CHAPTER IV: MATHEMATICS ACHIEVEMENT AT PRIMARY AND SECONDARY SCHOOL LEVEL

A COMPARISON BETWEEN CURRICULA

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4. MATHEMATICS ACHIEVEMENT AT PRIMARY AND SECONDARY SCHOOL LEVEL: A COMPARISON BETWEEN CURRICULA

SUMMARY

- By **integrating the European public schools** (EPS) into the Luxembourg School Monitoring Programme "*Épreuves Standardisées*" (ÉpStan), the full-cohort data including primary and secondary school students collected in autumn of the school year 2022/23 was analysed in an attempt to compare EPS students to their peers in schools following the Luxembourgish curriculum in the subject of mathematics; a subject for which a bigger overlap is assumed between the two school offers than for the language curricula (e.g., German, French).
- With regard to students' academic achievement in mathematics at **primary school level**, EPS students perform on average better than their peers in schools following the Luxembourgish curriculum. Looking at student subgroups with specific background characteristics, the present chapter's findings offer a first preliminary indication that students with a low socioeconomic status (SES) and/or students speaking a language other than Luxembourgish/German at home (i.e., French, Portuguese, English) attending EPS perform on average better in mathematics than their respective peers in schools following the Luxembourgish curriculum.
- At **secondary school level**, results indicate that EPS students are on average performing better than students allocated to the *Enseignement secondaire général - voie d'orientation* (ESG) and the *Enseignement secondaire général - voie de préparation* (ESG-VP), while showing lower mean values in mathematics than students in the *Enseignement secondaire classique* (ESC).
- Findings are preliminary and have to be interpreted with caution due to a number of **important methodological limitations**, such as very small student groups with specific background characteristics (i.e., low SES students at EPS) and the fact that the ÉpStan achievement tasks were developed based on the Luxembourgish curriculum. In addition, the current data analysis does not allow to identify one specific explanation for the observed results.
- Findings at secondary school level need to be interpreted with even more caution due to a number of **specific additional challenges**, such as the problem of comparing an ability-based tracked school system to the comprehensive school system in EPS.
- The **continuous monitoring of EPS** within the ÉpStan will allow an in-depth analysis of potential achievement differences in the future (e.g., investigation of longitudinal data sets, propensity score matching of specific EPS students with comparable students in schools following the Luxembourgish curriculum). By aiming at operationalising the students' learning environment,

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future research studies would furthermore allow to analyse which characteristics of EPS could explain the observed achievement differences.

4.1 THEORETICAL BACKGROUND

With 47.1% (see *Table I.1* in *Chapter I* for details) of inhabitants having a foreign nationality (Klein & Peltier, 2022), Luxembourg is a highly diverse country with regard to the socioeconomic, cultural, and linguistic composition of its population. This multiculturality is reflected in Luxembourg's education system, where recent figures illustrate that 65.4% of primary and 61.4% of secondary school students are speaking a language other than Luxembourgish and/or German at home (see *Figures I.13* and *I.14* in *Chapter I*).

Although this diversity is a great asset, international large-scale assessments (e.g., the OECD's PISA studies) have repeatedly shown that many education systems in modern societies struggle with the adequate handling of increasingly diverse student populations (e.g., Germany, Belgium; OECD, 2018a). This finding also applies to Luxembourg, for which the competencies assessed (e.g., reading, science, or mathematics) were found to be significantly below the OECD average (Fischbach et al., 2016).

Findings from national and international studies illustrate that students with a low socioeconomic status (SES) and/or students speaking a language other than Luxembourgish and/or German at home are especially at risk to struggle academically in Luxembourg's education system (Boehm et al., 2016; Hadjar et al., 2018; Hornung et al., 2021; OECD, 2018a; Sonnleitner et al., 2021). Longitudinal studies working with data from the Luxembourg School Monitoring Programme "*Épreuves Standardisées*" (ÉpStan) have identified significant achievement differences (e.g., in mathematics) both at primary and secondary school level, with low SES students and/or students speaking another language than Luxembourgish and/or German at home being less likely to reach the *Niveau Socle* defined by the national education standards (see *4.3.1* for more details) than their peers who have a high SES and who speak Luxembourgish and/or German at home (Hornung et al., 2021; Sonnleitner et al., 2021).

In order to deal more adequately with the increasing language diversity of the student population in Luxembourg and to counter the educational inequalities that are assumed to result (at least in part) from the curriculum, where high language expectations present an important challenge for a growing number of students, the Luxembourgish government has introduced various educational projects. These encompass, for example, a multilingual education programme

aiming at children aged between one and four, in which French is promoted in playful activities and the students' home languages are integrated through verbal usage (Kirsch, 2018); a French literacy acquisition pilot project established in four primary schools that gives students in C2.1 the possibility of learning to read and write in French (MENJE, 2022); and the introduction of European public schools (EPS) that are following the European curriculum (Eurydice, 2022).

In contrast to schools following the Luxembourgish curriculum, EPS offer language sections (i.e., German, French, and English) in which students choose their first language called L1 (e.g., native language or equivalent) and mainly pursue their educational trajectory in this language. In the first year of primary school, students also select their first foreign language (L2 followed up to their baccalaureate) and in the first year of secondary education, a second foreign language (L3) is required.

Through the opportunity to choose a main language of instruction among the available language sections, EPS might provide a learning environment to their students which is more adapted to the highly diverse student population in Luxembourg and which might in turn reduce the identified educational inequalities that have persistently been identified in schools that follow the Luxembourgish curriculum (Boehm et al., 2016; Hadjar et al., 2018; Hornung et al., 2021; Sonnleitner et al., 2021).

As stated in the *National Education Report* (Lenz et al., 2018), educational research in Luxembourg is pursuing the goal of scientifically accompanying the reforms that have been started in order to provide reliable evidence of their impact on educational success. By integrating the EPS into the ÉpStan (see *4.3.1* for details), the full-cohort data collected in autumn of the school year 2022/23 enables educational research to provide initial and tentative answers to the question whether the diversification of the school offer through the implementation of EPS reduces previously observed inequalities in Luxembourg's education system in regard to students' academic achievement as well as their attitudinal perception of schooling (e.g., motivation to learn, see *4.5*).

4.2 RESEARCH AIM

The research aim of the present chapter is to compare students attending primary and secondary schools following the Luxembourgish curriculum to their peers attending EPS in regard to their achievement in mathematics. The decision to initially focus on mathematics was jointly taken by the Ministry of Education, Children and Youth, the *Service de Coordination de la Recherche et de*

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l'Innovation pédagogiques et technologiques, and the *Luxembourg Centre for Educational Testing*, together with representatives from the EPS.

Current psychometric shortcomings (e.g., task development, comparability of tasks) have resulted in the fact that the ÉpStan administered in EPS only assessed academic achievement in mathematics, a school subject for which a bigger overlap between curricula is assumed than for language subjects (e.g., German, French, see *4.3.2* for a content-based comparison of the mathematics curricula), and which can thus be considered as a suitable starting point to compare EPS and schools following the Luxembourgish curriculum. Creating achievement tests to compare the students' academic achievement in reading or listening comprehension was not (yet) feasible considering that the timepoint of introduction of the different languages (L1 to L3) differs from one language section to another in EPS.

Despite an assumed bigger overlap in the mathematics curricula, it should however be noted that all ÉpStan tasks presented to the 2022/23 cohort (including EPS students) were developed based on the education standards defined by the Ministry of Education, Children and Youth for schools following the Luxembourgish curriculum. The existence of potential differences between the curricula (e.g., later introduction of a certain mathematical concept in EPS or vice versa) should be considered when interpreting the subsequent findings, although they have been taken into account in the development process of the mathematics competency tests (e.g., linguistic item validation by teachers working at EPS, see *4.3.2* for details).

Against this backdrop, the present chapter aims at generating first results on (a) achievement scores in mathematics of students attending schools that follow the Luxembourgish curriculum and their EPS peers in general, and (b) on achievement scores when taking student background characteristics (i.e., gender, SES, language, and migration background) into account more specifically.

Considering that low SES students and/or students speaking a language other than Luxembourgish and/or German at home have repeatedly been found to struggle academically in schools following the Luxembourgish curriculum (see *4.1* for details), understanding how disadvantaged students attending EPS are performing in mathematics seems of central importance regarding the aim of reducing educational inequalities in Luxembourg.

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4.3 METHODOLOGY

4.3.1 INFORMATION ON THE ÉPSTAN

The ÉpStan are an established school monitoring tool in Luxembourg and consist of standardized achievement tests, which assess academic achievement of primary and secondary school students in selected key areas of education (e.g., German, French, and mathematics; Martin et al., 2015). Administered in autumn at the beginning of each new learning cycle in Luxembourg's schools, the ÉpStan allow to systematically monitor whether the education standards of the previous learning cycle (as defined by the Ministry of Education, Children and Youth) have been achieved by all students in the respective grade (MENFP, 2011).

The ÉpStan take into account socioeconomic and sociocultural student characteristics (e.g., SES, language, migration background) that were proven to have an important impact on educational success in both national and international studies (e.g., Agirdag & Vanlaar, 2016; Duong et al., 2016; Hornung et al., 2021; Sirin, 2005; Sonnleitner et al., 2021; Voyer & Voyer, 2014). Hence, they ensure a fair performance comparison in Luxembourg's highly diverse student population.

Besides the standardized achievement tests, the ÉpStan entail questionnaires to assess central features of students' motivation to learn (e.g., academic self-concept, academic interest, school anxiety), teacher-student relationship as well as school and class climate.

The ÉpStan are administered in the classroom setting with achievement tests taking approximately 40 to 50 minutes per subject to complete. In order to allow an economical and highly standardized assessment, the ÉpStan items are presented in a closed format (i.e., multiple-choice, true-false, ordering, or matching items) or require short answers only (Fischbach et al., 2014). After the achievement tests, students have approximately 20 minutes to complete the student questionnaire. In primary school, all standardized achievement tests and the student questionnaire are presented in paper-and-pencil format, whereas secondary school students complete computer- or tablet-based tests and questionnaires.

In autumn of the school year 2022/23, the ÉpStan were administered, for the first time, to five grade levels in EPS (P1, P3, P5, S1, and S3); which are equivalent to C2.1, C3.1, C4.1, G7, and G9 in schools following the Luxembourgish curriculum. By integrating the EPS into a well-established school monitoring tool, the ÉpStan can contribute to the systematic evaluation of how a diversification of the national school offer (e.g., choice between different language sections) affects previously

observed performance differences in relation to students' SES, language, and migration background in Luxembourg's education system with regard to academic achievement in mathematics as well as students' attitudinal perception of schooling (e.g., motivation to learn, see *4.5*).

4.3.2 MEASURES

MATHEMATICS ACHIEVEMENT TESTS

To ensure a strong test quality, all items included in the ÉpStan standardized achievement tests are developed by interdisciplinary test development groups that consist of researchers from the ÉpStan team (e.g., expertise in the domains of psychometrics and test development), of teachers actively teaching the different subjects at each respective grade level (e.g., expertise in subject contents and in the educational curriculum), and of members from the Ministry of Education, Children and Youth (e.g., expertise in educational curriculum and in reference documents).

As mentioned above, all tasks presented in the standardized achievement tests are based on the education standards that were defined by the Ministry of Education, Children and Youth for all primary (C2.1, C3.1, and C4.1) and secondary schools (G7, and G9) following the Luxembourgish curriculum. In terms of content regarding primary school, mathematics achievement tests include tasks assessing the following areas: (a) *Space and shapes*, (b) *Numbers and operations*, and (c) *Sizes and measures* (MENFP, 2011, pp. 26–31). In both C3.1 and C4.1, the ÉpStan mathematics tasks are presented in either a contextualized (*problem solving and modeling*) or decontextualized way (*specific basic skills*, which are defined as mathematical knowledge and skills that can be applied independently, without any context or transfer work) to allow an implicit assessment of the content area (d) *Solving arithmetic word problems* (MENFP, 2011, pp. 32–33). In G7, the ÉpStan are designed to assess whether the students have acquired all competences that are expected at the end of C4 of primary education and therefore cover the same four sub-areas as mentioned above (MENFP, 2011, pp. 26–33).

Regarding G9, the mathematics achievement tests include tasks assessing mathematical models and problems that can be allocated to the content areas of (a) *Numbers and operations*, (b) *Figures of plane and space*, (c) *Dependence and variation,* and (d) *Data (*MENFP, 2008, pp. 18–32). Different test versions are created for the three school tracks *Enseignement secondaire classique* (ESC), *Enseignement secondaire général - voie d'orientation* (ESG), and *Enseignement secondaire général - voie de préparation* (ESG-VP). Each test version contains different proportions

of easy, medium, and difficult items that are specifically tailored to adequately assess the assumed competency level of the respective track (Fischbach et al., 2014). In addition, each test version entails at least one third of overlapping tasks that function as anchor items and ensure the comparability of competencies across school tracks (Fischbach et al., 2014).

For all primary schools following the Luxembourgish curriculum, the mathematics achievement test in C2.1 is presented in Luxembourgish, which is the main language of instruction in preschool. In C3.1 and 4.1, mathematics achievement tests are presented in German, which is the language of instruction in primary school. In secondary school (G7 and G9), all items assessing mathematics are developed in German and French (i.e., the language of mathematics instruction in secondary school) with students having the possibility to switch between languages at any time in order to select the language they consider most appropriate to solve the respective task.

In line with international large-scale assessments (e.g., PISA; OECDb, 2018), one global score is used for mathematics achievement, which is normed in such a way that the mean value for all students in Luxembourg lies at 500 points with a standard deviation (mean deviation of the test values from the mean) of 100 points in a reference school year (usually the first school year the respective competency was assessed in the respective grade; Fischbach et al., 2014).

To allow a comparison between the mathematical competences of students attending schools following the Luxembourgish curriculum and EPS students, the same tasks were presented to both groups. Considering that these items are based on the education standards defined by the Ministry of Education, Children and Youth for schools following the Luxembourgish curriculum, the following aspects have been taken into consideration in the development process of the mathematics achievement tests presented to the 2022/23 cohort:

(a) Language versions offered to the students. As described in more detail in *Chapter I*, EPS offer primary and secondary education in three main language sections (i.e., German, French, and English). In order to adapt the ÉpStan to this diverse language offer, mathematics achievement tests were presented to primary school students attending EPS in the language of their respective language section. In secondary schools, mathematics achievement tests were presented in all three languages of the language sections (i.e., German, French, and English) with students having the possibility to switch between language versions at any time to select the language they consider most appropriate to solve the respective task. Further, in this first analysis, measurement invariance has not yet been tested for the different language versions, which limits the statistical

comparability of the two groups' mean values (i.e., EPS and schools following the Luxembourgish curriculum).

(b) Linguistic item validation by teachers actively teaching in EPS. Considering that the items from the mathematics achievement tests are developed based on the education standards of the Luxembourgish curriculum, a call inviting teachers who actively teach mathematics in EPS was launched with the aim to validate each item linguistically. In collaborative workshops including researchers from the test development groups and EPS teachers from the French and English language sections of the repsective grade levels, each item was discussed with regard to the understandability of mathematical terms or signs (e.g., the usage of " ·" as a sign for multiplication in German vs. "x" in French). Based on the teachers' feedback, small adaptations were made to the translated versions of the mathematics tasks and instructions in C2.1/P1 were shortened with the aim to reduce the text load as much as possible. Whereas items have been linguistically validated, they have not specifically been validated with regard to their content (e.g., whether a certain mathematical construct has been introduced in both the Luxembourgish and European curriculum). Although no official content validation took place in the scope of the above-mentioned collaborative workshops, the teachers involved were free to comment on individual items when they felt the underlying mathematical competence, or concept, had not been introduced at the respective grade level of the European curriculum. The fact that only a very limited number of items were pointed out based on the content assessed, appeared to be in line with observations made during the comparison of the mathematics curricula implemented in the two school offers. Thus, the curricula appear to be comparable in terms of the content with a slight difference in its classification into domains. While at primary school level, the domains are listed as (a) *Space and shapes*, (b) *Numbers and operations*, and (c) *Sizes and measures* in the Luxembourgish curriculum (MENFP, 2011, pp. 26–31), they are listed as (a) *Numbers*, (b) *Operations*, (c) *Measurement and units*, (d) *Shape and space*, and (e) *Data handling* in the European curriculum (Schola Europaea, 2022, p. 31). In comparison, the domains at secondary school level are (a) *Numbers and operations*, (b) *Figures of plane and space*, (c) *Dependence and variation,* and (d) *Data* in the Luxembourgish curriculum (MENFP, 2008, pp. 18–32), and (a) *Numbers,* (b) *Algebra,* (c) *Geometry,* (d) *Statistics and probability,* and (e) *Set theory* in the European curriculum (Schola Europaea, 2019, p. 34), both corresponding to similar content and learning objectives.

