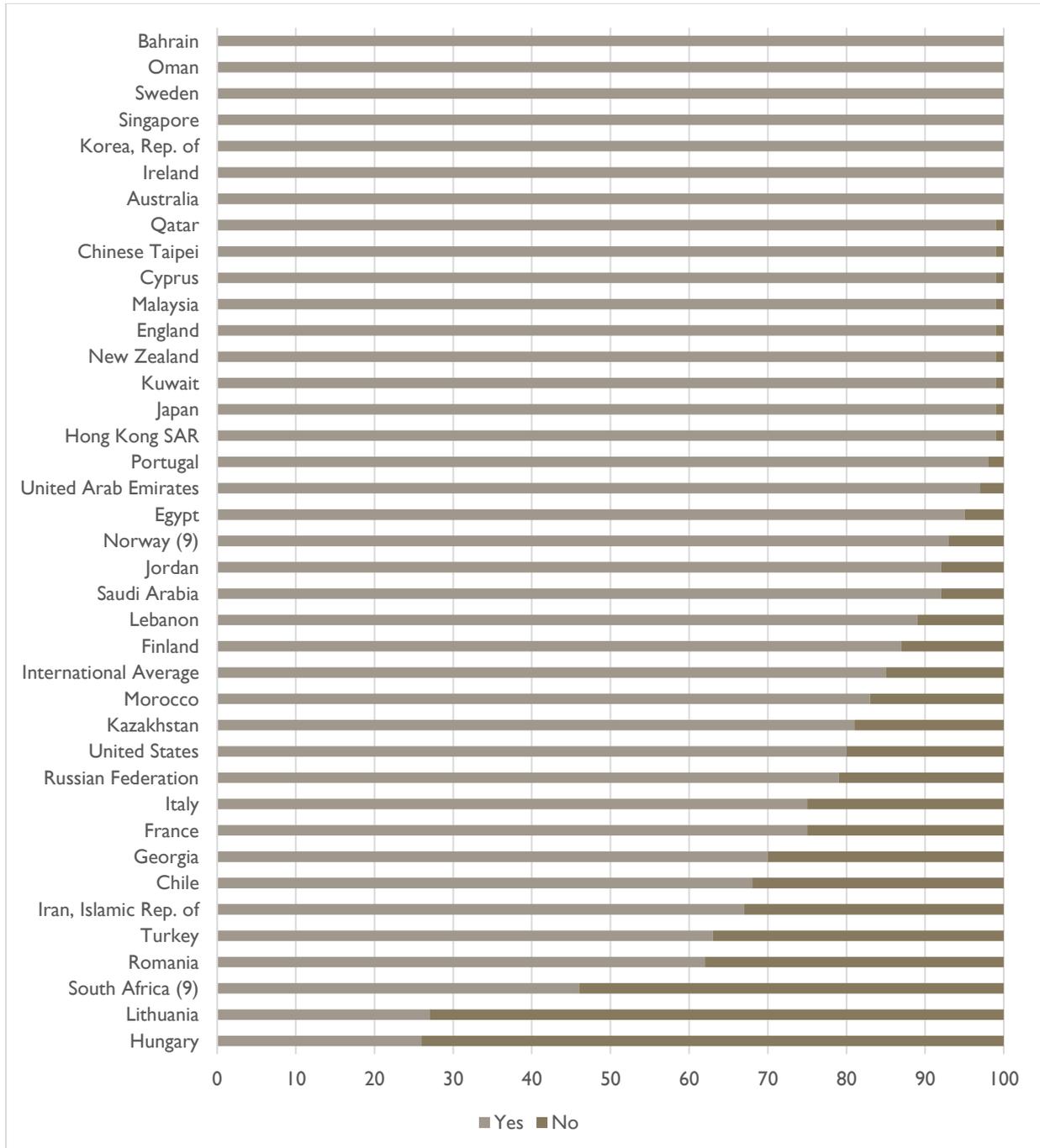


Source: Exhibit 12.13: Disorderly Behaviour During Mathematics Lessons. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

10.4. Additional factors concerning learning science

Teaching science requires different resources from mathematics. This is the case because the different science disciplines can have fields of applications that require alternative teaching tools.

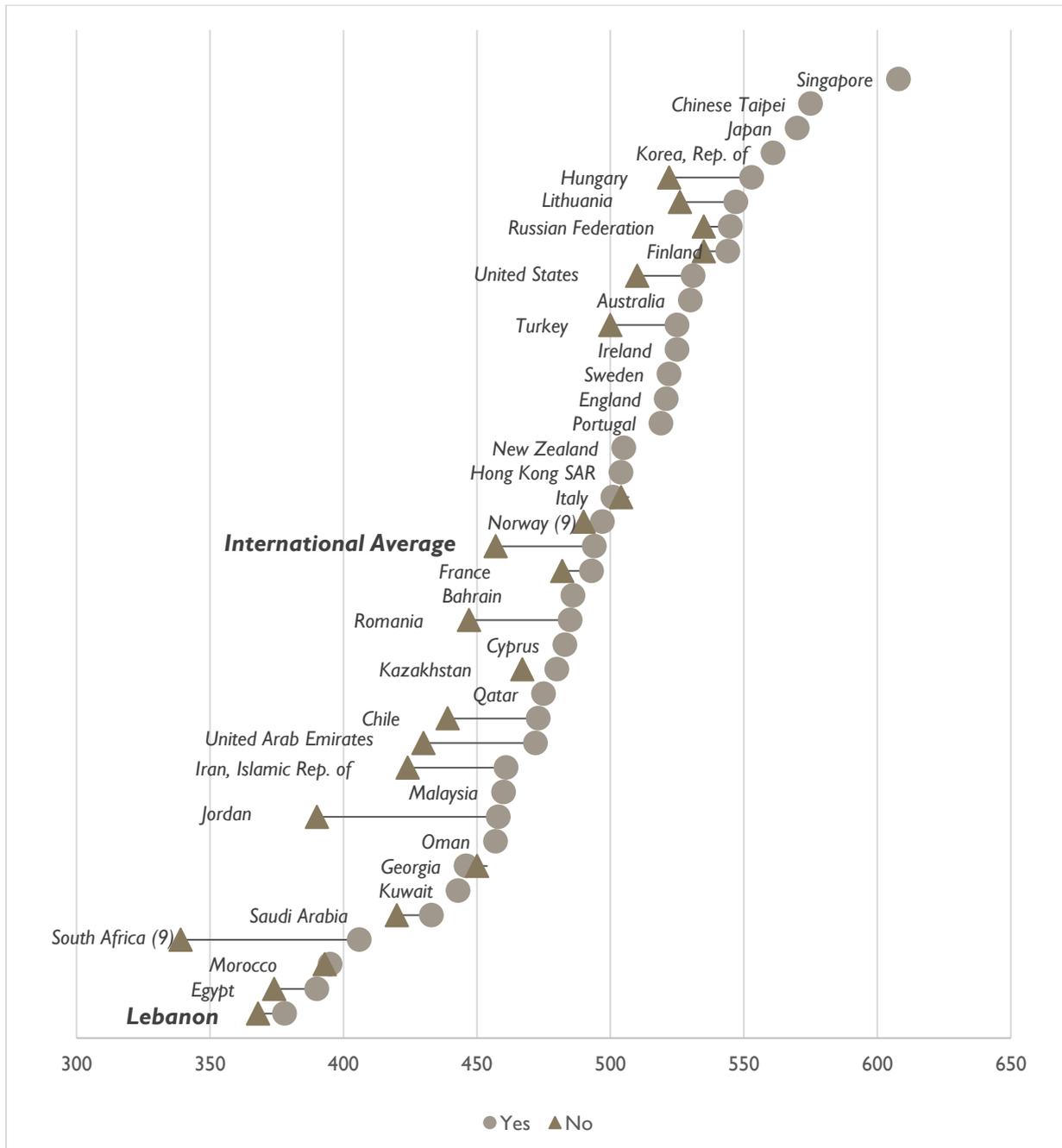
Figure 10.25. Percentage of schools, which have a science laboratory



Source Exhibit 13.15: School Resources for Conducting Science Experiments. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

The main challenge that schools might face is the lack of proper experimental resources. In the TIMSS assessment, teachers are also asked whether their school has an experimental laboratory. Figure 10.25 shows the **percentage of schools equipped with a laboratory** in each country.

