HIGH SCHOOL CHOICE: HOW DO PARENTS MAKE THEIR CHOICE?

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ABSTRACT

Location, well-qualified teachers, leaving score and academic performance are the main factors associated with parents' high school choices. This paper aims to provide students and their parents with a helpful tool for synthesizing these elements. By focusing on a small Italian town, we analyze Eduscopio and ScuolainChiaro's data concerning high schools' characteristics and students' performances, and apply the Analytic Hierarchy Process (AHP) in order to derive the ranking of high schools taking into account three criteria: the students' performance at school, their academic performance and the school's characteristics (such as the number of students per class and per teacher). The results from the AHP procedure using only school performances and characteristics highlight that the classic lyceum has the best performance and the scientific lyceums rank second, albeit rather close to the other lyceums. Entering the academic performance factor into the model changes the ranking of preferences in favor of the scientific lyceum, whose value is slightly higher than the classic one, and decreases the values of the other lyceums and technical high schools. This is due to the excellent academic performance of those who leave scientific schools, mostly in terms of credits at the end of the first year and average exam scores.

Keywords: School choice; school performance; academic performance; AHP; Eduscopio

1. Introduction

Wespieser et al. (2015) analyzed the factors that parents consider when choosing a school: location, well-qualified teachers, discipline and exam results to cite a few. The importance of these factors may vary depending on the parents' household income. The authors highlight that, in order to decide (or help them decide) which school their child should attend parents discuss with other parents, undertake their own research on possible schools and/or select the school attended by the child's siblings.

The international literature about this topic is vast. The literature covers aspects dealing with educational choice ranging from the effect of educational reforms in favor of

improving equity and social justice, to the influence of parents' involvement and family engagement on the students' achievements, and last but not the least, the role of socio-economic status in the choice among public and private school (Anderson & Minke, 2007; Hanushek et al., 2007; Goldhaber, 1999; Seitsinger, 2019; Seitsinger & Brand 2011; Taylor, 2018).

By considering preferences for schools, Burgess et al. (2014) showed that parents' choices are influenced by the academic performance of the school, but recognized the great importance of socio-economic factors and location (proximity to home) too. Lauer (2003) analyzed the impact of family background and cohort on educational achievement.

With regard to the Italian school system, Agasisti and Murtinu (2012) highlighted that the main factors influencing students' achievements are their socio-economic status, geographical area of residence and the type of school attended. A number of scholars have analyzed the effect of school size and other significant characteristics, such as students' features and school management and resources, on Italian students' achievements (Giambona & Porcu, 2018; Masci et al., 2018). In recent decades, schools have achieved more autonomy in organizing their activities and introducing innovative teaching methods and changes in their educational programs. Nevertheless, Masci et al. (2018) showed that managerial practices have little influence on students' school performance.

Investigating the main factors behind the parents' choice between public and private school, Pandolfini (2013) underlined, besides the influence of parents' educational level and socio-economic status, the importance of other latent variables like family involvement and parents' motivation. In order to provide a tool for parents to be involved in a school choice for their children, we propose the application of the Analytic Hierarchy Process (AHP) to rank preferences among different types of high schools, considering three criteria: the students' school and academic performance and the school characteristics. Since in Italy only 4.24% of students attend a private high school (I.stat 2014), we consider the socio-economic factor negligible in our analysis.

Annually, the Eduscopio portal provides parents with a tool to identify the best school within their area of residence. The ranking of schools is based only on students' academic performance.

In this paper, we performed the AHP procedure in two steps. First (Model 1), we considered only 2 criteria accounting for school characteristics and performance in order to capture the "school effect", and then in (Model 2) we included the students' academic performance in the model in order to identify the "mixed school/academic effect".

This paper is organized as follows: after a brief introduction on the school choice problem, section 2 describes data sources and provides an exposition on the methodology used to support parents in that choice; then, a discussion of results is performed (Section 3); finally some concluding remarks are provided (Section 4).

2. Data & methods

2.1 Data collection

In Italy, the Eduscopio portal has provided parents with a tool to identify the best school within their area of residence. The ranking of schools is based only on students' academic performance, as measured by the FGA (Giovanni Agnelli Foundation) index, taking into account academic credits and average exam scores. For more details, see Bordignon et al. (2017).

In order to support parents' school choice, we performed a pilot analysis based on 28 high schools located in the province of Benevento, Campania, grouped into 4 typologies: 8 classic lyceums, 10 scientific lyceums, 4 linguistic and human sciences lyceums and 6 technical (economic or technological) high schools. The Eduscopio (Giovanni Agnelli Foundation) and ScuolainChiaro (Ministry of Education) portals provided the data.