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(c) Choice of test version for S3 classes of the EPS. Whereas secondary school students who attend schools following the Luxembourgish curriculum are allocated to one of three schools tracks (ESC, ESG, or ESG-VP; Lenz & Heinz, 2018) in G7 based on their academic abilities, secondary school students attending EPS are enrolled in one common track until S3, which marks the end of lower secondary education. Considering that different test versions are available for the three different school tracks as described in more detail above, directors of the EPS were given the choice of the test version to be presented to their S3 classes with the vast majority selecting the ESG version (i.e., intermediary school track in schools following the Luxembourgish curriculum). In light of the fact that the test versions are psychometrically linked using at least one third of overlapping tasks that function as anchor items (Fischbach et al., 2014), the test versions measure on the same scale. Thus, a comparison between S3 and G9 classes following the Luxembourgish curriculum remains possible.

STUDENT BACKGROUND CHARACTERISTICS

Parents (primary school) and students (secondary school) provide information on the background characteristics of socioeconomic status (SES), language, and migration background via a questionnaire (i.e., self-reports). The *International Socio-Economic Index of Occupational Status* (ISEI, Ganzeboom, 2010; Ganzeboom et al., 1992) was used for the classification of a student's SES based on the occupational status of the parents. The Index can take on values between 10 and 90. Within ÉpStan, the highest available ISEI value (HISEI) of either the father or the mother (or the respective caretaker) is considered. This value is also used to classify students into high and low SES groups. The lowest 25% of the distribution are defined as having a low SES and the highest 25% as having a high SES (Muller et al., 2014). When it comes to migration background, students are considered as natives when the students themselves and at least one of their parents were born in Luxembourg. As the language of literacy acquisition in Luxembourg is German, speaking Luxembourgish and/or German at home is assumed to provide students with the language resources needed for literacy acquisition in primary schools following the Luxembourgish curriculum (Hadjar et al., 2018; Hornung et al., 2023). To compare students based on their languages, students are considered to have a specific language background (i.e., Luxembourgish/German, French, Portuguese, or English) when they speak the respective language with at least one of their parents at home. This means that a student can be found in different language groups (e.g., a student speaking Luxembourgish with its mother and Portuguese with its father is considered to a Luxembourgish and Portuguese language background). In line with *Figures I.13* and I.*14* from *Chapter I*, in which Luxembourgish/German,

French, Portuguese, and English were identified as languages primarily spoken at home in EPS and schools following the Luxembourgish curriculum, the present chapter focuses on those four language groups. With regard to gender, the student administrative database of the Ministry of Education, Children and Youth has been used in order to split the student population into male and female students.

4.3.3 THE ÉPSTAN SAMPLE

The results presented in the present chapter are based on representative data from approximately 28.700 students from five different grade levels of primary and secondary school (C2.1, C3.1, C4.1, G7, and G9 in schools following the Luxembourgish curriculum, and P1, P3, P5, S1, and S3 in EPS). Looking at primary school level, 869 students attended EPS, which equals to 4.8% of the full ÉpStan cohort of primary school students. With regard to secondary education, 1.032 students attended EPS (9.6% of the full ÉpStan cohort of secondary school students). The total number of students at both primary and secondary school level might differ from official Ministry numbers considering that some children did not take part in the ÉpStan (e.g., due to sickness on the day of the data collection). Although the *International School Michel Lucius* takes part in the ÉpStan both at the primary and secondary school level, students following its UK-Style education (i.e., A-levels; *N* = 239 in primary and *N* = 259 in secondary school) have been excluded from the sample used in the present chapter as its aim is to focus on schools following the European curriculum. The sociodemographic characteristics of the two student populations (i.e., EPS students and students in schools following the Luxembourgish curriculum) can be found in *Table IV.1* (see *4.3.2* for details on the measures used to assess the students' background characteristics.

4.4 RESULTS

4.4.1 MATHEMATICS ACHIEVEMENT AT PRIMARY SCHOOL LEVEL

In a first step, the present chapter addresses mathematics achievement scores among students attending primary schools following the Luxembourgish curriculum and their EPS peers. *Figure IV.1* shows the distribution of academic achievement in mathematics for all three primary school grades split by curriculum. Each student's ÉpStan score is represented by an individual dot and the density of the dots reflects the size of each group (i.e., the total *N* of students as indicated on the x-axis). The mean values are depicted in the center of each distribution. This visualization furthermore allows to graphically display outliers (e.g., students with a particularly low or high ÉpStan score in mathematics).

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Table IV.1 - Detailed Sample Description of the ÉpStan Cohort for the School Year 2022/23

							Language background			
			N	HISEI (mean)	% female	% natives	% Lux/German	% French	% Portuguese	% English
Schools following the Luxembourgish curriculum	EF	C2.1	5876	51.2	48.9%	39.2%	42.3%	20.9%	23.0%	5.9%
		C3.1	5861	49.8	48.3%	39.1%	40.9%	18.5%	21.6%	4.9%
		C4.1	5432	49.3	48.9%	40.7%	42.1%	19.9%	23.2%	4.2%
	ES – G7	ESC	1178	53.3	54.1%	53.1%	58.5%	21.5%	10.9%	3.0%
		ESG	1826	39.4	47.9%	33.2%	35.4%	15.1%	33.3%	1.9%
		ESG-VP	524	33.3	40.3%	22.1%	21.2%	10.5%	45.2%	1.9%
	ES – G9	ESC	1817	56.0	46.2%	56.7%	61.3%	21.5%	10.7%	2.9%
		ESG	3728	39.7	45.3%	30.9%	33.2%	13.5%	37.3%	1.6%
		ESG-VP	609	34.4	41.9%	19.7%	23.6%	12.2%	42.7%	1.5%
EPS	EF	P1	363	60.5	48.8%	11.6%	14.6%	43.3%	11.6%	24.8%
		P3	268	58.7	50.0%	9.7%	13.8%	45.9%	10.4%	20.5%
		P5	238	60.1	44.5%	16.0%	15.1%	42.9%	9.7%	18.9%
	ES	S1	623	51.8	45.3%	15.6%	20.9%	33.4%	18.5%	12.0%
	ES	S3	409	52.1	46.0%	21.0%	27.4%	36.7%	19.8%	12.0%

Note. *N* = Number of students. HISEI = Highest available *Index of Socio-Economic Index of Occupational* Status value. EF = *Enseignement fondamental* (primary school level). ES = *Enseignement secondaire* (secondary school level). ESC = *Enseignement secondaire classique*. ESG = *Enseignement secondaire général - voie d'orientation*. ESG-VP = *Enseignement secondaire général - voie de préparation*. For details on the operationalisation of student background variables, see 4.3.2. Due to methodological differences in the composition of the HISEI variable, means cannot be compared between EF and ES.

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With regard to achievement scores in mathematics, *Figure IV.1* indicates that students attending EPS display higher mean values than their peers attending schools following the Luxembourgish curriculum across all three grade levels. As described in more detail in section *4.3.2*, the ÉpStan metric (i.e., the y-axis) is normed in such a way that the mean value for all students in Luxembourg lies at 500 points with a standard deviation of 100 points (Fischbach et al., 2014) for the respective reference school year. In the subject of mathematics, regular fluctuations of ± 10 ÉpStan points were observed from one year to another at both primary and secondary school level (see Fischbach et al., 2021, *Figures 1* and *3*) and these rather small changes should generally not be interpreted as considerable differences in academic achievement. With group differences of approximately 20 ÉpStan points in C2.1/P1 and C3.1/P3 and close to 40 ÉpStan points in C4.1/P5, the observed achievement differences that are in favor of primary school students attending EPS go beyond regularly observed fluctuations in the subject of mathematics and thus seem to be an important indication that EPS students are on average performing better than students in schools following the Luxembourgish curriculum, and this is most prominent in C4.1/P5.

Figure IV.1 - Distribution of Achievement in Mathematics Separately by Curricula at Primary School Level (School Year 2022/23)

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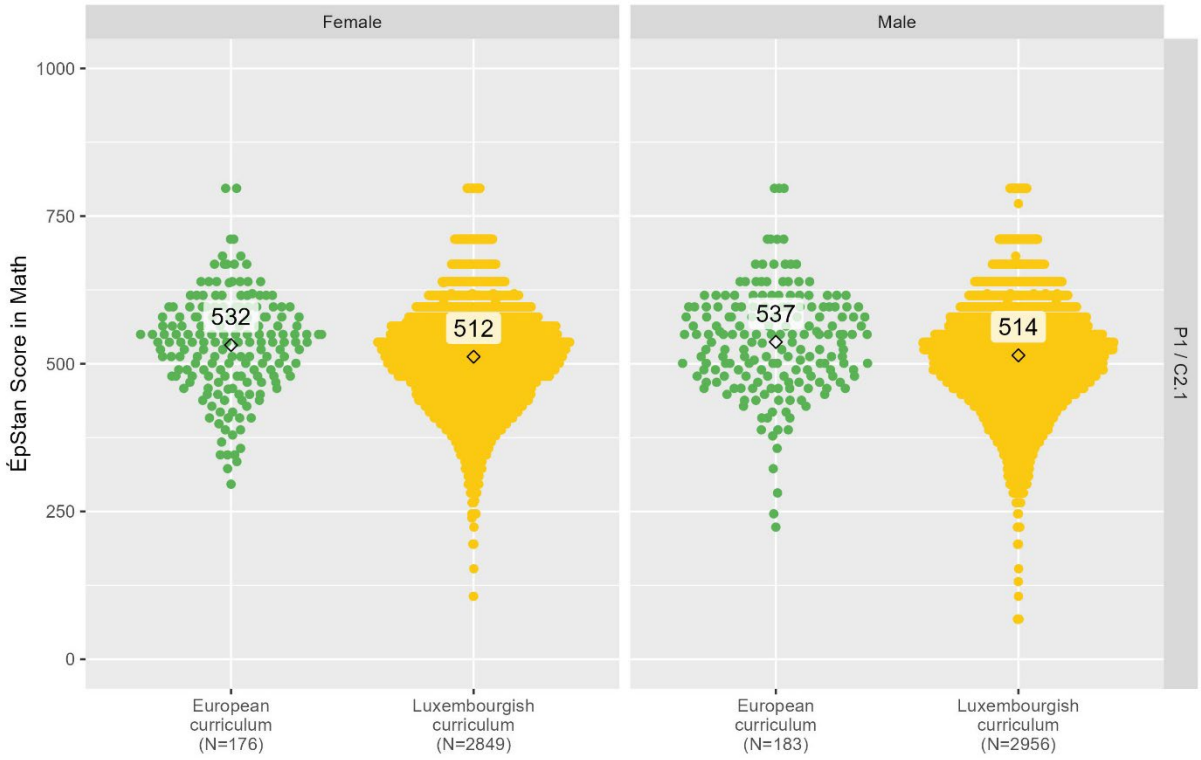
Considering that low SES students, students having a migration background, and/or students speaking a language other than Luxembourgish and/or German at home have repeatedly been found to struggle academically in schools following the Luxembourgish curriculum (see *4.1* for details), the present chapter aims, in a second step, to understand how students in EPS with specific background characteristics perform in mathematics when compared to peers with the same characteristics attending schools following the Luxembourgish curriculum.

As indicated in *Table IV.1* (see *4.3.3*), the distribution of primary school students by **gender** appear to be comparable across school offers with 48.3 to 48.9% female students following the Luxembourgish curriculum compared to 44.5 to 50.0% female students in EPS. *Figure IV.2* shows the distribution of academic achievement in mathematics for all three primary school grades separately by curriculum and gender. With regard to potential achievement differences in mathematics, *Figure IV.2* indicates that students attending EPS show higher mean values (e.g., ≈ 20 ÉpStan points higher in C2.1/P1 and ≈ 40 ÉpStan points higher in C4.1/P5) than students in schools following the Luxembourgish curriculum across all grade levels, irrespective of gender.

Figure IV.2 - Distribution of Achievement in Mathematics Separately by Curricula and Gender at Primary School Level (School Year 2022/23)



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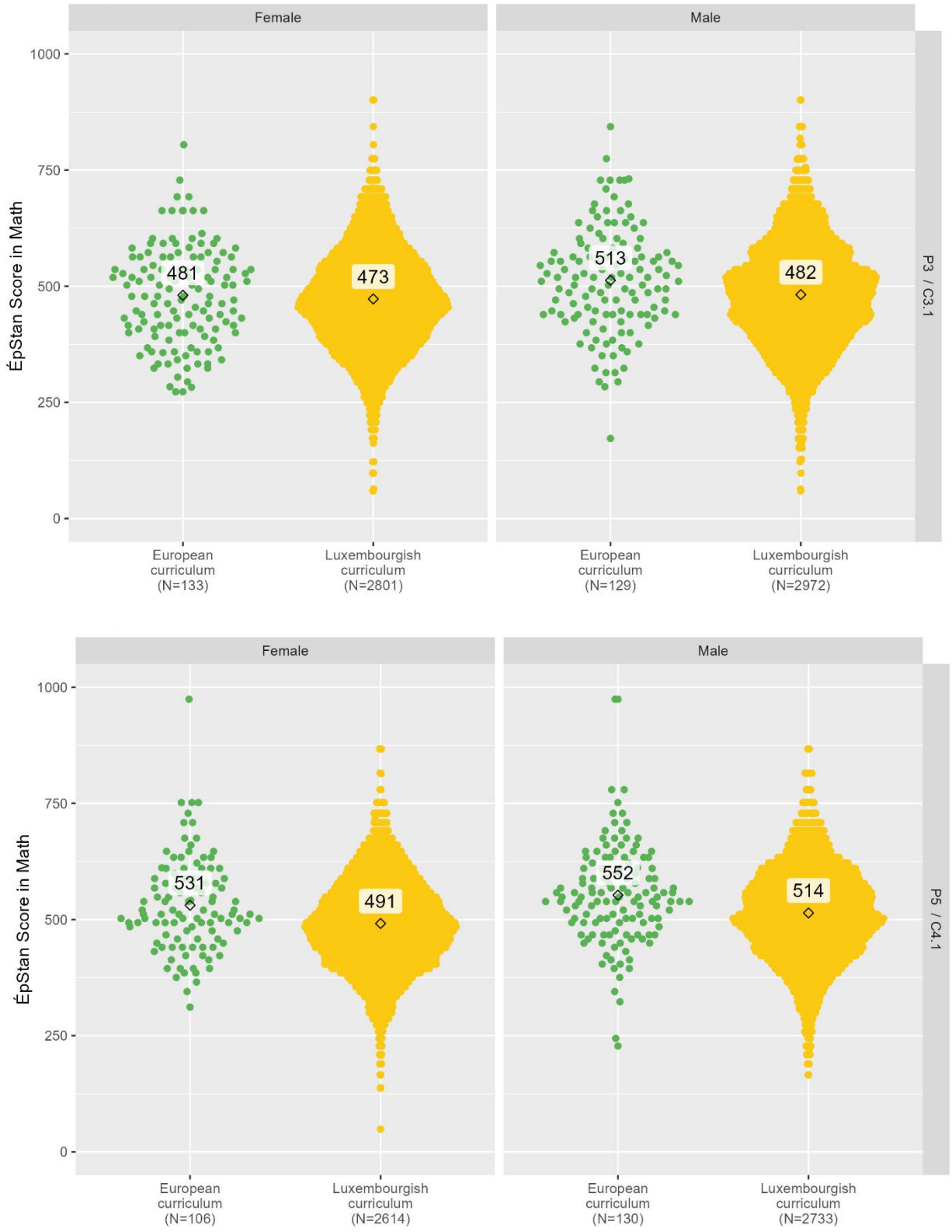

These results seem to indicate that both male and female students in EPS are on average performing better than students in schools following the Luxembourgish curriculum with the group difference

being highest in C4.1/P5 and lowest for female students in C3.1/P3 with a mean value that is only 8 ÉpStan points higher than for their female peers in schools following the Luxembourgish curriculum. When looking at gender differences within systems, male students demonstrate higher mean values than their female peers both in EPS and in schools following the Luxembourgish curriculum, and this is especially the case in C4.1/P5. Although not the focus of the present chapter, this finding is in line with the typically reported pattern in national and international studies of male students outperforming female students in the subject of mathematics (e.g., Boehm et al., 2016; Winkelmann et al., 2008; Zhu, 2007).