Figure 10.26. Average results in G8 TIMSS science assessment, with respect to the accessibility of laboratory at school

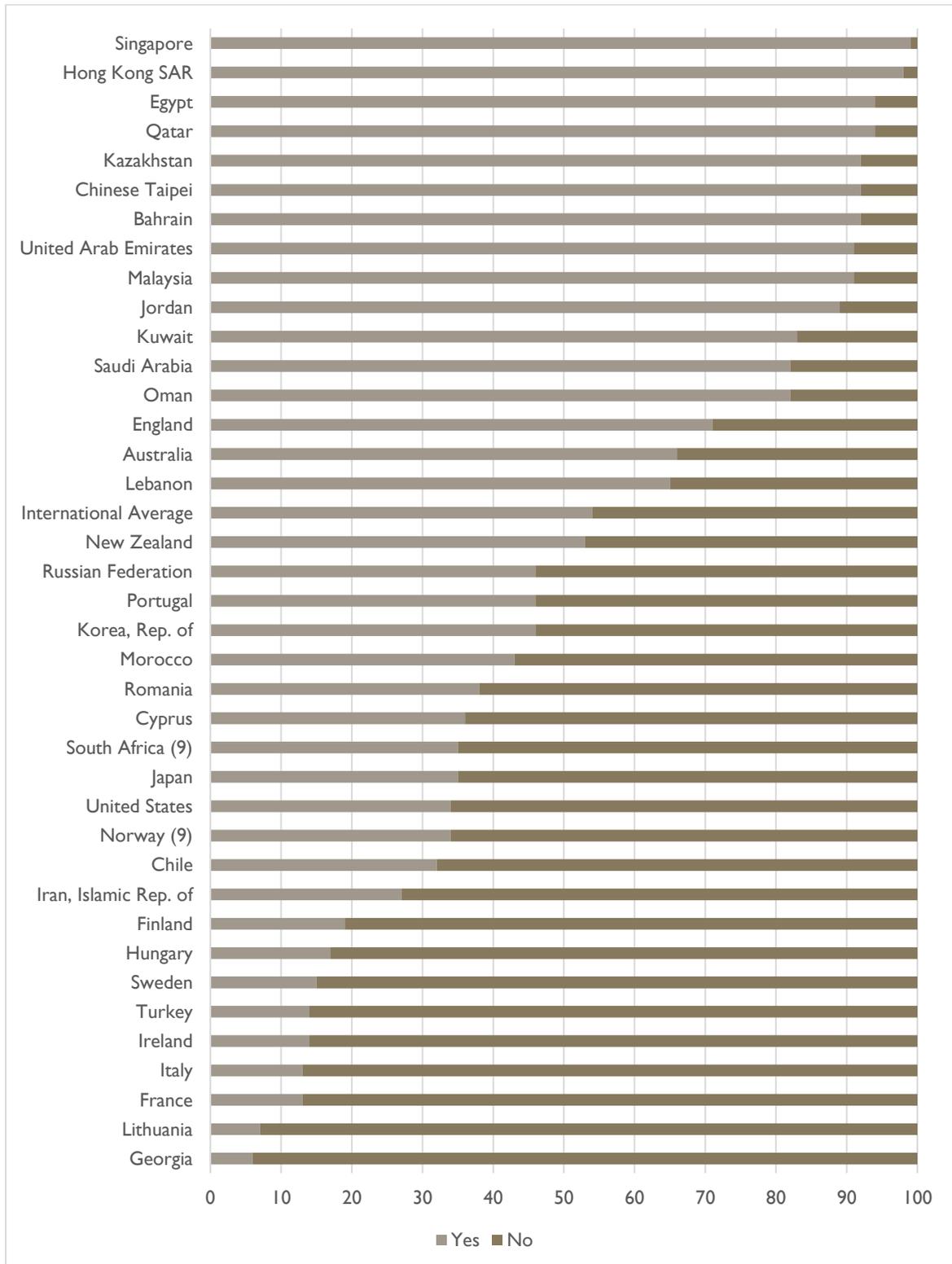


Source Exhibit 13.15: School Resources for Conducting Science Experiments. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In the majority of the countries, most schools are equipped with professional laboratories, with only a few countries lacking these practical resources. In Lebanon, almost 90% of eighth-graders have access to a laboratory in school. However, easily accessible laboratories did not lead to better outcomes, as Lebanese students scored very poor in the assessment on average. Conducting a policy- and curriculum-based analysis of the application of laboratory experiments in the process of learning might provide insights about the underperformance of students. It is essential, as inquiry remains one of the most important factors when it comes to learning science. Hence, understanding why conducting experiments does not lead to better outcomes is crucial. Figure 10.26 shows the results in the science assessment with respect to the accessibility of a laboratory at the country level. In the majority of the countries, when students can access a laboratory at school, higher scores in science are observed. In Lebanon, moderate differences between students can be found.

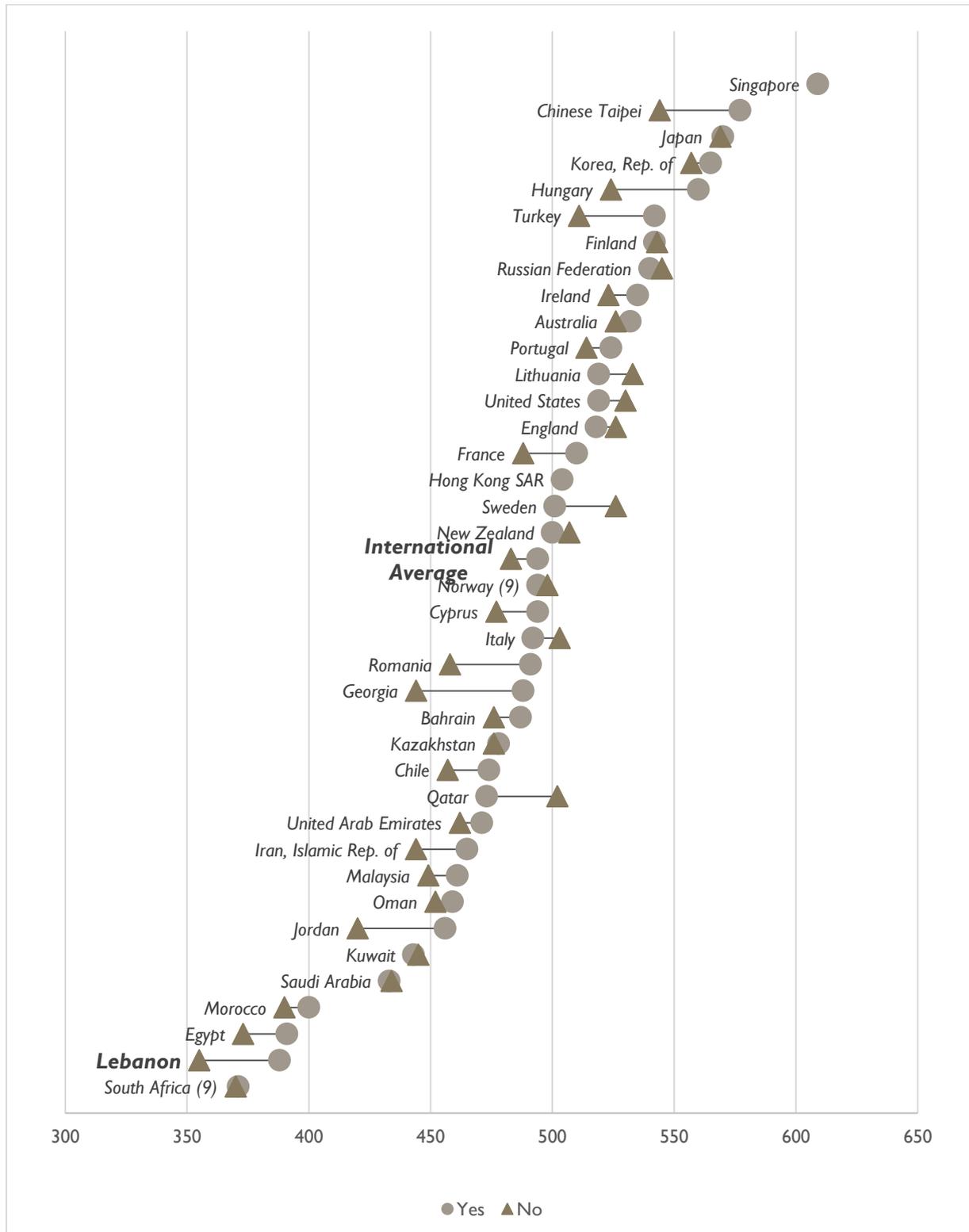
When conducting experiments, the **availability of additional assistance** can be useful for teachers and prove effective for learning. Figure 10.27 presents the share of schools where this availability is found among participating countries. Figure 10.28 presents the country-level analysis of the relationship between the availability of additional assistance and achievements in science.