Besides gender, the present chapter addresses whether students from low **socioeconomic status (SES)** households differ in their academic achievement in mathematics from their comparably low SES peers attending EPS. As can be seen in *Table IV.1*, the student population in EPS is characterized by a higher mean SES (HISEI mean of ≈ 60) across all primary school grades than students in schools following the Luxembourgish curriculum (HISEI mean of ≈ 50). Consequently, this observed difference in mean HISEI translates into smaller groups of students characterized as low SES in EPS (e.g., 14 students in C4.1/P5, see *Figure IV.3*) compared to the Luxembourgish curriculum. The average HISEI of low SES students in EPS seems comparable to the average HISEI of low SES students in schools following the Luxembourgish curriculum (e.g., HISEI of 33 in EPS and of 31 in schools following the Luxembourgish curriculum in C2.1/P1). The same holds true for the average HISEI of high SES students (e.g., HISEI of 68 in EPS and of 69 in schools following the Luxembourgish curriculum in C2.1/P1). Nevertheless, in light of the small student groups having a low SES in EPS, the results on academic achievement differences in mathematics based on SES should be interpreted with caution.

Figure IV.3 shows the distribution of academic achievement in mathematics for all three primary school grades separately by curriculum and SES. Looking at high SES students (i.e., highest 25% of the HISEI distribution), results in all three primary school grades indicate small achievement differences in favor of students attending schools following the Luxembourgish curriculum, which however fail to differ considerably from the previously described regular fluctuations of ± 10 ÉpStan points. In general, the findings for high SES students imply no important achievement differences, with high SES students performing well irrespective of their school's curriculum.

For low SES students (i.e., lowest 25% of the HISEI distribution), a different pattern can be observed in *Figure IV.3*. With mean differences ranging from ≈ 30 ÉpStan points (C3.1/P3 and C4.1/P5) to 45 ÉpStan points in C2.1/P1, the observed academic achievement differences in mathematics in favor of low SES students attending EPS go beyond regularly observed fluctuations and thus appear to be a preliminary indication that low SES students in EPS perform better, on average, than their low SES peers in schools following the Luxembourgish curriculum. This is most prominently visible in C2.1/P1. As visualized by the small number of individual points in *Figure IV.3*, it must be kept in mind, however, that

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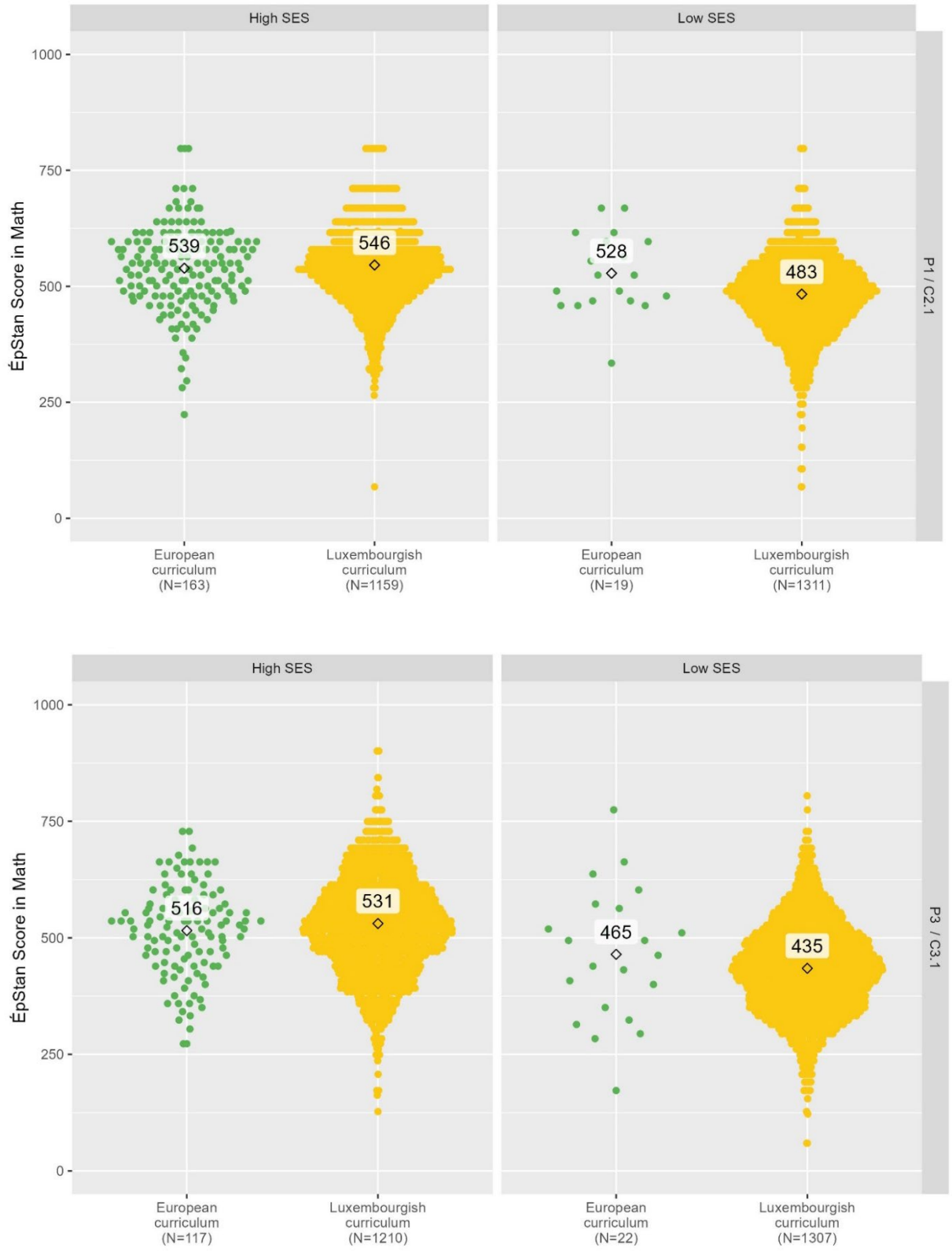
these results are based on very small *Ns* (between 14 and 22 students only) and should thus be interpreted with caution.

Figure IV.3 - Distribution of Achievement in Mathematics Separately by Curricula and SES at Primary School Level (School Year 2022/23)



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In addition to gender and SES, the present chapter investigates how students with a **migration background** attending EPS perform compared to their peers with a migration background in schools following the Luxembourgish curriculum. As shown in *Table IV.1*, the percentage of native students (i.e., students whose own country of birth is Luxembourg and so is that of at least one of their parents) lies at approximately 40% in schools following the Luxembourgish curriculum. Ranging between 10% in C3.1/P3 and 16% in C4.1/P5, the amount of native students is considerably lower in EPS. Similar to the background variable of SES, this difference in the student population translates into small groups of native students in EPS (e.g., 26 native students in C3.1/P3, see *Figure IV.4*). In addition, it has to be presumed that EPS students with a migration background are coming from different countries of origin (e.g., other non-EU countries) than their peers with a migration background in schools following the Luxembourgish curriculum (e.g., Portuguese). In light of small student groups and potential differences in the countries of origin between school curricula, the following results on achievement differences in mathematics based on migration background must be interpreted with caution.

Figure IV.4 shows the distribution of academic achievement in mathematics for all three primary school grades separately by curriculum and migration background. No consistent pattern is visible for native students across all primary school grades. Whereas native students in EPS show lower mean values in C2.1/P1 (11 ÉpStan points) and C3.1/P3 (30 ÉpStan points) than native students in schools following the Luxembourgish curriculum, native students attending EPS seem to perform better than

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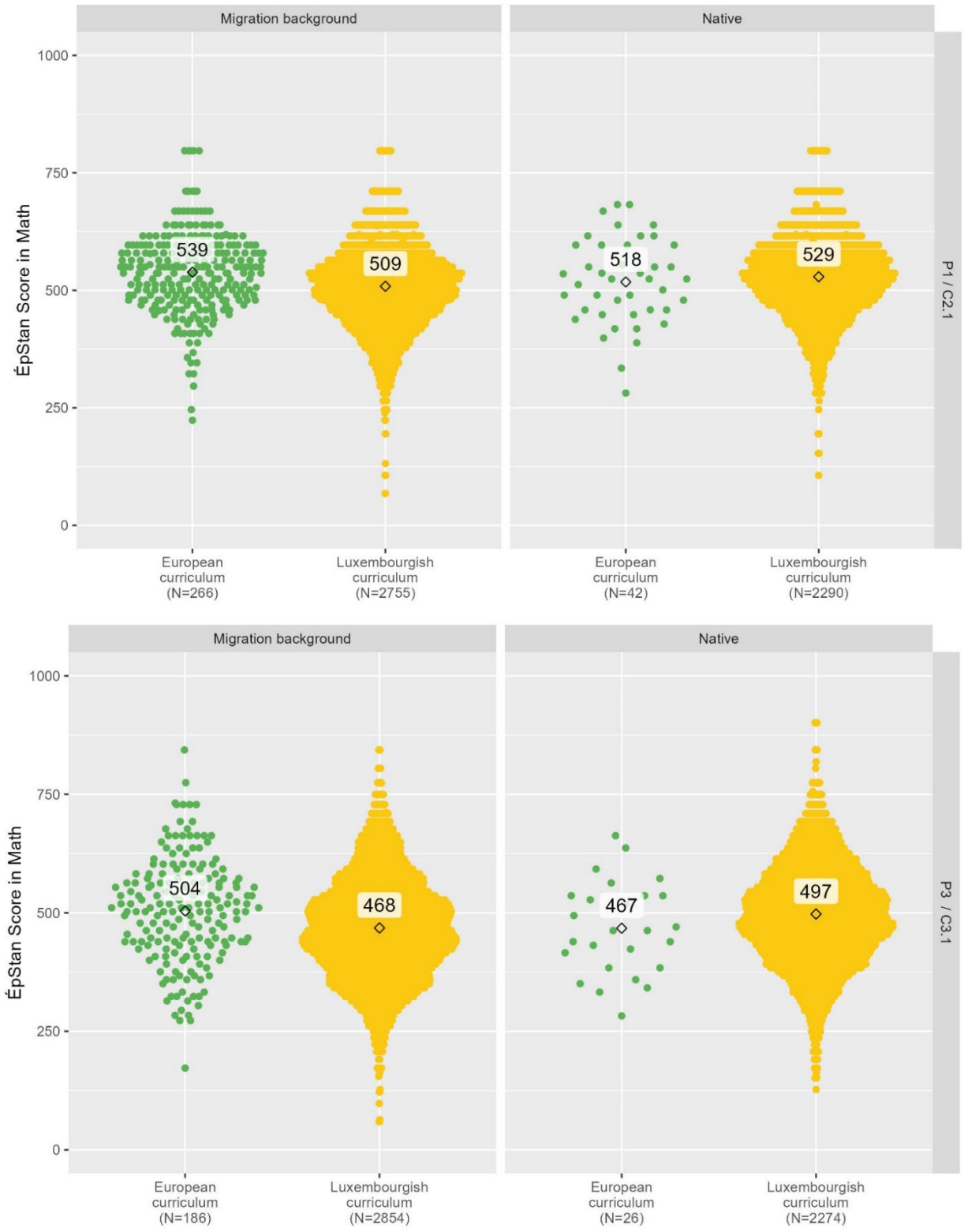
their native peers attending schools following the Luxembourgish curriculum in C4.1/P5 (29 ÉpStan points; see *Figure IV.4*).

Figure IV.4 - Distribution of Achievement in Mathematics Separately by Curricula and Migration Background at Primary School Level (School Year 2022/23)



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For students with a migration background, a consistent pattern can be found across all three primary school grades. Mean value differences in favor of students with a migration background attending EPS range from ≈ 30 ÉpStan points (C2.1/P1 and C3.1/P3) to 48 ÉpStan points in C4.1/P5. Considering that the group differences in favor of EPS students with a migration background go beyond regularly observed fluctuations (± 10 ÉpStan points), they indicate that students with a migration background attending EPS appear to struggle considerably less in mathematics than their peers with a migration background in schools following the Luxembourgish curriculum.

However, as already indicated, an interpretation of these findings must keep in mind that being *non-native* (i.e., having a migration background) potentially represents very different socioeconomic and sociocultural groups at EPS than in schools following the Luxembourgish curriculum. Looking at the average HISEI, it has to be underlined that EPS students having a migration background have a considerably higher mean HISEI (e.g., 61 in C2.1/P1) than their peers with a migration background in schools following the Luxembourgish curriculum (e.g., 49 in C2.1/P1). Hence, from these findings, it cannot be concluded that students irrespective of their specific migration background perform better at EPS, and potentially even better than native students at schools following the Luxembourgish curriculum. This cautionary note becomes even more relevant in light of the very small *N*s, particularly so for the group of native students in EPS.

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As a last variable of interest, the present chapter is about understanding whether students with a specific **language background** (i.e., Luxembourgish/German, French, Portuguese, and English) in EPS perform better than students with the same language background in schools following the Luxembourgish curriculum, where their respective language background might be further away from the language of instruction (e.g., a Portuguese speaking student learning to read and write in German in a school following the Luxembourgish curriculum in comparison to a Portuguese speaking student learning to read and write in French in EPS).

A first language group that has been taken into consideration are students speaking Luxembourgish and/or German at home with at least one of their parents. As displayed in *Table IV.1*, the percentage of students speaking Luxembourgish and/or German at home reaches ≈ 42% in schools following the Luxembourgish curriculum. With a percentage of ≈ 15%, this share is considerably lower in EPS. Similar to the variables of SES and migration background, this difference translates into small student groups in EPS that are speaking Luxembourgish and/or German at home.

Figure IV.5 illustrates the distribution of academic achievement in mathematics for all three primary school grades separately by curriculum for students speaking Luxembourgish and/or German at home. No consistent pattern is visible across all primary school grades. In C2.1/P1 and C3.1/P3, students with a Luxembourgish and/or German language background attending EPS have lower mean values than those in schools following the Luxembourgish curriculum (15 and 25 ÉpStan points less, respectively).

With regard to C4.1/P5, EPS students speaking Luxembourgish and/or German at home have a mean value that is 72 ÉpStan points higher than for students with a Luxembourgish and/or German language background in schools following the Luxembourgish curriculum. This divergent pattern observed in C4.1/P5 does not change when excluding students with very high ÉpStan values (as visualized in *Figure IV.5* by the individual dot representing an ÉpStan score of 974), but should nevertheless be interpreted with caution due to the small amount of EPS students with a Luxembourgish/German language background.

When looking at students that are speaking French at home with at least one of their parents, *Table IV.1* shows that ≈ 20% of the student population in schools following the Luxembourgish curriculum have a French language background. Ranging from 42 to 46%, this share is higher in EPS and translates into considerably bigger comparison groups than for all other language groups (see higher density of individual dots and *N*s indicated on the x-axis of *Figure IV.6*).