Figure 10.27. Percentage of schools, where teachers have available assistance while students are conducting experiments



Source: Exhibit 13.15: School Resources for Conducting Science Experiments. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

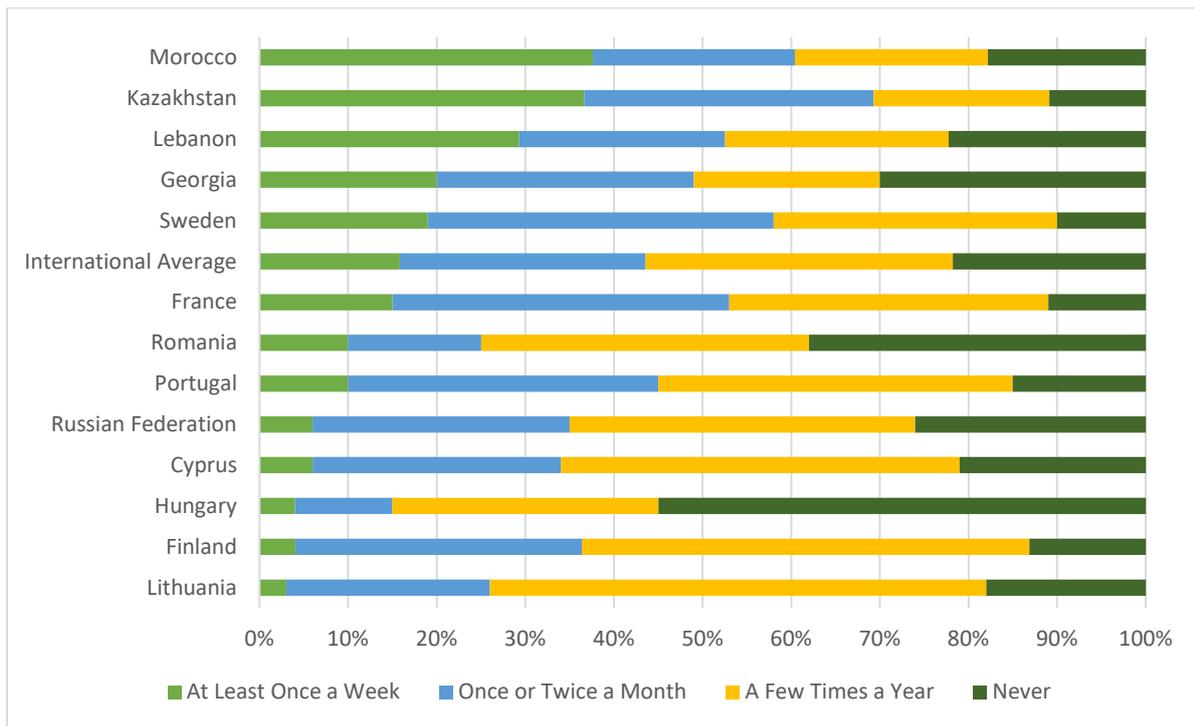
Figure 10.28. Average results in G8 TIMSS science assessment, with respect to the accessibility of assistance during conduction of experiments at school



Source: Exhibit 13.15: School Resources for Conducting Science Experiments. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Even though providing additional experiments in science during lessons might be beneficial for students to understand some phenomena, focusing only on this type of activity may also lead to distraction. Considering science disciplines independently, the **frequency of conducting biology, chemistry, and physics experiments** is analyzed below⁹. Figure 10.29 shows the frequency of conducting experiments in the domain of Biology.

Figure 10.29. Frequency of conducting science experiments during biology lessons

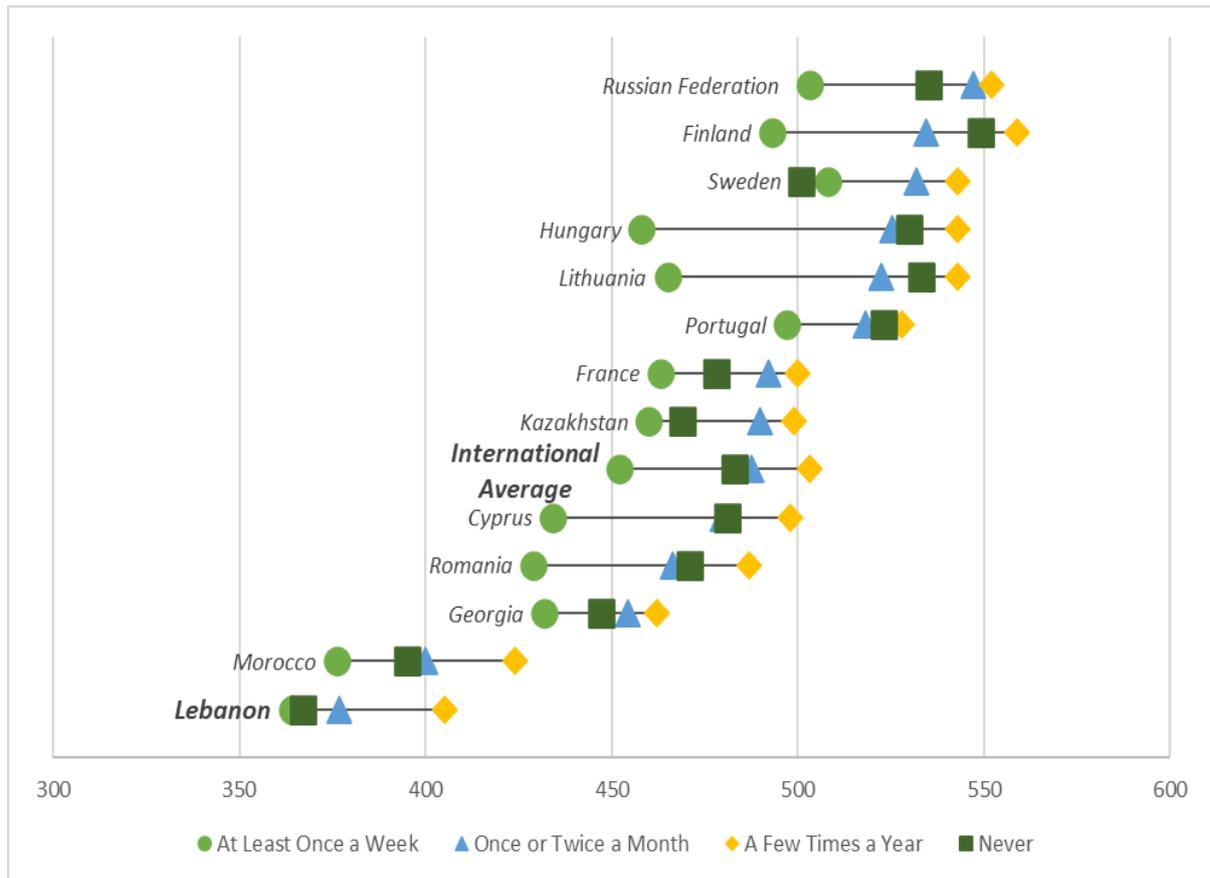


Source: Exhibit 13.17: Frequency Students Conduct Experiments in Science Lessons. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

Large differences are found between countries. In Lebanon, almost 30% of eighth-graders are asked to conduct experiments every week, but at the same time, more than 20% of Lebanese eighth-graders have never conducted any experiments during lessons. Figure 10.30 shows the country-level results of the relationship between achievements in Biology and the frequency of experiments.

⁹ No data for Earth Science.

Figure 10.30. Average results in G8 TIMSS science assessment with respect to the frequency of conducting experiments during biology lessons.