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Figure IV.5 - Distribution of Achievement in Mathematics Separately by Curricula for Luxembourgish/German Speaking Students at Primary School Level (School Year 2022/23)

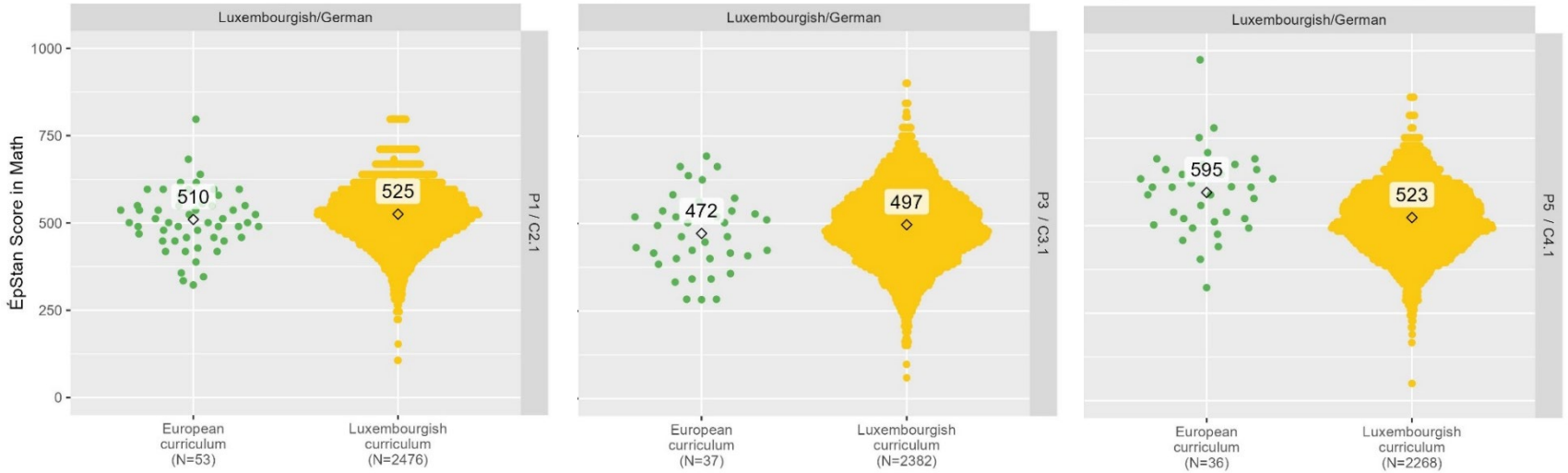
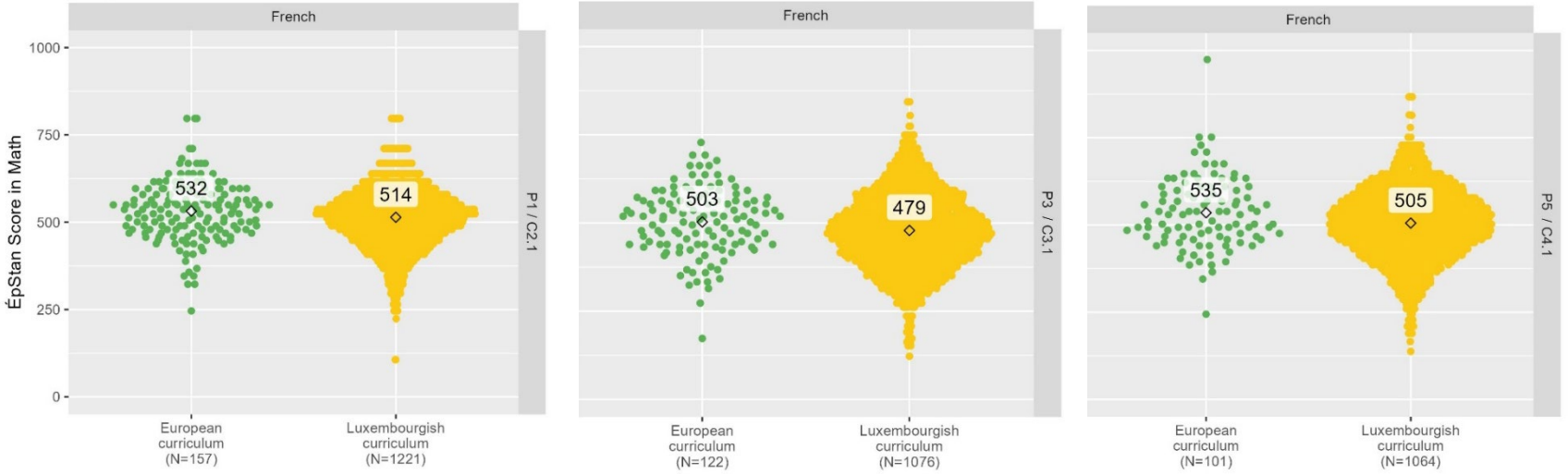


Figure IV.6 - Distribution of Achievement in Mathematics Separately by Curricula for French Speaking Students at Primary School Level (School Year 2022/23)



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As can be seen in *Figure IV.6*, students with a French language background attending EPS show higher mean values in mathematics ranging from 18 ÉpStan points in C2.1/P1 to 30 ÉpStan points in C4.1/P5 than French speaking students in schools following the Luxembourgish curriculum. This consistent pattern of higher mean values, going beyond regularly observed fluctuations in the subject of mathematics (± 10 ÉpStan points), thus seems to be an important first indication that students with a French language background attending EPS are on average performing better in mathematics than their French speaking peers in schools following the Luxembourgish curriculum.

Looking at students that are speaking Portuguese at home with at least one of their parents *Table IV.1* indicates that ≈ 23% of the students in schools following the Luxembourgish curriculum have a Portuguese language background. With a percentage of ≈ 10%, the share of students with a Portuguese language background is lower in EPS. Similar to Luxembourgish and/or German as language background, this small share of the student population translates into small groups of students in EPS that speak Portuguese at home (e.g., 23 students in C4.1/P5, see *Figure IV.7*).

Figure IV.7 illustrates the distribution of academic achievement in mathematics for all three primary school grades separately by curriculum for students speaking Portuguese at home. As for students with a Luxembourgish and/or German language background, there is no consistent pattern for students speaking Portuguese at home across all primary school grades.

In C2.1/P1 and C4.1/P5, students with a Portuguese language background display higher means in mathematics when attending EPS than their peers in schools following the Luxembourgish curriculum, with a difference of 28 and 58 ÉpStan points, respectively. Considering that these differences go beyond fluctuations that are regularly observed in the ÉpStan (± 10 points), these results seem to indicate that students with a Portuguese language background, who as a group, consistently struggle in schools following the Luxembourgish curriculum are on average performing better than their peers when they attend EPS. This pattern can however not be observed in C3.1/P3, where Portuguese speaking students in school following the Luxembourgish curriculum display a comparable mean value (difference of 9 ÉpStan points) as their peers attending EPS.

Although this group difference can be considered a regular fluctuation that does not indicate considerable disparities between the two curricula, the fact that this divergent pattern changes when excluding the student with the lowest ÉpStan value (as visualized in *Figure IV.7* through the individual dot representing an ÉpStan score of 172) underlines once more that the results for Portuguese speaking students should be interpreted with caution due to small *N*s in EPS, especially

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in light of wide spread distributions (i.e., distribution of Portuguese speaking students in EPS in C3.1/P3).

For students speaking English at home with at least one of their parents, *Table IV.1* indicates that ≈ 5% of the student population in schools following the Luxembourgish curriculum have an English language background. Ranging from 19 to 25%, the share of students speaking English at home is considerably higher in EPS. Although the amount of English speaking students is relatively small in schools following the Luxembourgish curriculum, the *N*s for comparison groups of English speaking students are higher than for students with a Luxembourgish/German or Portuguese language background (see higher density of individual dots and *N*s indicated on the x-axis of *Figure IV.8*).

As visualized in *Figure IV.8*, primary school students with an English language background attending EPS show higher mean values in mathematics than English speaking students attending schools that follow the Luxembourgish curriculum in all three grades. The difference observed in C3.1/P1 falls into regularly observed fluctuations in the ÉpStan. Nevertheless, by going beyond regularly observed fluctuations in the subject of mathematics (± 10 ÉpStan points) in both C2.1/P1 and C4.1/P5, with mean values that are 31 and 47 ÉpStan points higher, respectively, these findings appear to be a first indication that English speaking students attending EPS are on average showing better academic achievement scores in mathematics than their English speaking peers in schools following the Luxembourgish curriculum.

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Figure IV.7 - Distribution of Achievement in Mathematics Separately by Curricula for Portuguese Speaking Students at Primary School Level (School Year 2022/23)

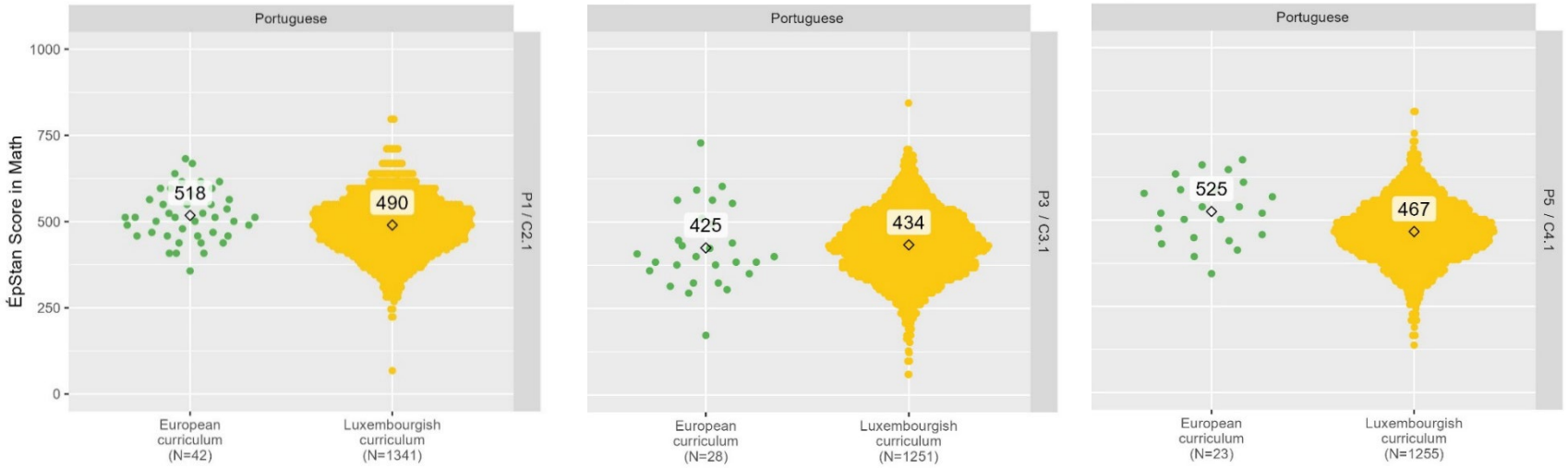
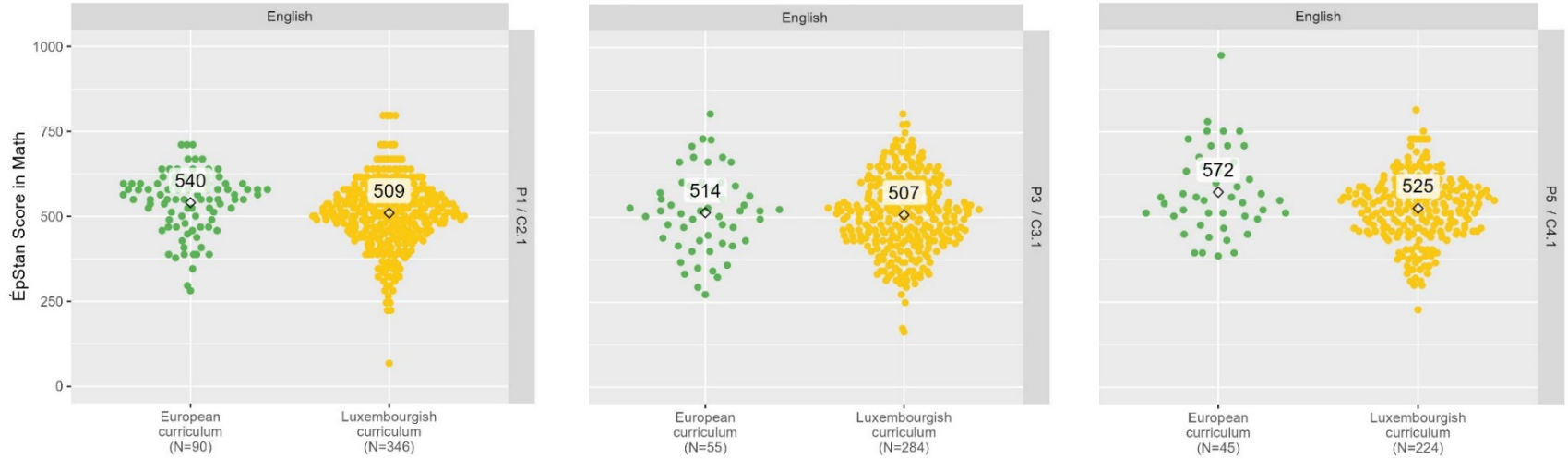


Figure IV.8 - Distribution of Achievement in Mathematics Separately by Curricula for English Speaking Students at Primary School Level (School Year 2022/23)



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4.4.2 MATHEMATICS ACHIEVEMENT AT SECONDARY SCHOOL LEVEL

With the ÉpStan being administered not only in primary school but also in G7 and G9 (schools that follow the Luxembourgish curriculum) and S1 and S3 (EPS), potential achievement differences in mathematics between students attending schools following the Luxembourgish curriculum and students in EPS can be investigated at secondary school level as well. In secondary schools following the Luxembourgish curriculum, students are allocated to three school tracks based on their abilities. The *Enseignement secondaire classique* (ESC) prepares students for higher academic studies. Within the *Enseignement secondaire général,* the *Voie d'orientation* (ESG) prepares students either for professional life or further academic studies, and the *Voie de préparation* (ESG-VP) prepares students for joining the ESG or for starting a vocational training (Lenz & Heinz, 2018). Considering that previous national and international studies (e.g., Boehm et al., 2016; Keller et al., 2014) have identified that extensive differences in academic achievement exist between school tracks, the present chapter will report findings for secondary school students attending schools following the Luxembourgish curriculum separately by school tracks. In contrast, secondary school students attending EPS are represented as a single group because EPS follow the principle of allocating all students to one common track until the end of lower secondary education (for more details see *Chapter I*). This difference needs to be taken into consideration when interpreting the findings at secondary school level (i.e., comparison of ability-based school tracks to a common school track in EPS), as it is likely to affect various aspects such as classroom management and teaching.

As described in *Chapter I* (see *Table I.3* for details), primary education in EPS spans from P1 to P5 and after five years of primary school, students are transitioning into secondary education. In S1, which marks the first year of lower secondary education in EPS, students with regular educational pathways (i.e., no grade repetition) should generally be 11 years of age. Considering that primary education in schools following the Luxembourgish curriculum spans over a duration of six years instead of five, students with regular educational pathways are generally 12 years old when transitioning into G7, which marks the first year of secondary education in schools following the Luxembourgish curriculum. As EPS students and students in schools following the Luxembourgish curriculum were assessed in their first year of secondary education, respectively (i.e., S1 or G7), it has to be taken into account that secondary school students in EPS might have one year of schooling less than their peers in schools following the Luxembourgish curriculum. *Figure IV.9*

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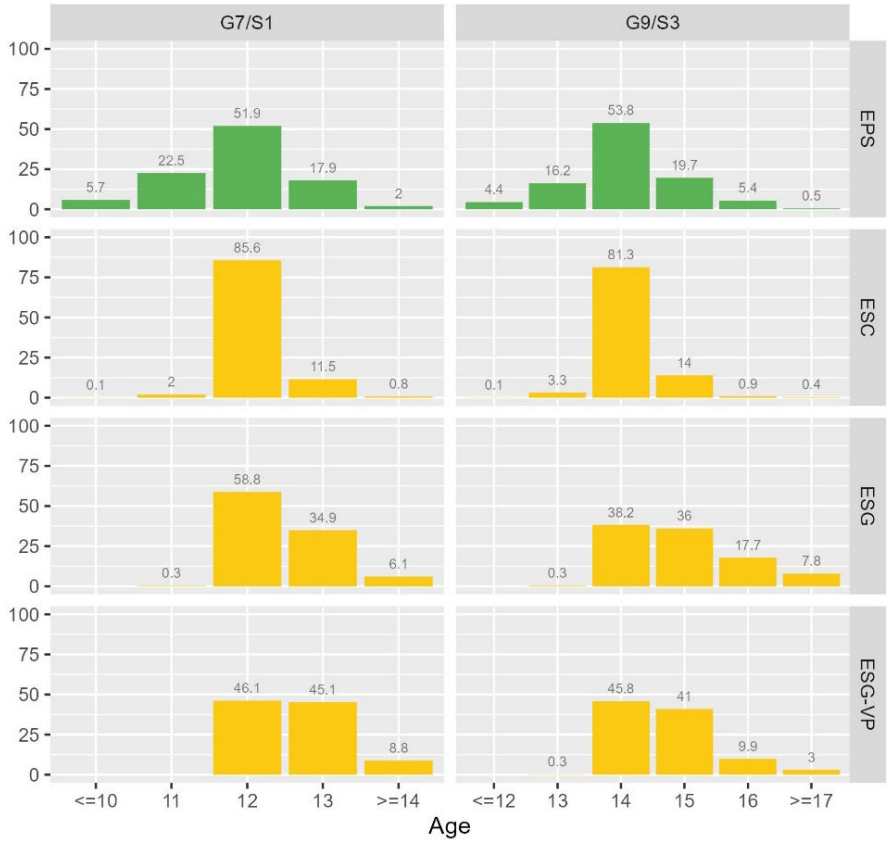
illustrates the age distribution of secondary school students in S1/G7 and S3/G9 separately by school curriculum for the ÉpStan 2022/23 cohort.

Figure IV.9 - Age Distribution of Secondary School Students in Percentages Separately by Curricula (School Year 2022/23)



Although students aged 11 and below can be identified in EPS in S1, *Figure IV.9* shows that approximately two thirds of the EPS student population are of a comparable age (i.e., 12 years and older) to students in schools following the Luxembourgish curriculum. This observation seems to indicate that the majority of EPS students at secondary school level have transitioned to the EPS system from primary schools following the Luxembourgish curriculum. This finding seems to be in line with the observed trajectories described in *Chapter III*.

Against the backdrop that two thirds of EPS students have only transitioned into the EPS system after having pursued primary education in school following the Luxembourgish curriculum and that the other third has had one year less of primary education than their peers in secondary schools following the Luxembourgish curriculum, the following results on achievement differences in secondary education should be interpreted with additional caution.

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Figure IV.10 - Distribution of Achievement in Mathematics Separately by Curricula at Secondary School Level (School Year 2022/23)

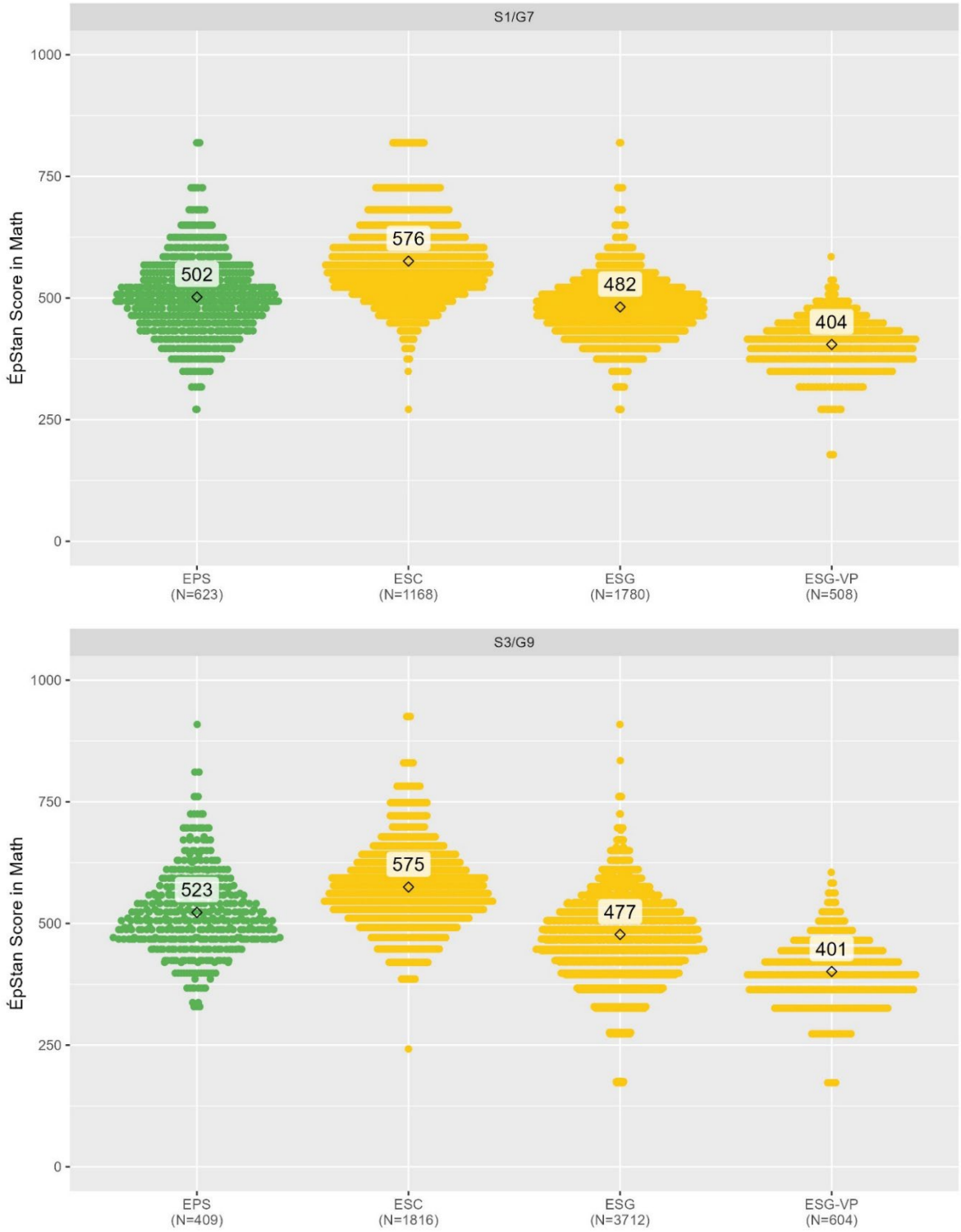

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Figure IV.10 shows the distribution of academic achievement in mathematics in secondary school separately by curriculum and school track for schools following the Luxembourgish curriculum. In line with the graphs presented in section *4.4.1* of the present chapter, *Figure IV.10* displays the ÉpStan score of each secondary school student by an individual dot and the density of all dots reflects the size of each group (i.e., the total *N* of students as indicated on the x-axis) for G7/S1 and G9/S3.

Looking at potential achievement differences in the subject of mathematics between different curricula and school tracks, secondary school students attending EPS in G7/S1 display higher mean values than their peers allocated to ESG or ESG-VP with a difference of 20 and 98 ÉpStan points, respectively. In comparison to ESC, EPS students display a mean value that is 74 ÉpStan points lower. Although EPS generally follow the common core approach (i.e., one single track), some EPS in Luxembourg also offer preparatory classes (*Voie de préparation,* see *Figure I.18* for details). In G7/S1, a total of *N* = 60 students attending such preparatory classes (EPS-VP) are included in the full EPS sample (*N* = 623 students). When excluding these students from the full sample, the mean ÉpStan score in mathematics increases from 502 to 511 for EPS. When looking at the 60 EPS-VP students separately, they display a mean ÉpStan score of 421 in mathematics, which remains above the mean for the ESG-VP (404) and below the mean for the ESG (482).

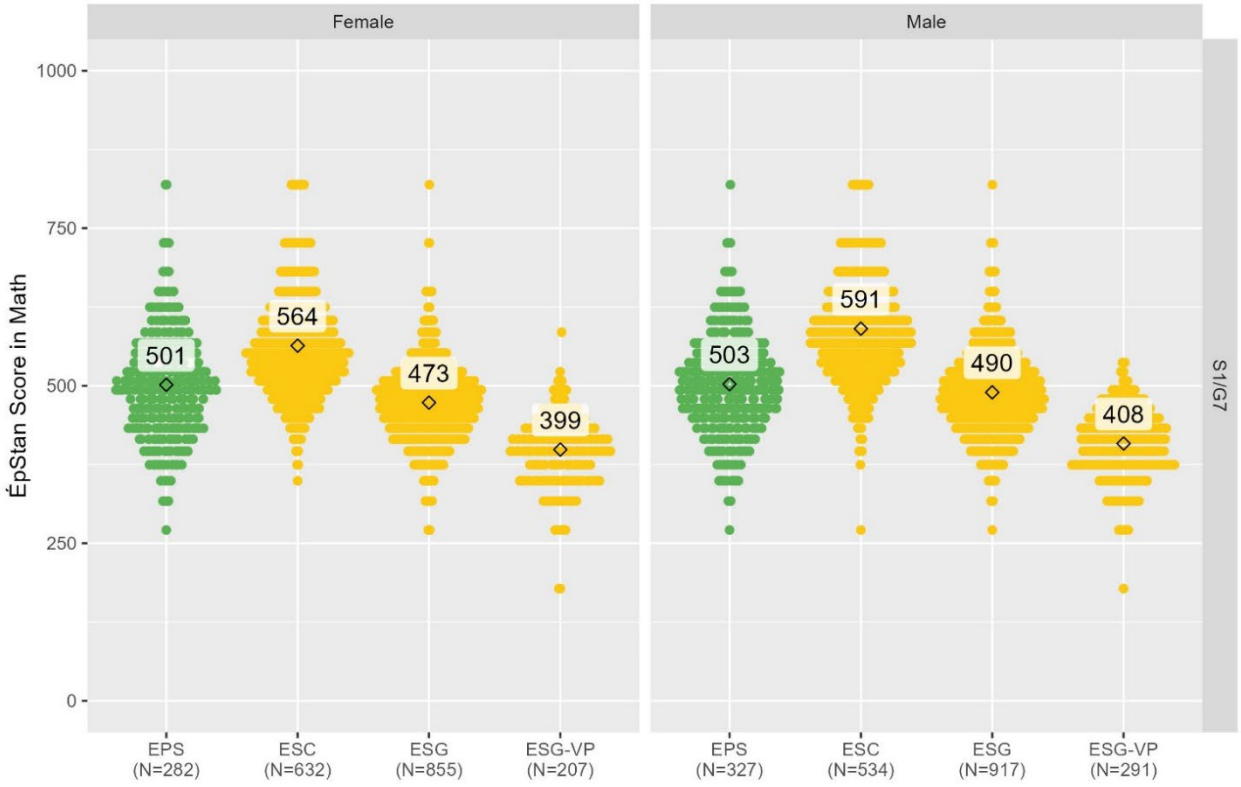
While following the same pattern in G9/S3, the mean differences in favor of students in EPS when compared to their peers in ESG (46 points) and ESG-VP (122 points) become more extensive. For ESC students in secondary schools that follow the Luxembourgish curriculum, the mean difference in comparison to EPS students can also be identified in G9/S3 (74 ÉpStan points higher), but is less extensive than in G7/S1 (52 ÉpStan points higher). With group differences ranging between 20 and 98 ÉpStan points in G7/S1 and between 46 and 122 ÉpStan points in G9/S3, the observed achievement differences in favor of secondary school students attending EPS go beyond the regularly observed fluctuations in the subject of mathematics and can thus be considered a first indication that EPS students are performing better than their peers allocated to the ESG and the ESG-VP in schools following the Luxembourgish curriculum. Their achievement in mathematics does however remain below the average performance of ESC students in both G7/S1 and G9/S3.

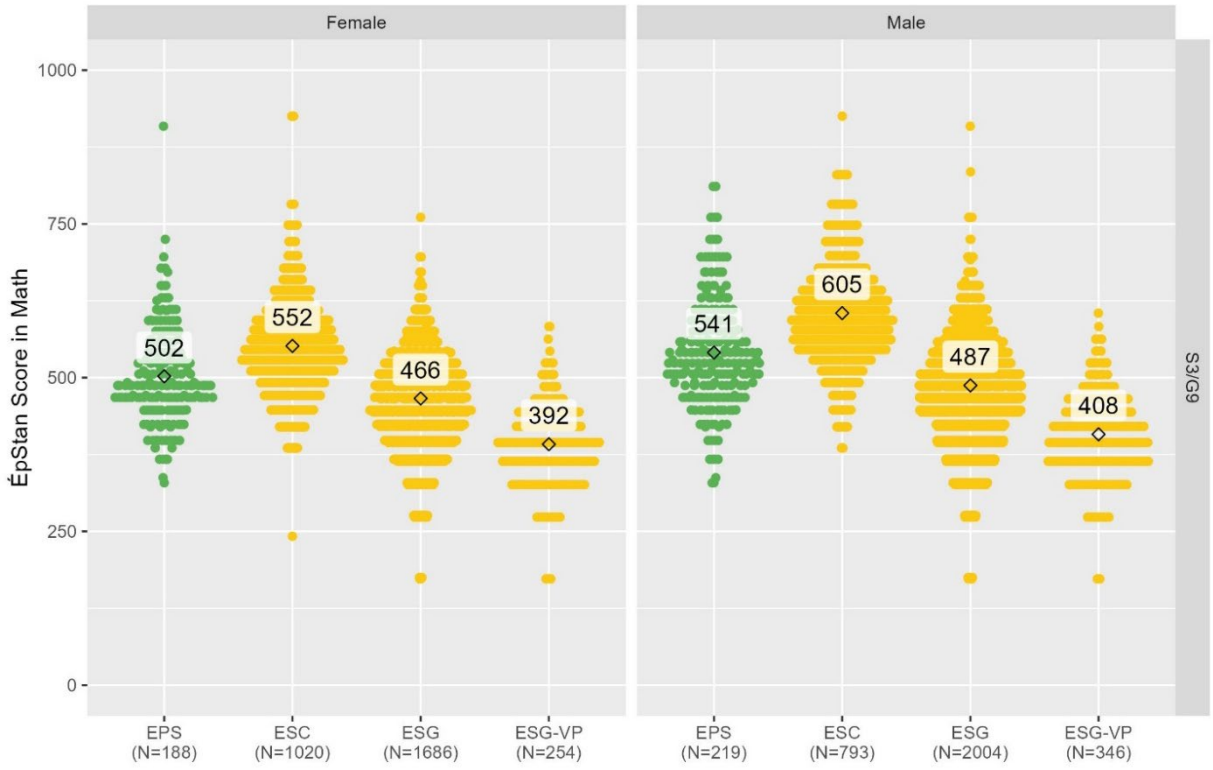
In line with the results for primary school students, these general patterns are now investigated relative to relevant background variables. Regarding **gender**, *Table IV.1* indicates that ≈ 46% of the students in EPS are female. Looking at schools following the Luxembourgish curriculum, female

students account for a higher share of the student population in ESC (ranging from 46.2 to 54.1%) than in ESG-VP (≈ 41%). *Figure IV.11* shows the distribution of achievement in mathematics for G7/S1 and G9/S3 separately by curriculum/school track and gender.

With regard to potential achievement differences in mathematics, *Figure IV.11* indicates that EPS students show higher mean values than students attending ESG (e.g., between 13 and 54 ÉpStan points) and ESG-VP (e.g., between 95 and 133 ÉpStan points) across both secondary school grades and irrespective of their gender. In comparison, both male and female ESC students display higher mean values than their EPS peers (e.g., between 50 and 88 ÉpStan points). Following the same pattern as in *Figure IV.10*, differences in favor of EPS students become more extensive in G9/S3, whereas the difference in favor of ESC students seems less pronounced in older students.

Figure IV.11 - Distribution of Achievement in Mathematics Separately by Curricula and Gender at Secondary School Level (School Year 2022/23)





These results indicate that both male and female students in EPS are on average performing better in the subject of mathematics than their peers allocated to ESG or ESG-VP in schools following the Luxembourgish curriculum, while performing lower than ESC students. Whereas no gender differences can be observed between male and female EPS students in G7/S1, the pattern of male students outperforming female students can once again be found in G9/S3 in both systems.

Regarding **SES**, *Table IV.1* indicates that the student population in ESC is characterized by a higher SES (HISEI mean of ≈ 55) across all grades than the student population in ESG (HISEI mean of ≈ 40) and ESG-VP (HISEI mean of ≈ 34). With a HISEI mean of ≈ 52, the student population in EPS seems to be closest to students attending ESC. The higher HISEI means in these two groups translate, as at the primary school level, into relatively small groups of students characterized by a low SES in EPS (e.g., 43 students in G9/S3) and in ESC (e.g., 96 students in G7/S1). In addition, the number of students with a high SES is low in ESG-VP (e.g., 11 students in G7/S1, see *Figure IV.12*). In light of the small student groups, the results on academic achievement differences in mathematics based on SES should again be interpreted with caution.