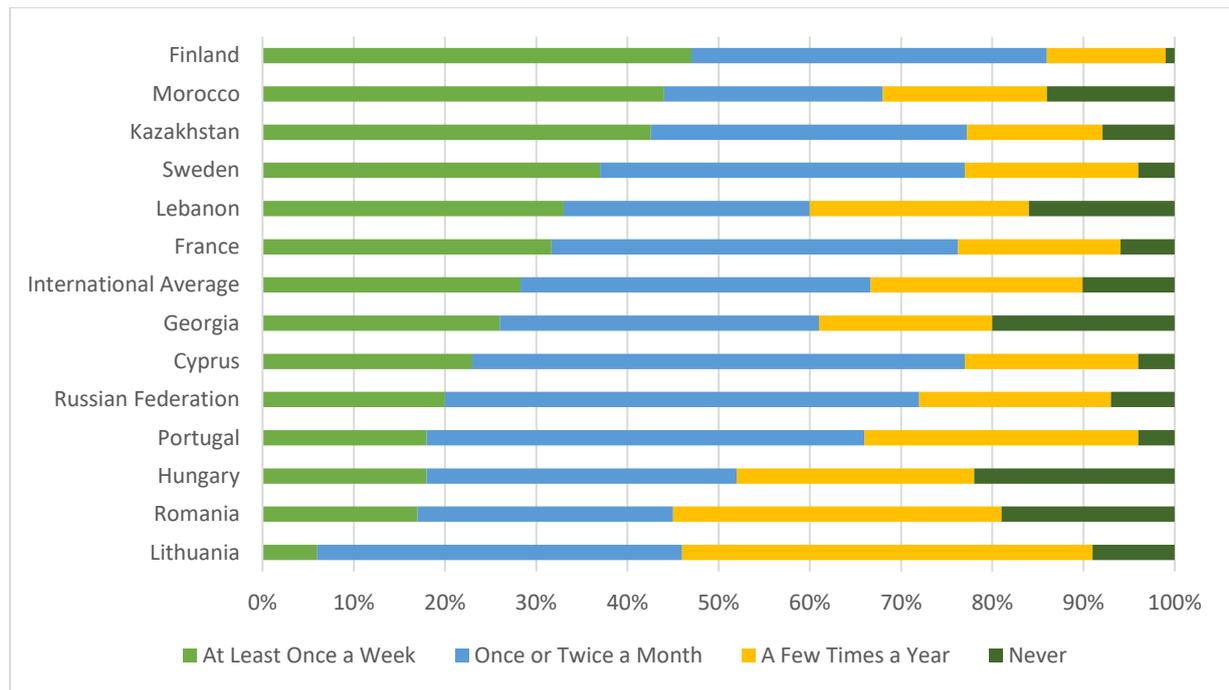


Source: Exhibit 13.17: Frequency Students Conduct Experiments in Science Lessons. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

The worst results were achieved by students used to having biology experiments the most often, and the second-worst performance is found among students who have never conducted any biology experiments. It can be concluded that supporting instruction with experiments from time to time might be beneficial since, in the majority of the countries, including Lebanon, the best performance was found among students who perform biology experiments a few times per year.

Figure 10.31 shows the frequency of conducting experiments for Chemistry.

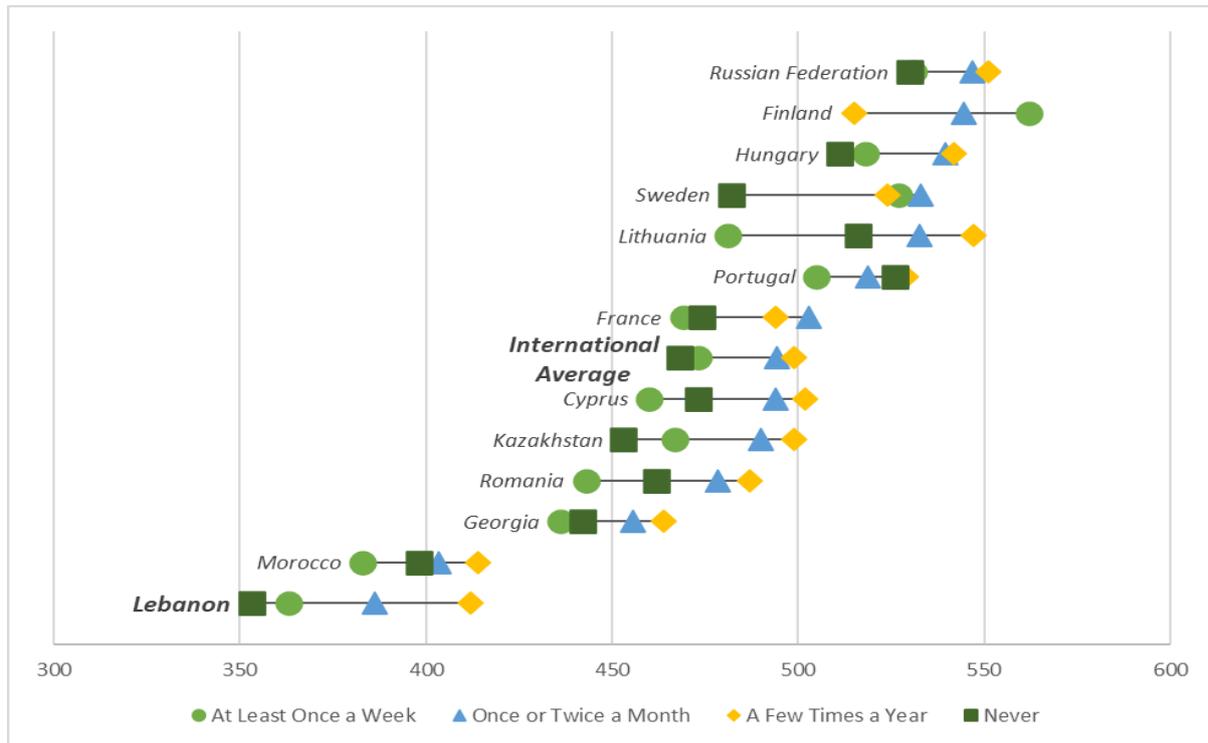
Figure 10.31. Frequency of conducting science experiments during chemistry lessons



Source: Exhibit 13.17: Frequency Students Conduct Experiments in Science Lessons. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

On international average, almost 30% of students are used to conducting such experiments at least once a week, while when it comes to Lebanon, more than 75% of eighth-graders participate in chemical experiments at least once a month. Figure 10.32 shows the country-level results of the relationship between achievements in Chemistry and frequency of experiments.

Figure 10.32. Average results in G8 TIMSS science assessment with respect to the frequency of conducting experiments during chemistry lessons.

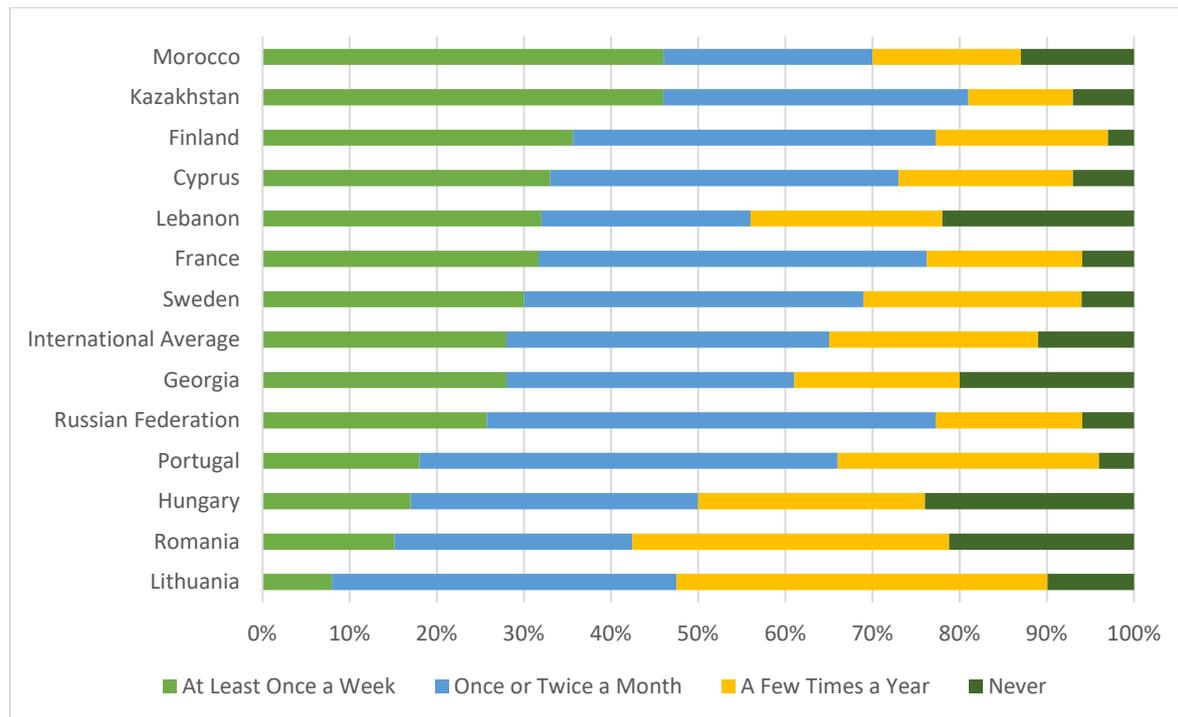


Source: Exhibit 13.17: Frequency Students Conduct Experiments in Science Lessons. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In the majority of the countries, the best performance was found among students who conducted chemistry experiments a few times per year, since students who take part in chemistry the most often receive rather poor achievements in comparison to others. In Lebanon, eighth-graders whose instruction was supported by chemistry experiments a few times per year, obtained almost 50 points more than students who took part in experiments at least once a week.