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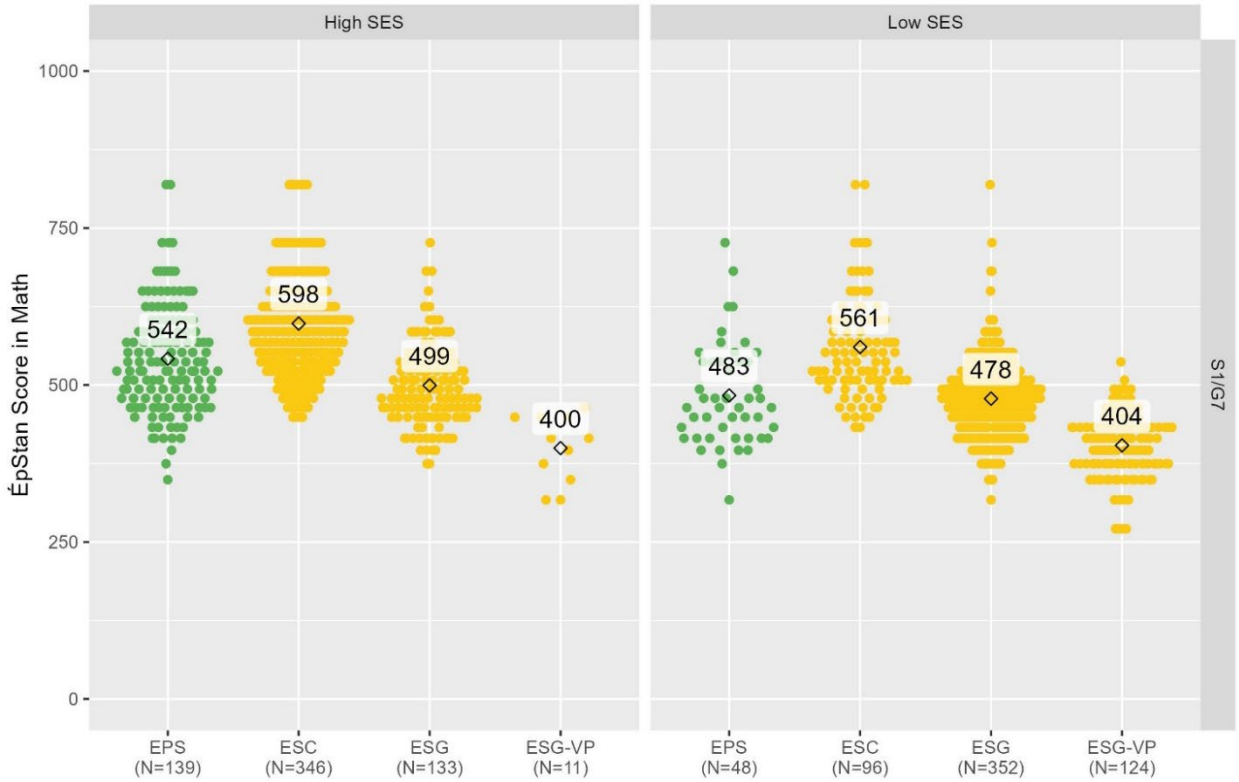
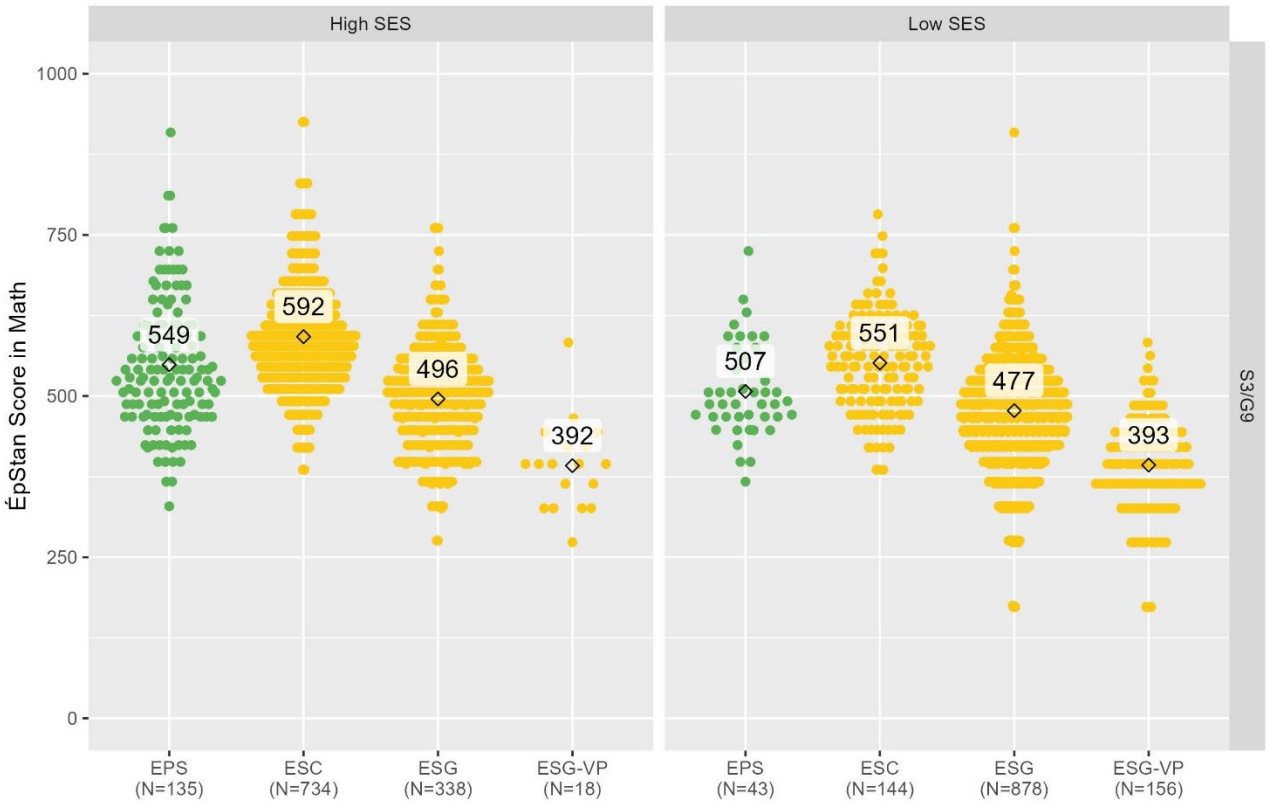
Figure IV.12 shows the distribution of academic achievement in mathematics for secondary school students separately by curriculum/school track and SES. Students attending EPS have lower mean values in mathematics than their peers attending ESC (e.g., between 43 and 78 ÉpStan points lower) and higher mean values than ESG (e.g., between 5 and 53 ÉpStan points higher) and ESG-VP students (e.g., between 79 and 157 ÉpStan points higher) across the two secondary school grades and this largely irrespective of their SES. In line with the findings for gender, differences in favor of students attending EPS become more extensive in G9/S3, whereas the group difference in favor of ESC students seems less pronounced in older students.

By going beyond regularly observed fluctuations of ± 10 ÉpStan points, the identified achievement differences in mathematics in favor of low SES students attending EPS can be understood as a first important indication that this student group is on average performing better than their peers in ESG and ESG-VP – school tracks to which students with a low SES are more frequently allocated to when attending schools following the Luxembourgish curriculum. This is most prominently visible in G9/S3. As visualized by the small number of individual points in *Figure IV.12*, it has, however, to be kept in mind that these findings are based on rather small *N*s.

Figure IV.12 - Distribution of Achievement in Mathematics Separately by Curricula and SES at Secondary School Level (School Year 2022/23)





Regarding **migration background**, *Table IV.1* indicates that the percentage of native students (i.e., students whose own country of birth and that of at least one of their parents is Luxembourg) is highest in ESC (ranging from 53.1 to 56.7%) and lowest in ESG-VP (≈ 20%). Ranging between 15.6% in G7/S1 and 21.0% in G9/S3, the share of native students in EPS seems closest to students attending ESG-VP in schools following the Luxembourgish curriculum. Similar to SES, this difference in student population translates into small groups of native students in EPS (e.g., 86 native students in G9/S3) and in ESG-VP (e.g., 115 native students in G9/S3, see *Figure IV.13*). In addition, it has to be presumed that students with a migration background in EPS are coming from other countries of origin (e.g., other non-EU countries) than their peers with a migration background in schools following the Luxembourgish curriculum (see also the relevant passage in the findings at the primary school level). Due to small student groups and potential differences in countries of origin between school curricula, the following results on achievement differences in the subject of mathematics based on migration background have to be interpreted with caution.

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Figure IV.13 - Distribution of Achievement in Mathematics Separately by Curricula and Migration Background at Secondary School Level (School Year 2022/23)

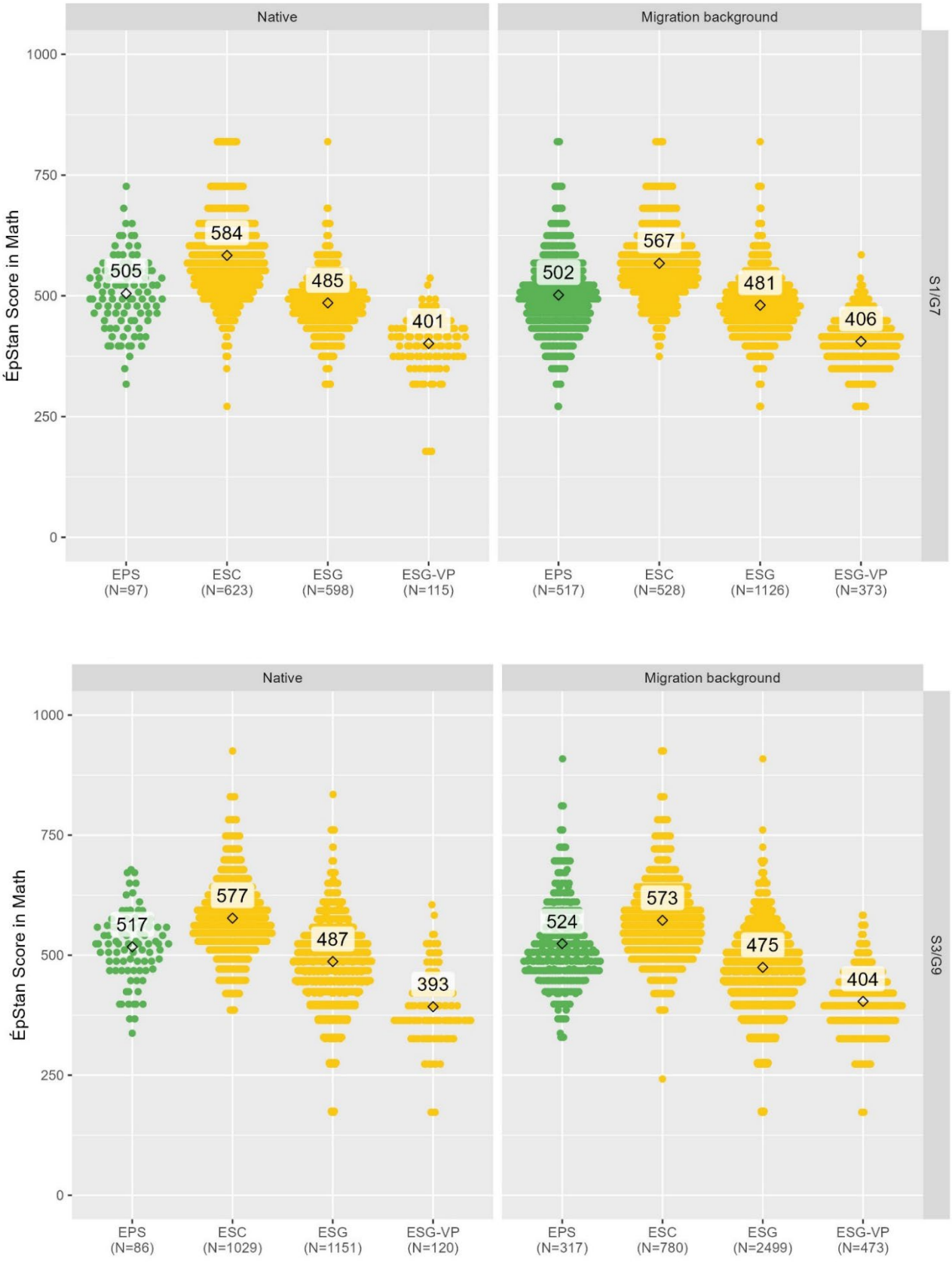

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Figure IV.13 illustrates the distribution of academic achievement in mathematics for secondary school students separately by curriculum/school track and migration background. In line with earlier findings on gender and SES, a consistent pattern can be seen among native students and students with a migration background attending EP. Both groups display lower mean values than their peers attending ESC (e.g., between 49 and 79 ÉpStan points lower), but higher mean values than their peers in ESG (e.g., between 20 and 49 ÉpStan points higher) and in ESG-VP (e.g., between 96 and 120 ÉpStan points higher) across both secondary school grades. In addition, the identified trend of less pronounced group differences in favor of ESC students when compared to EPS students and of more extensive group differences in favor of EPS students when compared to their peers in ESG and in ESG-VP in G9/S3 is also observable for migration background.

Looking at **language background** among secondary school students, *Table IV.1* illustrates that the share of students speaking Luxembourgish and/or German at home with at least one of their parents is highest in ESC (≈ 60%) and lowest in ESG-VP (≈ 22%). In EPS, the percentage of students speaking Luxembourgish and/or German at home is of 20.9% in G7/S1 and of 27.4% in G9/S3.

Figure IV.14 illustrates the distribution of achievement in mathematics for G7/S1 and G9/S3 separately by curriculum/school track for students speaking Luxembourgish and/or German at home. Following the same pattern that was observed for the previous comparisons at secondary school level, students with a Luxembourgish and/or German language background attending EPS show higher mean values than peers with the same language background attending ESG (between 25 and 36 ÉpStan points higher) and ESG-VP (between 109 and 122 ÉpStan points higher), while staying below the mean values of ESC students (between 55 and 74 ÉpStan points lower).

Regarding French, *Table IV.1* shows that ≈ 35% of secondary school students in EPS are speaking French at home. In schools following the Luxembourgish curriculum, the share of students with a French language background is lower in each track ranging from ≈ 11% in ESG-VP to ≈ 22% in ESC. These observed differences in the characteristics of the student population result in relatively small *N*s of French speaking students in ESG-VP (e.g., 54 students in G7/S1).

As can be seen in *Figure IV.15*, findings for students with a French language background follow the same pattern previously observed for students speaking Luxembourgish and/or German at home. EPS students display lower mean values than their peers attending ESC (between 53 and 73 ÉpStan points lower) and higher mean values than their peers in ESG (between 18 and 52 ÉpStan points higher) and in ESG-VP (between 96 and 128 ÉpStan points higher) across both secondary school grades.

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Figure IV.14 - Distribution of Achievement in Mathematics Separately by Curricula for Luxembourgish/German Speaking Students at Secondary School Level (School Year 2022/23)

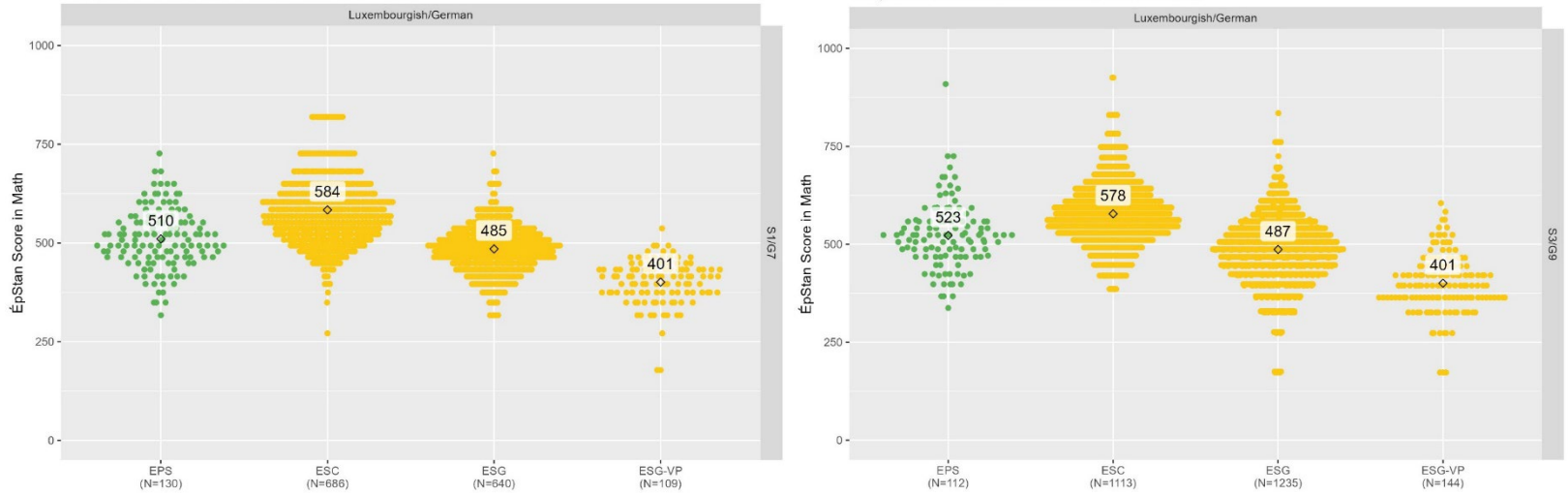
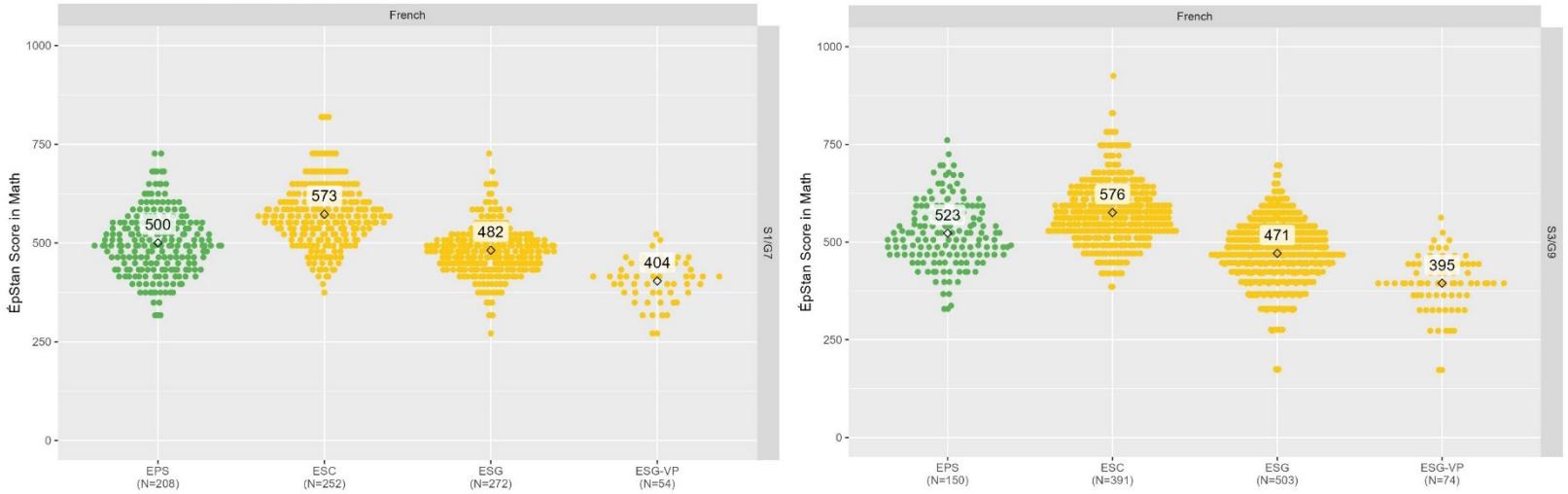


Figure IV.15 - Distribution of Achievement in Mathematics Separately by Curricula for French Speaking Students at Secondary School Level (School Year 2022/23)



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Looking at secondary school students that speak Portuguese at home with at least one of their parents, *Table IV.1* shows that ≈ 19% of the students in EPS have a Portuguese language background. In schools following the Luxembourgish curriculum, the share of Portuguese speaking students is highest in ESG-VP (≈ 44%) and lowest in ESC (≈ 11%).