Figure 10.33 shows the frequency of conducting experiments for Physics.

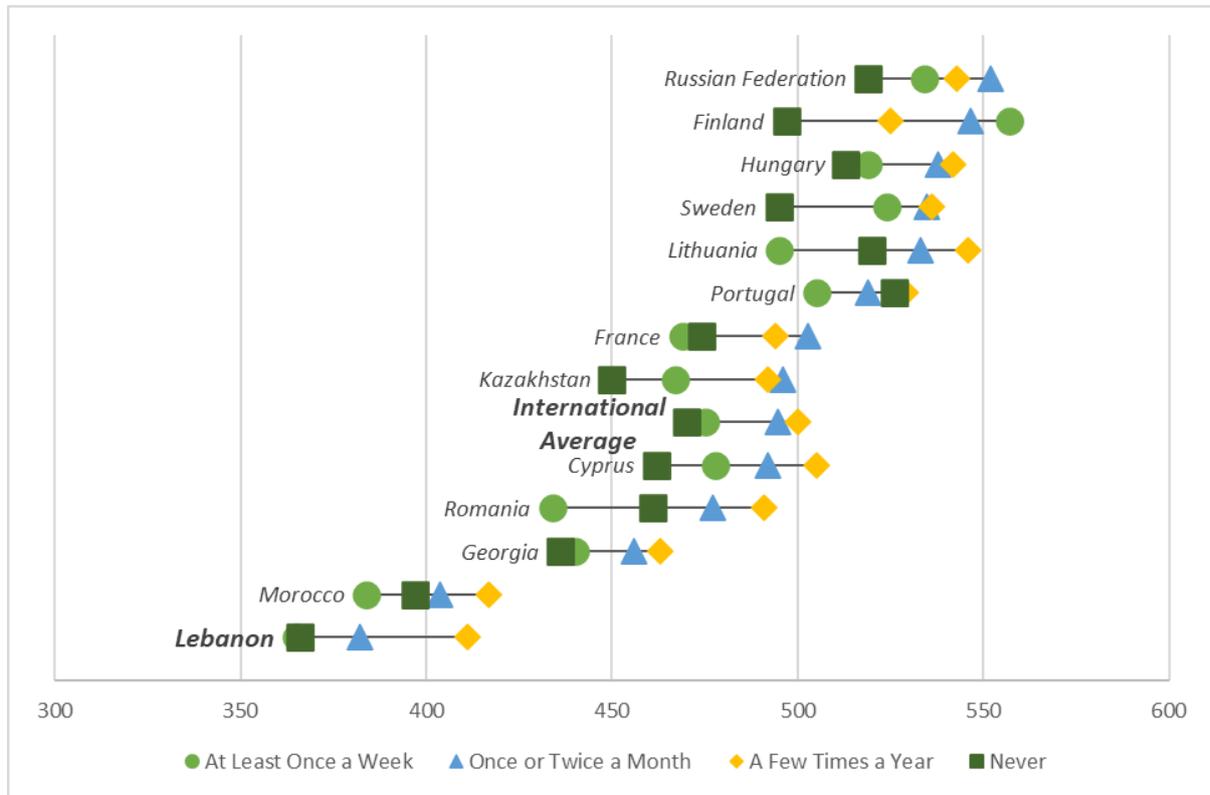
Figure 10.33. Frequency of conducting science experiments during physics lessons



Source: Exhibit 13.17: Frequency Students Conduct Experiments in Science Lessons. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

In most countries, more than half of the students have conducted physics experiments at least once a month. In Lebanon, many students have conducted physical experiments very often, while 22% of them have never done it at school. Indeed, the highest share of students who have never done any experiments during science instruction can be found in Lebanon. Figure 10.34 shows the country-level results of the relationship between achievements in Physics and the frequency of experiments.

Figure 10.34. Average results in G8 TIMSS science assessment with respect to the frequency of conducting experiments during physics lessons.



Source: Exhibit 13.17: Frequency Students Conduct Experiments in Science Lessons. TIMSS 2019 International Results in Mathematics and Science. Downloaded from: <https://timssandpirls.bc.edu/timss2019/international-results/>

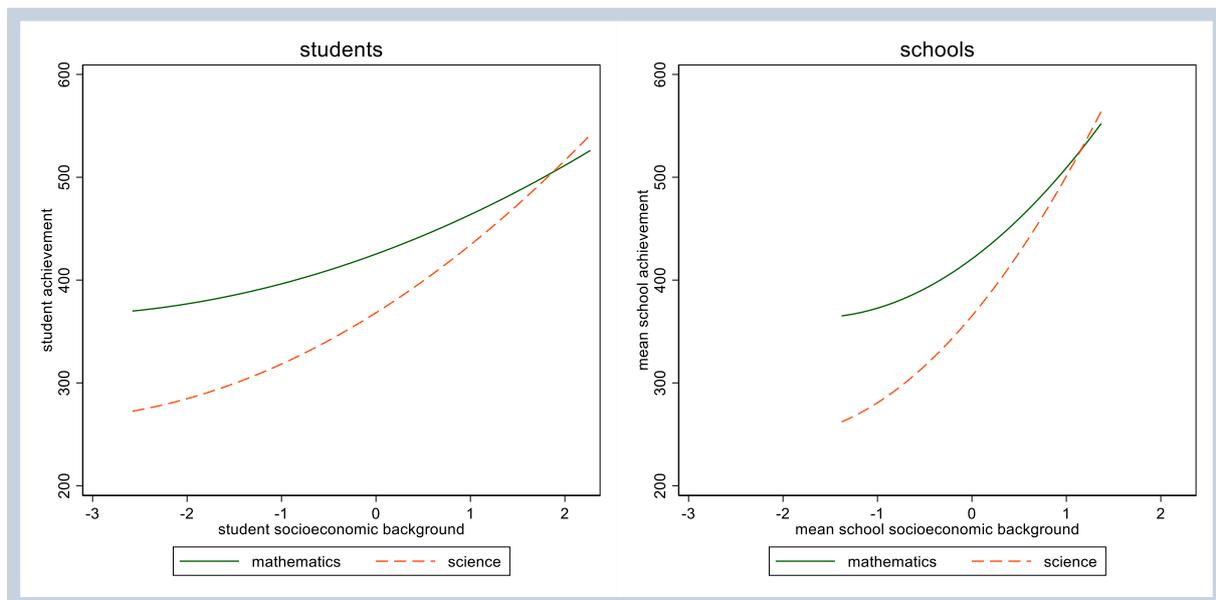
As in the case of other subjects, the worst score was in the majority of the cases obtained by students who did experiments the most often. The best performance is instead found among students who take part in the experiments a few times per year. It can be concluded that too many experiments are not beneficial and may even have a negative impact on one's achievements in science or that the experiments implemented might have reflected „limited” or „structured” inquiry, and not „open” inquiry where students employ higher order thinking skills.

Chapter 11. Socioeconomic status and School type – statistical comparison of the achievements

The descriptive analysis of the Lebanese students' achievements in mathematics and science suggested the presence of socioeconomic status influence on one's performance. Students from a more affluent background obtained higher achievements in mathematics and science than their peers from more disadvantaged households. Also, high and significant differences were observed between 8th graders based on the accessibility to home resources and school resources shortages. Thus, it is hypothesized that the low performance of Lebanon in Large Scale Assessments is in a great manner reflected in the socioeconomic inequalities and underperformance of public schools. Hence, in this chapter, the significance of socioeconomic status on individual and school's levels will be determined.

As shown in figure 11.1, the correlation of socioeconomic status and average achievement is positive and relatively strong on student and school levels. Yet, the strength of the correlation varies – average achievements in science were much more related to socioeconomic status. Individuals from the most affluent background scored more points in the assessment than their peers from disadvantaged backgrounds. The disproportion between students based on their status is much more observable on the school level, as the slope of the relation curves is steeper.

Figure 11.1. Association between socioeconomic background and student achievement in Lebanon



Source: Own calculations based on TIMSS 2019 microdata

Interestingly, the most disadvantaged students were far better in mathematics than science. The same pattern applies to the school – in more disadvantaged schools, there is a substantial achievement gap between mathematics and science. Yet, with the increase in socioeconomic status, the gap between mathematics and science achievements diminishes.