Figure IV.16 illustrates the distribution of achievement in mathematics for secondary school students separately by curriculum for Portuguese speaking students. While a consistent pattern has been observed thus far for all other student background variables - EPS students having higher mean values than their peers in ESG and ESG-VP - this pattern has not been observed for Portuguese speaking students in G7/S1. With ESG students speaking Portuguese at home displaying a mean value that is 8 ÉpStan points higher than the mean value of their peers in EPS, and thus below regularly observed fluctuations of ± 10 ÉpStan points, it appears that Portuguese speaking students in EPS do not differ considerably from their peers in ESG.

In G9/S3 however, the pattern that has been observed in all other group comparisons at the secondary school level can once again be found for Portuguese speaking students in EPS. They display lower mean values than their peers in ESC (53 ÉpStan points lower) and higher mean values than those in ESG (28 ÉpStan points higher) and ESG-VP (98 ÉpStan points higher), which indicates that students with a Portuguese language background attending EPS are on average performing better in the subject of mathematics than their peers allocated to the ESG or ESG-VP, while staying below the performance of ESC students.

For secondary school students speaking English at home with at least one of their parents, *Table IV.1* indicates that 12% of the student population in EPS have an English language background. With percentages ranging from 3.0% in ESC to 1.5% in ESG-VP, the share of students speaking English at home is considerably smaller in schools following the Luxembourgish curriculum, which in turn results in very small *N*s of English speaking students for all school tracks (e.g., 9 students in ESG-VP in G9/S3, see *Figure IV.17*). Thus, the following findings should be interpreted with caution.

Figure IV.17 illustrates the distribution of achievement in mathematics for G7/S1 and G9/S3 separately by curriculum/school track for students speaking English at home. In line with the findings for students speaking Portuguese at home, the observed pattern was not consistent across the two secondary school grades. With a difference of 1 ÉpStan point between English speaking students in EPS and their peers with an English language background in ESG, it appears that students speaking English at home do not differ from their peers in ESG in G7/S1 when attending EPS. In G9/S3, English speaking students display lower mean values than students in ESC (64 ÉpStan points) and higher mean values than their peers in ESG (24 ÉpStan points) and ESG-VP (102 ÉpStan points).

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Figure IV.16 - Distribution of Achievement in Mathematics Separately by Curricula for Portuguese Speaking Students at Secondary School Level (School Year 2022/23)

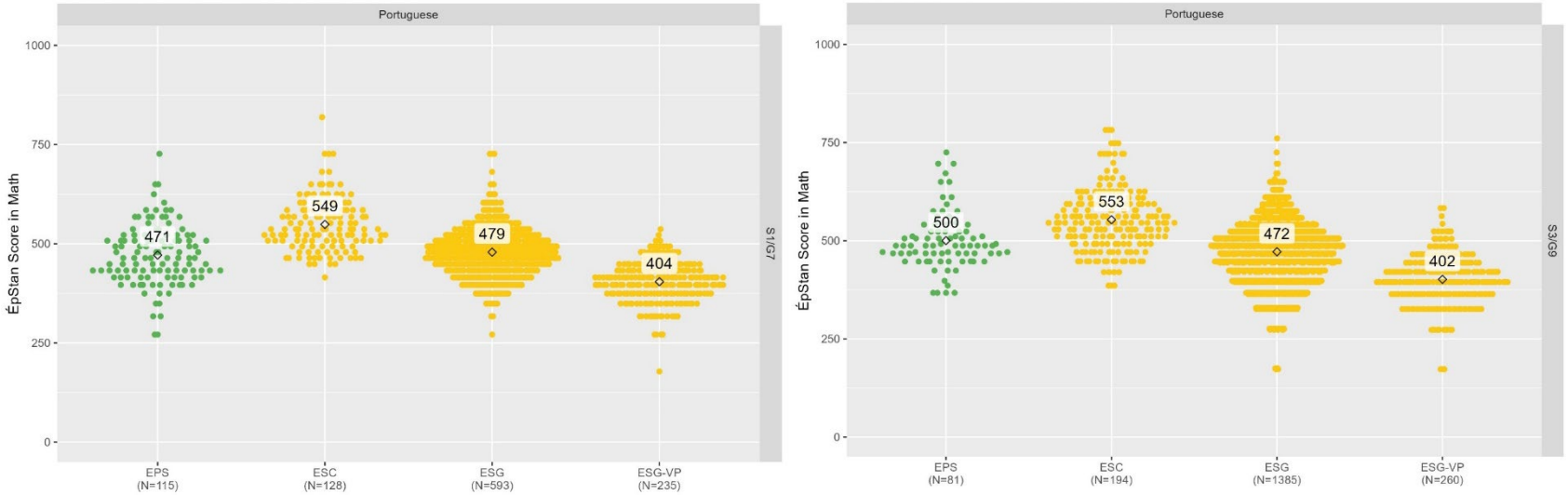
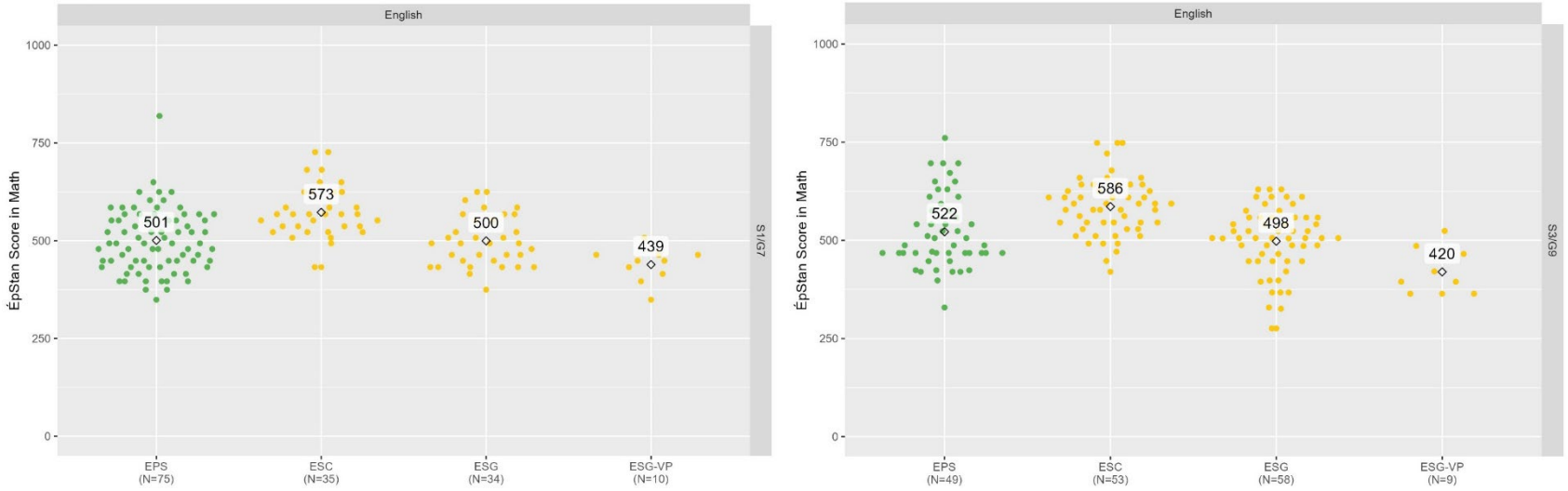


Figure IV.17 - Distribution of Achievement in Mathematics Separately by Curricula for English Speaking Students at Secondary School Level (School Year 2022/23)



4.5 ADDITIONAL ANALYSES ON ACADEMIC MOTIVATION

Schooling is not only about the acquisition of academic skills. Schools are also places where children and adolescents should feel safe and cared for, and where they can develop a positive attitude towards themselves as well as towards learning and personal development more generally. Hence, schools provide a critical environment in supporting students to develop a sense of control and of purpose in their lives, enabling them to develop high future aspirations and thus, preparing them for a culture of lifelong learning (Eccles & Wigfield, 2020; Ryan & Deci, 2020). There is a strong consensus that academic motivation and academic achievement go hand in hand (see Hornung et al., 2014; Wollschläger et al., 2022, for data concerning Luxembourg). Importantly, both higher academic achievement has been shown to depend on higher academic motivation, and inversely, higher achievement has been shown to predict higher subsequent motivation in students (Niepel et al., 2014; Schiefele et al., 2016; Wolff et al., 2021).

Therefore, three motivational variables, **interest** in mathematics, students' **academic self-concept** regarding mathematics (i.e., students' sense of their proficiency in mathematics), and students' **anxiety** regarding mathematics have also been considered in the comparison between students attending schools following the Luxembourgish curriculum and their peers in EPS (see Ugen et al., 2015, for a methodological background on these self-report measures within the Luxembourg School Monitoring Programme "*Épreuves Standardisées*" - ÉpStan).

The analyses were carried out following the same logic as for achievement in mathematics. However, by and large, no coherent group differences emerged that would have justified a detailed description and discussion of these initial findings. That is, differences between EPS students and their peers attending schools following the Luxembourgish curriculum have either been small (e.g., < 0.25 for all comparisons at primary and secondary level for academic interest in mathematics, on a scale ranging from 1 to 4 with a standard deviation between 0.75 and 1.21 for all groups, which translates to small effect sizes d < .31 for all comparisons, see Cohen, 1988) and/or did not yield a coherent pattern across grades (e.g., a slightly higher value for academic self-concept in mathematics may have been observed for EPS in C3.1/P3, but this effect disappeared in C4.1/P5). This was the case for primary as well as for secondary education.

Similarly, when taking student background characteristics into account, there was no clear indication that typically disadvantaged groups in the schooling context (e.g., low SES students) differed in their interest or academic self-concept in mathematics when attending EPS compared to a school following the Luxembourgish curriculum.

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4.6 SUMMARY AND DISCUSSION OF RESULTS

By integrating EPS into the Luxembourg School Monitoring Programme "*Épreuves Standardisées*" (ÉpStan), the full-cohort data including primary and secondary school students collected in autumn of the school year 2022/23 were analysed in an attempt to provide initial answers to the question whether the diversification of the school offer contributes to reducing previously observed inequalities in Luxembourg's education system. In the following, the results for primary school are summarized and discussed in light of important methodological limitations that make it difficult to draw a final conclusion. In a second step, the observations made at secondary school level will be put into context in regard to a number of more specific methodological challenges, which further limit a comparison of EPS and schools following the Luxembourgish curriculum at secondary school level.

4.6.1 SUMMARY AND DISCUSSION OF RESULTS AT PRIMARY SCHOOL LEVEL

With regard to students' academic achievement in mathematics at primary school level, students in EPS are on average performing better than students in schools following the Luxembourgish curriculum across all three grades that were assessed within the ÉpStan, and this is particularly so in higher grades (e.g., C4.1/P5). When looking at students with specific background variables, both male and female students in EPS display higher mean values in the subject of mathematics relative to their peers in schools following the Luxembourgish curriculum. Regarding gender differences within systems, male students were found to outperform their female peers both in EPS and in schools following the Luxembourgish curriculum. While high SES students seem to perform equally well in mathematics irrespective of their school's curriculum, these results offer a preliminary indication that students with a low SES attending EPS are on average showing higher achievement scores than their low SES peers in schools following the Luxembourgish curriculum. Looking at migration background, no consistent pattern was identified for native students across all three grades. For students with a migration background, however, higher mean values were identified for students attending EPS which can be understood as a first indication that EPS students with a migration background perform better in mathematics than their peers with a migration background in schools following the Luxembourgish curriculum. In light of the previously described observation that students having a migration background in EPS have a considerably higher SES than their peers with a migration background in schools following the Luxembourgish curriculum, it cannot however be concluded that students with a migration background, irrespective of type or origin, perform better at EPS. Regarding students' language background, French speaking students were identified as the only language group showing a consistent pattern across all three grades, with students attending EPS showing higher mean values in mathematics than their French speaking peers in schools following the Luxembourgish curriculum. Whereas Luxembourgish and/or German speaking students in EPS display lower mean values than their peers in schools following the Luxembourgish curriculum in both C2.1/P1 and C3.1/P3, the trend

in C4/P5 is in favor of students attending EPS. Similarly, EPS students with a Portuguese language background are on average showing better achievement scores in mathematics than their Portuguese speaking peers in schools following the Luxembourgish curriculum in C2.1/P1 and C4.1/P5, although the difference in C3.1/P1 fails to go beyond regularly observed fluctuations. The same pattern has been observed for English speaking students. Taken together, the results found at primary school level might be considered as a first indication of achievement differences in mathematics that are in favor of EPS students when compared to students in schools following the Luxembourgish curriculum.

As explained in more detail in *Chapter I*, EPS have been established in order to encounter the growing diversity of the student population in Luxembourg, especially in light of their diverse linguistic backgrounds. Based on the assumption that the opportunity to choose a language section and thereby a main language of instruction (i.e., L1; German, French, or English) at EPS allows students to pursue their education in the language they speak at home or in a related language (e.g., another Romance language), the better linguistic fit offered by EPS could contribute to reducing educational inequalities that have been identified persistently in schools following the Luxembourgish curriculum (e.g., low SES students and Portuguese speaking students being at a disadvantage in the educational system; Boehm et al., 2016; Hadjar et al., 2018; Hornung et al., 2021; Sonnleitner et al., 2021).