The same conclusions can be derived from the regression model. In table 11.1 the estimates of the regression are presented. The regression models suggest that one standard deviation increase in socioeconomic status increases the score by 35.1 in mathematics and 56 points in science. Additionally, the R-squared statistics of the model indicate that 16% of the variance in the case of mathematics and 21% in the case of science was explained by socioeconomic status. Even higher estimates were obtained in the school model – one standard deviation change in the school's average socioeconomic status resulted in the increase of the average school score by 65.6 in mathematics and 107.2 points in science. Based on the results, the socioeconomic differences between schools can be resulting in high inequalities in educational results.

Table 11.1. Regression estimates of the relationship between socioeconomic background and achievement

	Student level			School Level		
		mathematics	science		mathematics	science
Socioeconomic background	Coef.	35.1***	56.0***	Coef.	65.6***	107.2***
	S.E.	(-2.2)	(-2.7)	S.E.	(-4.4)	(-6.5)
Constant	Coef.	429.3***	376.9***	Coef.	428.9***	376.8***
	S.E.	(-2.6)	(-4.1)	S.E.	(-2.4)	(-4.0)
	R-squared	0.16	0.21	R-squared	0.53	0.58
	N	4730	4730	N	204	204

Source: Own estimations based on TIMSS 2019 microdata

Note: * p<0.05, ** p<0.01, *** p<0.001

The achievements in the TIMSS assessment might result from the characteristics of an individual as well as be corresponding school's features. **As students exhibit intra-school heterogeneity, the analysis should be enriched with the estimation of the within-school and between-school effects.**

In the multilevel model, the students' characteristics served as the 1-level predictor and the school's features as the 2-level predictor, and the estimates were shown in table 11.2. The within-school coefficients provide information about the difference in students' achievements from the same

school based on the socioeconomic differences between them. For instance, one can find that a change of one standard deviation in socioeconomic status in school is reflected in the higher achievements in mathematics by 8.9 TIMSS points and in science by 17.8 TIMSS points. The analysis of the 2-level predictors is the same as covered in the previous part – it provides information on the differences between students attending different schools. Additionally, an empty model was applied for the decomposition of variance - it provides information about the decomposition of the total variance in the school achievements between students.

The estimates of the individual's socioeconomic status on I-level were positive but fairly small compared to the observed between-school effects. As mentioned above, one standard deviation in the students' socioeconomic status in a given school resulted in 8.9 points higher achievement in mathematics and 17.8 points higher score in science.

The between-school observed differences are much higher – change by one standard deviation in the school's socioeconomic status is reflected in the average achievement in mathematics higher by 64.6 points and in science by 106.9 points. Consequently, the school's achievements are strongly affected by students' socioeconomic status. The achievements of an individual are highly dependant on the school that one attends.

These results are well-represented in the share of variance explained on the school level. Around 55.4% of the variance in the case of mathematics and 60.8% in the case of science is explained by the school's socioeconomic status. Such observation is consistent with the data about the Lebanese educational system. Recent report on the Lebanese Educational system, published by the World Bank, emphasized the need to change the system through the public-private partnership because education in Lebanon was highly dependent on household affluent. What is more, recently, the inflow of Syrian refugees has drastically changed the educational system. Public schools, where around 30% of Lebanese eighth-graders have attended, became overloaded with the new students (Abdul-Hamid, Krayem and Ghaleb, 2018).

Table 2. Multilevel model variance decomposition and variance explained by socioeconomic background

	Mathematics		Science	
	(1)	(2)	(3)	(4)
Multilevel regression coefficients:				
Within school coefficient		8.9***		17.8***
		(2.0)		(2.2)
Between school coefficient		64.6***		106.9***
		(5.4)		(8.0)
Constant	417.7***	429.1***	356.2***	375.3***
	(4.4)	(3.2)	(7.1)	(4.9)
Variance components:				
Variance at the school level	2100.6	935.9	5251.9	2058.5
	(241.9)	(119.4)	(603.1)	(266.2)
Variance at the student level	2881.2	2849.6	5271.0	5142.0
	(107.1)	(103.0)	(242.3)	(242.5)
School level variance as the share of total variance	42.2%		49.9%	
Share of variance explained at the school level		55.4%		60.8%
Share of variance explained at the student level		1.1%		2.4%
Sample size:				
Number of students	4730	4730	4730	4730
Number of schools	204	204	204	204

Source: Own estimations based on TIMSS 2019 microdata

Note: standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

This part, it was shown the importance of socioeconomic status in the Lebanese educational system. The relationship between individual affluence and mathematics and science achievement was proven to be significant and strong. More importantly, socioeconomic inequalities were a key factor on a school level. It turned out, that Lebanese students are highly segregated into schools based on their

socioeconomic status. In consequence, socioeconomic inequalities are reproduced in the educational system. As the average achievement in mathematics and science was highly dependent on schools' average socioeconomic status, the relationship between the average achievements and the type of school will be estimated in the following part.

Private schools are usually attended by students with more affluent backgrounds. Schools that charge students with fees cannot be afforded by poorer families. Also, well-educated or more ambitious parents will prefer to send their kids to private schools when a common view is that they provide a higher quality of teaching. In addition, families might be willing to pay additional fees to show their status or have their children attend schools with other privileged families. Thus, even without any differences in teaching quality or services provided, private schools might attract more affluent families due to selection bias.

Schools in the private sector usually require a fee, while public schools are usually free of charge. As some households are not able to cover the fee, it is expected that only affluent parents will choose a private school for their children. According to the report published by World Bank, in Lebanon, around 70% of all pupils attend private schools. Indeed, the private sector is large in Lebanon, but the range of quality proposed by private schools strongly differs (Abdul-Hamid, Krayem and Ghaleb, 2018). Hence, the fee that needs to be paid is also highly dependent on the school's policy. It is expected that the schools with the highest required fees will provide the most stratified environment in school – only the most affluent households will be able to afford it. As the offer of private schools is highly diversified, only the most disadvantaged pupils will attend public schools.

To analyze the differences between the public and private schools, the additional CERD micro-dataset was used, as no information on the private/public sector is available in the TIMSS Database. In table 11.3, one can find descriptive information about the dataset. In the sample, one could find information on 96 public schools with 2077 students from public schools and 102 private schools with 2467 students. It is estimated that there are 20784 students in public schools, while in private schools, there are 42897 students in the TIMSS assessment.

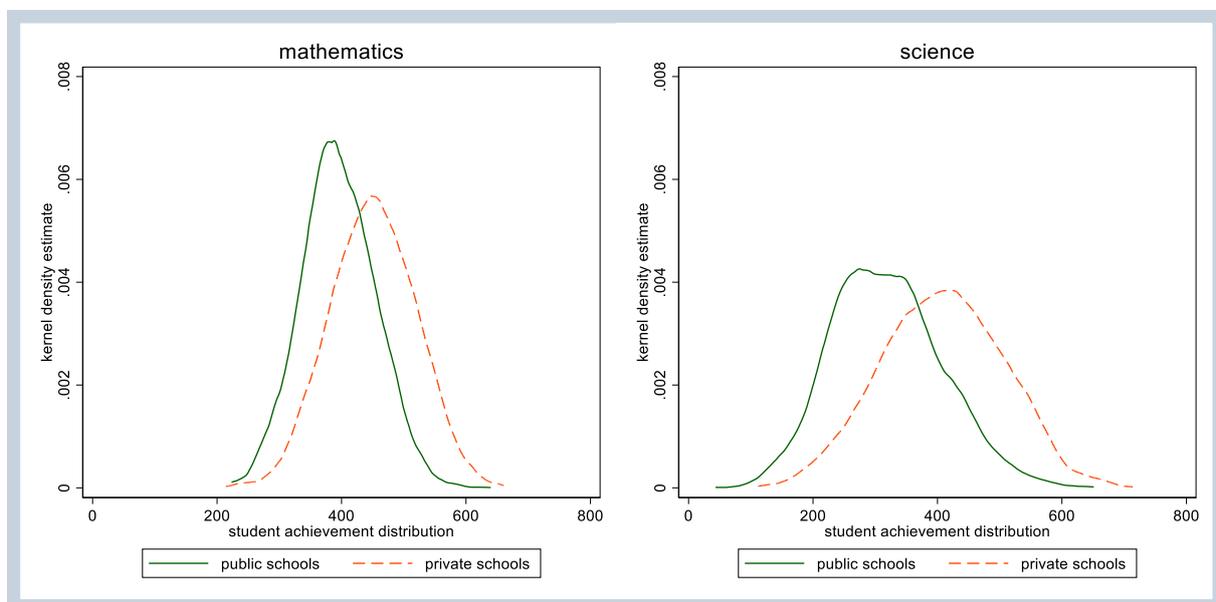
Table 11.3. Sample size and population of public and private schools in the TIMSS 2019 sample

	Sample size		Estimated 8th grade student population	
	Students	Schools	Number of students	share
Public schools	2077	96	20784	32.6%
Private schools	2467	102	42897	67.4%
Total	4544	198	63681	100%

Source: CERD and TIMSS 2019 data

The distributions of the students' results, based on the type the school they attend, were presented in the figures below. To analyse these distributions, the kernel density estimation method was used. By doing this, the results are smoothed, which makes the interpretation easier. The average mathematics achievement of students attending private schools is higher. However, pupils from private schools are also characterized by a slightly higher heterogeneity (standard deviation) of mathematics achievements. The same applies to science, as it can be observed that there is a substantial gap between students attending private and public schools.

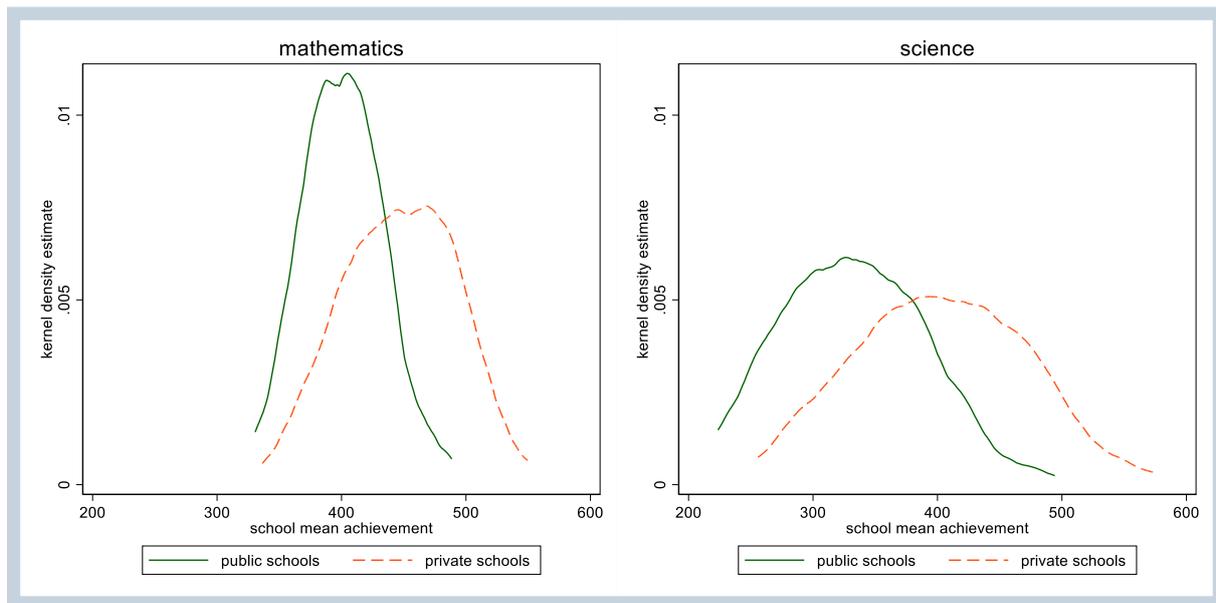
Figure 11.2. Student achievement distributions in private and public schools



Source: Own calculation based on CERD and TIMSS 2019 data

The distributions of the school's achievements in Math hold lower variation (Figure 11.3). Similarly, as in the case of the results of the individuals, the distribution of the science achievements is more spread around its mean, which is confirmed by a higher standard deviation when compared to mathematics. In the case of private schools, higher variation might correspond to more diversified offers and the quality of the schools.

Figure 11.3. Mean school achievement distributions in private and public schools



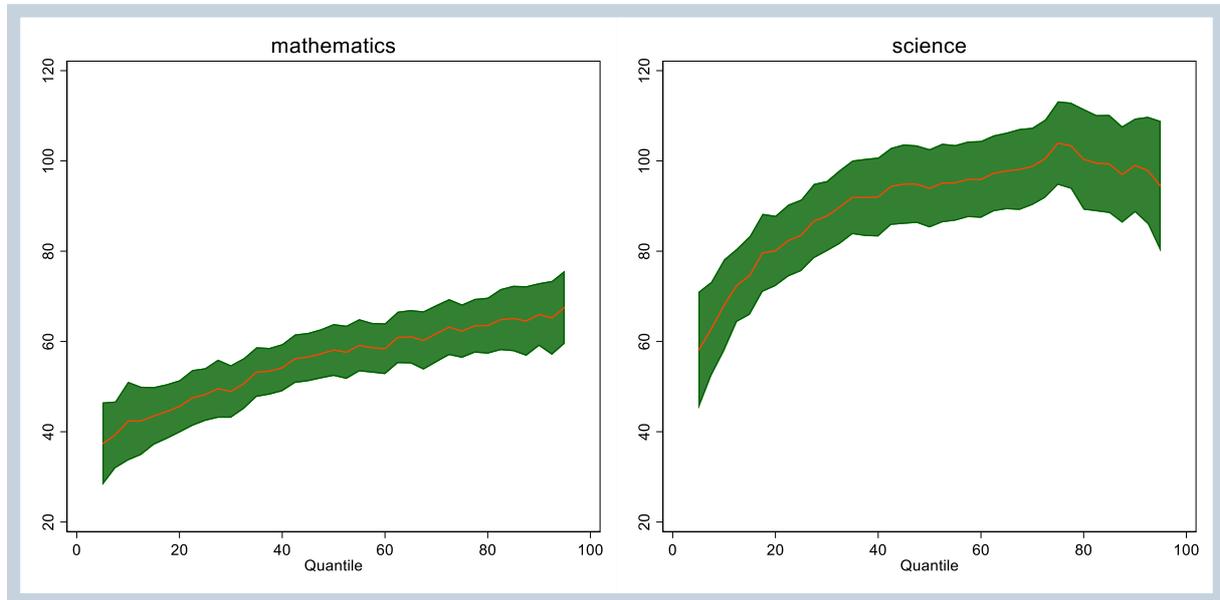
Source: Own calculation based on CERD an TIMSS 2019 data

Since the offer of private schools is highly heterogeneous, the large variation of students' performance results, i.e., from the differences between the private schools. In some private schools, the advantage of public schools might be relatively low, while in the most prestigious schools, the advantage is considerably high. Hence, applying the quantile regression with a confidence interval, in which the advantage of students from private schools will be estimated based on the distribution of the achievements of private school students, might provide an insight concerning the offer of the private schools.

In the figure presented below, the advantage of private school pupils is more significant in the case of science than in mathematics. The advantage in mathematics achievements is almost linear, while the science relationship is more inverted u-shape. The following increases in the science achievements advantages of private schools pupils are not as large as found before. In conclusion, the variation of the private schools' performance might be resulting from the overperformance of the highest achieving

students. Such observation might suggest that the best students in public schools are incomparable to their peers from the private schools.

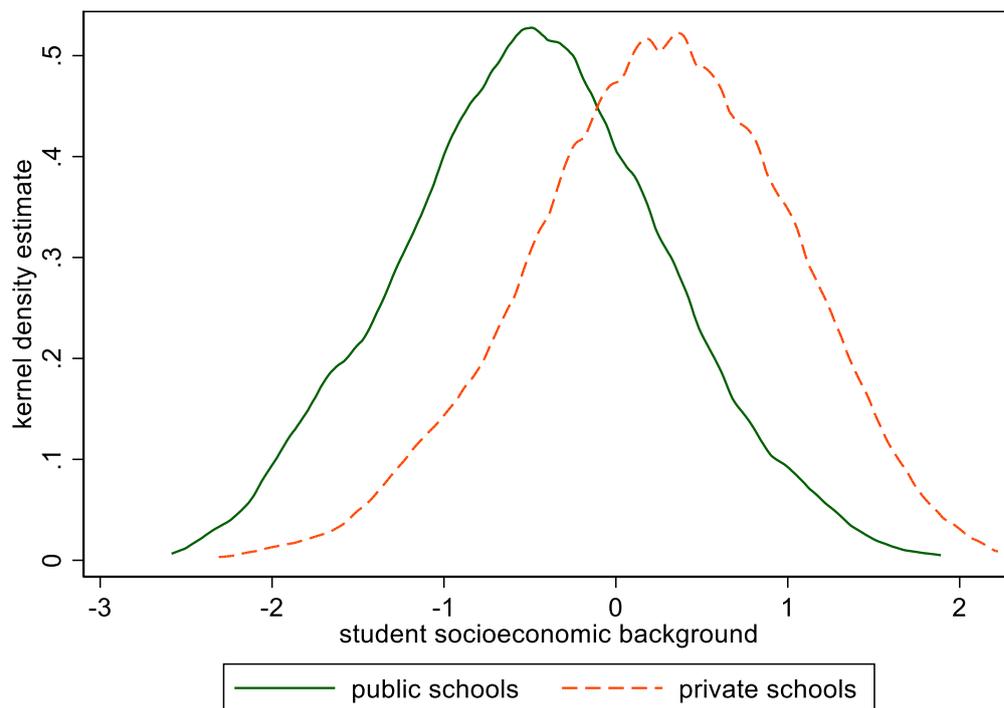
Figure 11.4. Achievement advantage of students in private schools for achievement quantiles



Source: Own calculation based on CERD an TIMSS 2019 data

The socioeconomic status of students seems to be the primary source of inequalities. Figure 11.5 presents the socioeconomic status distribution derived from the Kernel density estimation for both private and public – school students.