The present chapter's descriptive data analysis does not allow the drawing of a final conclusion regarding which specific aspect of EPS (e.g., student population that differs considerably to the one of schools following the Luxembourgish curriculum, see *Table IV.1* for details, the assumed better linguistic fit offered by EPS) decisively contributes in explaining the observed achievement differences. However, the findings that low SES students, students with a migration background, or Portuguese speaking students attending EPS are on average performing better than their peers with the same background characteristics in schools following the Luxembourgish curriculum could potentially be in line with the presumption that a better linguistic fit in EPS contributes to reducing educational inequalities. The observation that achievement differences in mathematics appear to be more pronounced in C4.1/P5 than in the lower primary school grades, both in general and when comparing students based on their background characteristics (e.g., results for students based on their language background as illustrated in *Figures IV.5* to *IV.8*), seems especially noteworthy in this context. With regard to academic achievement in mathematics, research on schools following the Luxembourgish curriculum found achievement differences to be significantly increasing over time with, for example, a higher share of Portuguese speaking students (60 to 66%) failing to meet the expected achievement standards in G9 than students speaking an instruction language at home (i.e., Luxembourgish, German, or French; Sonnleitner et al., 2021). This observation holds against existing potential in the earlier grades (i.e., C3.1), where fewer (26 to 30%) Portuguese speaking students fail to achieve the

required standards in mathematics (Sonnleitner et al., 2021). Sonnleitner et al. (2021) argue that one possible explanation for this observation might be due to the fact that Portuguese speaking students are disadvantaged in the education system because the language of instruction in mathematics is different from their language spoken at home, both in primary (i.e., German) and secondary education (i.e., French), and that the multilingual nature of Luxembourg's education system presents a considerable challenge for a growing number of students. Against this backdrop, and the research finding that for primary school students in Luxembourg, achievement in mathematics is partially dependent on language skills in the language of instruction (Greisen et al., 2021); the results presented above suggesting that achievement differences in favor of EPS students are more prominent in later school years, can be potentially explained by the fact that mathematical instruction is becoming both increasingly complex and thereby more language-bound in higher grades. The expected better linguistic fit offered by EPS (i.e., a Portuguese speaking student in a French language section, in which the language of instruction is more closely related to the language spoken at home) might thus come more strongly into play in later primary school grades (i.e., C4.1/P5). As mentioned above, the assumed better linguistic fit offered by EPS is however only one potential explanation for the achievement differences observed in favor of EPS students when compared to their peers in schools following the Luxembourgish curriculum and should therefore not be considered as a final conclusion (see limitation 2 on potential other explanations for the present chapter's findings further below).

Although the findings at primary school level can be considered as a first tentative indication that students with a low SES or students speaking another language than Luxembourgish and/or German at home attending EPS perform on average better in mathematics than their respective peers in schools following the Luxembourgish curriculum, they have to be interpreted with caution due to a number of important methodological limitations, that are described in more detail in the following.

(1) Very small groups of students with specific background characteristics: As visualized in *Table IV.1*, the EPS student population differs considerably from the student population in schools following the Luxembourgish curriculum, which translates into very small groups of students characterized, for example, by a low SES (e.g., 14 students in C4.1/P5) or a specific language background (e.g., 23 students speaking Portuguese at home in C4.1/P5) in EPS. As illustrated by the example that excluding one Portuguese speaking student with a particularly low ÉpStan value from the sample changes the observed pattern in C3.1/P3 (see p. 120 for a detailed description), the results of the present chapter should be interpreted with caution, especially in the light of widespread distributions (e.g., distributions including outliers with particularly high or low ÉpStan scores). In addition to limiting the interpretation of the presented results, the small *N*s in EPS did not allow to investigate students based on the language section they attend or on a combination of background variables that are disadvantageous in the context of schooling, although such students (e.g., low SES students speaking

Portuguese at home) are particularly at risk to struggle in schools following the Luxembourgish curriculum.

(2) Current data analysis does not allow to identify one specific explanation for the observed results: Whereas the assumed better linguistic fit offered by EPS can be considered as a potential explanation for the achievement difference between students in EPS and their peers in schools following the Luxembourgish curriculum, it has to be noted that the linguistic fit has not been operationalised directly (e.g., via the means of a student questionnaire or via an experimental manipulation) in the scope of the ÉpStan. As indicated in *Table IV.1*, the student population in EPS is considerably different from the one in schools following the Luxemburgish curriculum, for example, the share of students with a low SES or with a specific language background (e.g., Portuguese). This different student population could be another explanation for the achievement differences observed in favor of EPS students that would be in line with research findings illustrating that a higher SES at school level relates to individual student achievement (e.g., Caldas & Bankston, 1997; Opdenakker & Damme, 2001; Sykes & Kuyper, 2013). In a study that investigated the effects of classroom composition on academic achievement, Hornstra et al. (2015) discussed that teachers might for example lower their instructional level in classes with a higher share of low SES students and that low SES students might generally be more sensitive to contextual effects of their classroom (e.g., class size, didactical approaches, instruction quality) than their high SES peers, which might in turn result in achievement differences. As it can be assumed that EPS and schools following the Luxembourgish curriculum differ from each other in several other characteristics of the learning environment , the better linguistic fit in EPS has to be considered as only one potential aspect that might contribute to the observed achievement differences, while other explanations cannot be ruled out. Further studies would be needed to identify which characteristics of the learning environment are contributing to the achievement differences in mathematics (e.g., via classroom observations or self-reported student and teacher questionnaires). In this context (see *4.5*), it is worth noting that students' mathematical self-concept, their interest in mathematics and their anxiety in mathematics did not show a coherent pattern that fits the pattern found for mathematics achievement, thereby suggesting that overall EPS and schools following the Luxembourgish curriculum cater to students' needs equally well.

(3) Analyses were not conducted separately by language section in EPS: In terms of a better linguistic fit as a potential explanation for the observed differences between EPS students and their peers in schools following the Luxemburgish curriculum (e.g., possibility to pursue their education in their native or a related language), it could be pointed out that French speaking EPS students were identified as the only language group performing consistently better than their French speaking peers in schools following Luxemburgish curriculum. Since administrative data from past cohorts indicates that the vast majority of French speaking students attend the French language section in EPS (i.e., 88.1% in the

school year 2021/22, see *Chapter I*), this finding seems to be in line with the previously introduced linguistic fit explanation. However, due to the small group sizes in EPS, an analysis done separately by language section, comparing for example, French speaking students that attend the French versus English language section, was not yet feasible, but should be investigated in future studies.

(4) Definition of language groups: For the present analysis, language groups have been defined based on the respective language students speak at home with at least one of their parents (see *4.3.2*). This approach made the analysis feasible but resulted in a rather high heterogeneity within the respective language groups. For example, both monolingual and bilingual students are confounded in each language group, which is a characteristic that has been found to be linked to achievement (Martini et al., 2021). Future research, based on larger group sizes, should therefore apply a more fine-grained analysis on such linguistic features, for example, by comparing bilingual and monolingual Portuguese speaking students attending EPS.

(5) ÉpStan achievement tasks were developed based on education standards of schools following the Luxembourgish curriculum: In light of the fact that all tasks presented in the ÉpStan were developed based on education standards defined by the Ministry of Education, Children and Youth for primary and secondary schools following the Luxembourgish curriculum (see *4.3.2* for details), it cannot be excluded that achievement in mathematics was underestimated for students in EPS. Although a theoretical comparison of the mathematics curricula implemented in the two school offers indicated that they seem to be comparable regarding domains (see *4.3.2* for details), a more in-depth analysis of the respective curricula would have to be done in future studies (e.g., specific skills expected to be acquired for each domain) to allow for a more reliable conclusion about the observed achievement differences in mathematics between EPS and schools following the Luxembourgish curriculum.

(6) Migration background having a potentially different meaning in EPS: Besides small student groups for some background characteristics in EPS, the findings indicating that students having a migration background perform better in mathematics when attending EPS than their peers with a migration background in schools following the Luxembourgish curriculum should be interpreted with particular caution. As illustrated in *Figure IV.11* in *Chapter I* for a student's nationality, students with a migration background attending EPS are likely to have other countries of origin (e.g., other non-EU countries) than their peers having a migration background in schools following the Luxembourgish curriculum (e.g., Portugal). Considering that students with a migration background potentially represent very different socioeconomic and sociocultural groups at EPS than in schools following the Luxembourgish curriculum, it cannot be concluded that students of all sorts of migration backgrounds perform better in mathematics when attending EPS.

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4.6.2 SUMMARY AND DISCUSSION OF RESULTS AT SECONDARY SCHOOL LEVEL

At secondary school level, EPS students are on average performing better than students allocated to ESG or ESG-VP, while showing lower mean values in mathematics than ESC students in both G7/S1 and G9/S3. This pattern was found irrespective of the student's gender, SES, and migration background. Whereas it also held true for Luxembourgish/German and French speaking students, Portuguese and English speaking students attending EPS did not differ considerably from ESG students in G7/S1 in their mathematics achievement. In G9/S3, the pattern observed for all other group comparisons could also be found for Portuguese and English speaking students allowing the tentative conclusion that EPS students appear to perform better in mathematics than ESG and ESG-VP students and less well than ESC students irrespective of student background characteristics. In line with findings at primary school level, differences in favor of EPS students when compared to their peers in ESG and ESG-VP become more extensive in higher grades (i.e., S3/G9), whereas the group differences in favor of ESC students compared to students in EPS appear to grow less extensive.

The academic achievement differences in mathematics in favor of students attending EPS relative to their peers in the ESG or ESG-VP in schools following the Luxembourgish curriculum appear to be in line with the presumption that the better linguistic fit in EPS contributes to reducing educational inequalities. Inequalities that have been identified for low SES students and/or students speaking Portuguese at home, student groups that are more likely to be allocated to ESG or ESG-VP when attending a school following the Luxembourgish curriculum (see *Table IV.1* for differences in the school tracks' student populations). In addition, the language of instruction used in the subject of mathematics changes from German at primary school level to French at secondary school level for schools following the Luxembourgish curriculum, while the language of instruction remains the same in EPS (i.e., language of the language section). Therefore, the observed achievement differences in favor of EPS students could also be explained by a consistency in the use of the instruction language that does not result in additional challenges related to the change taking place in secondary schools following the Luxembourgish curriculum. As described in more detail for the findings at primary school level, the suspected better linguistic fit offered by EPS should only be considered as one potential explanation for the achievement differences in favor of EPS students when compared to their ESG and ESG-VP peers in schools following the Luxembourgish curriculum.

The results at secondary school level should be interpreted with even higher caution than those at primary school level. In addition to all the limitations described for the primary school level (see *4.6.1* for details), a number of important methodological limitations that are specific to the comparison of EPS and schools following the Luxembourgish curriculum at secondary school level further limit the statistical reliability of the results as described in the following:

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(1) Students with heterogenous trajectories in EPS at secondary school level: As described in more detail in *4.4.2*, the secondary school population in EPS consists of students with different educational trajectories. Whereas about one third of the students in S1 are 11 years or slightly younger, two thirds of them are at least 12 years old. With this being an indication that the majority of secondary school students in EPS transitioned from primary schools that followed the Luxembourgish curriculum into S1 (see *Chapter III* for details), it can be concluded that secondary school students in EPS have heterogenous trajectories that make an interpretation of the results difficult. Considering that the ÉpStan are taking place in autumn of each school year, two thirds of the students are labelled as EPS students although they have entered the system very recently. In addition, the ÉpStan administered to students in S1 and G7 are aiming at assessing whether the expected education standards of the previous cycle (i.e., C4) have been acquired by the students. It thus seems questionable to interpret the observed academic achievement differences in G7/S1 in light of a potentially better linguistic fit in EPS due to the high share of students that have transitioned into S1 from primary schools following the Luxembourgish curriculum. In order to draw methodologically sound conclusions, the student population at secondary school level should ideally be split based on trajectories with students having pursued their whole education in EPS being of special interest. Regarding the small number of EPS students at this moment in time, such an analysis is however not yet feasible. In future studies, it should be taken into considering how long students have been attending schools of the respective offer in order to draw methodologically more sound conclusions. Given this very important restriction, results at secondary school level should be interpreted with high caution and considered as tentative upon which no implications should be deduced.

(2) Comparison of an ability-based tracked school system to the comprehensive school system in EPS: A further limitation that is specific to the secondary school level is the fact that the ability-based tracked school system of schools following the Luxembourgish curriculum was compared to the comprehensive school system offered by EPS, in which all students are attending a common track in lower secondary education irrespective of their academic abilities (see *4.5.2* and *Chapter I* for details). In light of findings from previous national and international studies (e.g., Boehm et al., 2016; Keller et al., 2014), that have identified extensive differences in academic achievement between school tracks, and the more general research finding that ability-based tracking relates to both student' academic achievement and their learning motivation (e.g., Guill et al., 2017; Hallinan, 2003; Ireson & Hallam, 2009), the findings at secondary school level should be interpreted with additional caution. Although the test versions are statistically comparable, the concept of early tracking (i.e., schools following the Luxembourgish curriculum) stands in opposition to an educational system with later tracking (i.e., EPS). Therefore the secondary school students in schools following the Luxembourgish curriculum are, within the respective track they have been allocated to, more homogenous in terms of academic performance when compared to EPS secondary school students. As the highest school

track in schools following the Luxembourgish curriculum (ESC) is composed of students with high academic abilities, it does not seem surprising that ESC students are on average performing better than EPS students attending a common track irrespective of their academic abilities. In future studies, it would be of interest to compare high to low performing students irrespective of the track they have been allocated to in order to generate a better understanding of differences between an ability-based tracked school system to a more comprehensive school system.

(3) Representativeness of G7 data for schools following the Luxembourgish curriculum: Considering that G7 has been integrated into the ÉpStan at a later point than the other school grades (i.e., in the school year 2018/19) and that the assessment is solely tablet-based in G7 whereas it is tablet- and computer-based in G9, only about half of all G7 students in Luxembourg currently participate in the ÉpStan, which results in the fact that the data set is not (yet) fully representative for students attending schools following the Luxembourgish curriculum. This is mirrored in the smaller number of G7 students (*N* = 3.528 split across the three school tracks) when compared to the total number of G9 students (*N* = 6.154 split across the three school tracks; see *Table IV.1*).

(4) Representativeness of S3 data for EPS: In contrast to the higher amount of G9 students participating in the ÉpStan when compared to G7 students in schools following the Luxembourgish curriculum, the opposite holds true for EPS students. Whereas *N* = 623 students from six EPS participated in the ÉpStan at grade level S1, *N* = 409 students from four EPS participated at grade level S3. Due to the recent establishment of some EPS, they have not yet fully implemented the higher secondary school grades in their structures, which is why S3 data for EPS is the only one that allows for tentative conclusions.

When taking all these limitations together, it has to be underlined that the results for the secondary school level presented in this chapter are to be considered as a very tentative. The first indication that secondary school students in EPS perform better than their ESG and ESG-VP peers and lower than their ESC peers needs an in-depth verification using more statistically robust data that will hopefully become available in the future (e.g., increasing number of students attending EPS from P1 to S3, higher school grades established in more EPS).

4.7 CONCLUSION AND OUTLOOK

Before presenting a very tentative conclusion, it has to be underlined that the present chapter's data analysis does not allow the drawing of a final evaluation on which aspect of EPS decisively contributes to explaining the observed achievement differences in mathematics in favor of EPS students. In light of the findings that students that are considered disadvantaged in the context of schooling (e.g., low SES students, students speaking a language other than Luxembourgish and/or German at home) attending EPS have better academic achievement scores in mathematics when compared to their respective peers in schools following the Luxembourgish curriculum, it can be tentatively suggested

that the establishment of EPS might contribute to reducing educational inequalities in Luxembourg's education system, which can potentially be explained by the better linguistic fit that EPS offer to an increasingly diverse student pupation (i.e., choice of language section).

Considering all the limitations surrounding the interpretation of the present chapter's results (see *4.6.1* and *4.6.2* for details), it should be noted, that a verification of these preliminary results using more statistically robust (e.g., bigger student groups) and complete (e.g., number of years spent in the respective system) data is needed. In addition, the continuous monitoring of EPS within the ÉpStan will allow a more in-depth analysis of potential academic achievement differences in the future (e.g., investigation of longitudinal data, propensity score matching of specific EPS students with comparable students in schools following the Luxembourgish curriculum, investigation of the achievement gap within school curricula as an indicator for inclusiveness). By aiming at operationalising the presumed better linguistic fit (e.g., via students and/or parent questionnaires), future research studies would furthermore allow the analysis of which characteristics of EPS best explain the observed achievement differences.

Should future studies prove that the presumed better linguistic fit contributes to reducing the existing educational inequalities, it would be advisable to encourage EPS to target disadvantaged student groups more directly to increase the visibility of their school offer among students who could benefit considerably from attending EPS. Currently they account for only a very small share of the EPS student population (e.g., 14 low SES students in P5, or 23 Portuguese speaking students in P5). Besides raising the target population's awareness towards EPS, increasing the linguistic offer within schools following the Luxembourgish curriculum could also contribute to reducing existing inequalities, especially when taking into consideration that the six established EPS can only accept a limited number of students (e.g., availability of places) and that they are further away for many students than schools following the Luxembourgish curriculum (e.g., higher travel distances, see *Table IV.6* in *Chapter I*). In this context, the recent pilot project that was introduced in four primary schools to give C2.1 students the possibility of learning to read and write in French (MENJE, 2022) is of particular interest and its scientific evaluation will allow for a understanding of whether broadening the linguistic offer in schools following the Luxembourgish curriculum can counter the educational inequalities that are assumed to result (at least partially) out of a curriculum, in which high language expectations present an important challenge for a growing number of students.

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