Figure 11.5. Student socioeconomic background distribution in public and private schools



Source: Own calculation based on TIMSS 2019 microdata

The average socioeconomic status in private schools is higher in comparison to public schools. Yet, this is not surprising since private schools require a fee.

The regression model of the individual achievement controlling for: school type and the socioeconomic status of the individual provide similar conclusions. In table 11.4, the estimations of three models are displayed. The first, which is found in column (1) for mathematics and (4) for science, explains the achievement of the individual only by indicating the type of school the one attends. Two other models found in columns (2) and (5) add the influence of the socioeconomic status, while the model in columns (3) and (6) is enriched in the interaction between one's socioeconomic status and school type. All of the factors included in these models proved to be significant predictors of achievement. Yet, the estimated coefficients vary between the models. In these models, the individual's high achievement mainly results from the attendance to school in the private sector and the affluent socioeconomic background. Students attending private schools score around 40 points more in mathematics and 60 points more in science in comparison to the students attending public schools. Even though the estimations for the school sector coefficients were found to be higher, one could notice that there is also a relatively large standard error. In the models explaining the science achievements, the coefficients were even higher for both the school sector and the socioeconomic background. Similarly to the previous models, based on the R-squared statistics, the affluence and the type of school better

explain the variance of the science achievements in comparison to mathematics. Interestingly, including the interaction between the private sector and the socioeconomic background does not highly influence the explained variance. Thus, it may suggest that the organization of the private school provides more effective teaching methods, as there is a substantial difference between students with the same socioeconomic status, which only depends on whether one attends private or public schools (row 1).

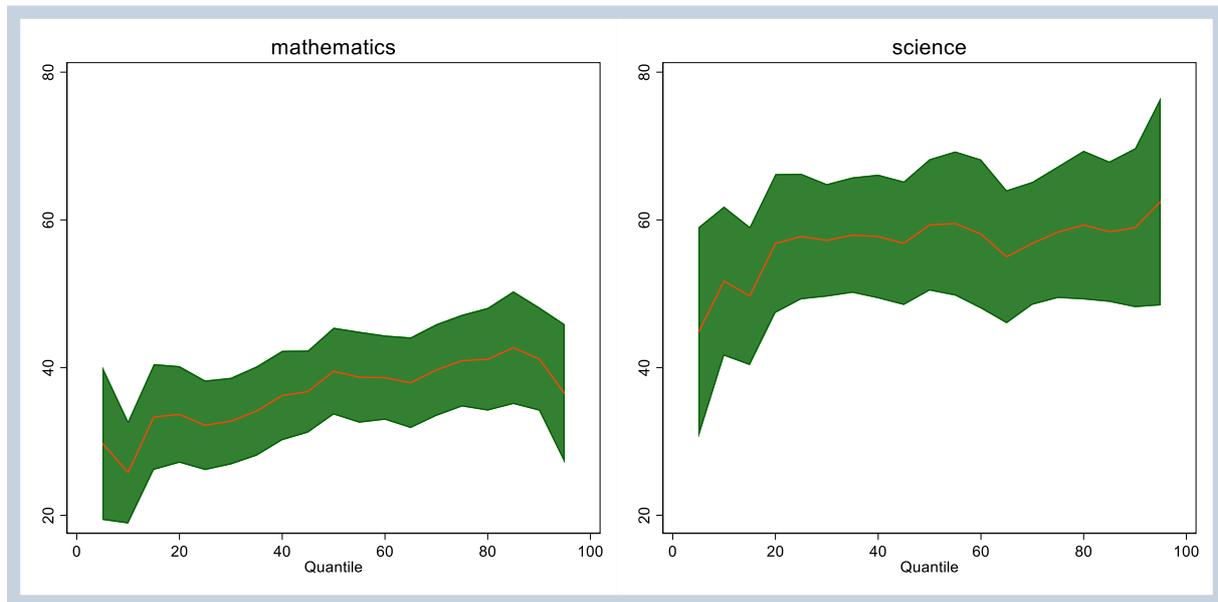
Table 11.4. Regression estimates for the difference in achievement related to school sector and socioeconomic background

	Mathematics			science		
	(1)	(2)	(3)	(4)	(5)	(6)
School sector (private=1; public=0)	56.1*** (5.1)	36.6*** (5.5)	40.2*** (5.4)	88.2*** (8.0)	55.0*** (8.7)	59.8*** (8.8)
Socioeconomic background		27.1*** (2.4)	17.2*** (2.9)		46.1*** (3.1)	32.9*** (4.2)
Private*socioeconomic background			14.8*** (3.8)			19.7*** (5.9)
Constant	393.6*** (3.7)	406.6*** (3.8)	401.8*** (3.6)	319.7*** (6.6)	341.9*** (6.7)	335.5*** (7.0)
R-squared	0.13	0.22	0.22	0.16	0.27	0.28
N	4544	4544	4544	4544	4544	4544

Source: Own calculation based on CERD and TIMSS 2019 data.

In figure 11.6., presented below, one can find the estimates of the quantile regression of the advantage of mathematics and science achievements of private school students. In comparison to the relation visualized in figure 11.4, the achievement gap is not increasing in the case of mathematics. On average, one can state that there are 30 points in difference between private and public schools students with the same socioeconomic status. In the case of science, the conclusion is similar – there is a 50-point difference. However, it can be observed that the poorest achieving students (0-10th quantile) have a little lower advantage over public school students. Additionally, it can be observed that the confidence interval is slightly larger, which may indicate the larger variation of the results.

Figure 11.6. Achievement advantage of students in private schools across achievement spectrum and after controlling for student socioeconomic background



Source: Own calculation based on CERD an TIMSS 2019 data

The estimates of the multilevel regression model, presented in table 11.5, confirmed the results derived in the previous parts. The average achievement of the student is highly affected by the school the one attends. It was estimated that around 60% of the variance is explained at the school level, while only 1-3% depends on the socioeconomic features of the individual.

Table 11.5. Multilevel model with socioeconomic background interaction with private school indicator for within- and between-school effects

	Mathematics		Science	
	(1)	(2)	(3)	(4)
Multilevel regression coefficients:				
Within school coefficient	8.9***	6.1	17.8***	15.8***
	(2.0)	(3.3)	(2.2)	(4.1)
Between school coefficient	64.6***	37.8***	106.9***	72.0***
	(5.4)	(8.0)	(8.0)	(12.6)
Private school dummy		18.3*		23.6
		(7.2)		(12.7)
Private*within school coefficient		4.3		3.125
		(4.0)		(5.0)
Private*between school coefficient		38.0**		50.2**
		(12.1)		(19.0)
Constant	429.1***	412.4***	375.3***	353.3***
	(3.2)	(5.3)	(4.9)	(10.9)
Variance components:				
Variance at the school level	935.9	841.9	2058.5	1947.8
	(119.4)	(120.4)	(266.2)	(268.5)
Variance at the student level	2849.6	2827.2	5142.0	5103.1
	(103.0)	(106.1)	(242.5)	(243.6)
Share of variance explained at the school level	55.4%	59.9%	60.8%	62.9%
Share of variance explained at the student level	1.1%	1.9%	2.4%	3.2%
Sample size:				
Number of students	4730	4730	4730	4730
Number of schools	204	204	204	204

Source: Own calculation based on CERD an TIMSS 2019 data

The above estimates are consistent with the previous research done in the field of educational research. **Lebanese system of education is reproducing the economic inequalities, as students from well-prospering households are attending segregated schools.** The quality of these schools is incomparable to the quality of the public schools. In consequence, the observed differences between students show that students from affluent and disadvantaged households do not have much in common when it comes to education. However, we should also take into account that this research was conducted in 2019 before the financial and economic crisis was witnessed in Lebanon, which not only did change the socioeconomic strata in Lebanon but also the quality of teaching in private sector.

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