With reference to the 2017/18 school year, data from Eduscopio (https://eduscopio.it/) deals with some students' school and academic performance (henceforth called criterion 1 and criterion 2); data from ScuolainChiaro (http://cercalatuascuola.istruzione.it/ cercalatuascuola/) provide information on the characteristics of the school (henceforth called criterion 3) and the INVALSI[1] test score. In order to define the sub-criteria associated with each criterion, we consider a number of basic indicators, as proposed directly by Eduscopio, and new indicators, as can be seen in Table 1.

The intuitive significance of the sub-criteria accounts for students' performance through the INVALSI's test score, the HS leaving score, the proportion of academic enrolled students and the percentage of those passing the first year specifically their credits and average exam scores. Regarding school characteristics, it is worth pointing out that the students per class and per teacher sub-criteria are considered in order to take into account the support (assistance provided) in the educational path, whilst the percentage of teachers employed in the school for more than 6 years may represent an indicator of educational continuity.

[1] The National Institute for the Evaluation of the Educational System

Table 1
The elements of the problem and data sources

portal	criteria	sub-criteria	Description
EDUSCOPIO	School performance	high school leaving score	calculated as the weight average between the high school leaving score of academic enrolled and not enrolled students
		proportion of academic enrolled students	*basic indicator*
		relative difference (compared to regional average) of academic enrolled students	calculated as the ratio between regional average minus school value (in the numerator) and corresponding regional value (in the denominator) for each school; values higher than 0 indicate a better performance than Campania's regional average; vice versa for values lower than 0
	Academic performance	percentage of students passing the first year	calculated as the proportion of academic enrolled students
		relative difference (compared to regional average) of students passing the first year	calculated as the ratio between regional average minus school value (in the numerator) and corresponding regional value (in the denominator) for each school; values higher than 0 indicate a better performance than Campania's regional average; *vice versa* for values lower than 0
		percentage of academic credits at the end of the first year	in reference to total credits expected at the end of the first year
		average exam score	*basic indicator*
SCUOLA IN CHIARO	School characteristics	students per class	average number of students per class - *basic indicator*
		students per teacher	average number of students per teacher - *basic indicator*
		percentages of teachers employed for more than 6 years in the school	*basic indicator*
	School performance	INVALSI's test score	computed as the average between individual students' math, reading and foreign language test scores - *basic indicator*

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Our dataset consists of the average values of the indicators for each type of school (Table 2). As can be expected, the data highlight the best school and academic performances of lyceums, particularly classic and scientific lyceums. The high school leaving score exceeds 80 out of 100, and the INVALSI's test score is very close to 5. More than 85% of school leavers continue their studies, achieving approximately a third of their total academic credits at the end of the first year, with an average exam score of more than 25 out of 30. On the opposite side, there are the technical high school students. Their leaving score is nearly 8 points lower than the classic lyceum students, the INVALSI's test score is 1.2 points lower than scientific lyceum students; interestingly, only 1 in 3 school leavers decide to continue their studies, achieving less than half of their credits during the first academic year, with an average exam score 2 points lower than scientific lyceum students.

Table 2
Average values of the sub-criteria

Criteria	sub-criteria	Classic lyceum	Scientific lyceum	Other Lyceum	Technical HS
School performance	- high school leaving score	83.9	81.2	78.1	75.7
	- proportion of academic enrolled students	87.2	85.6	64.3	38.2
	- relative difference (compared to regional average) of academic enrolled students	-4.8	0.1	-0.6	-6.5
	- INVALSI's test score	4.7	4.8	4.1	3.6
Academic performance	- percentage of students passing the first year	88.0	88.6	83.7	79.4
	- relative difference of students passing the first year	-2.9	1.8	-2.0	8.0
	- percentage of academic credits at the end of the first year	61.8	66.0	50.5	48.7
	- average exam score	25.3	25.9	23.2	23.8
School characteristics	- students per class	18.7	20.9	20.4	19.2
	- students per teacher	10.2	10.7	10.6	8.4
	- percentage of teachers employed in the school for more than 6 years	51.7	52.4	57.4	50.8

Compared to the regional average (for the same type of school), scientific lyceums seem to almost always achieve the best score (values higher than 0) in the students' academic enrollments and the overcoming of the first year factors, whilst classic lyceums almost always achieve the worst score. Nevertheless, even if the percentage of academic enrollments for technical high school students is much lower than the regional value, they

perform much better with regard to first year university careers. Regarding school characteristics, the lowest value of students per teacher is in the technical high schools and extended teacher employment in other lyceums should be noted.

2.2 Methodology

The AHP, developed by Saaty at the end of the 1970s, is a multicriteria method which provides the decision maker with a tool to analyze problems involving several conflicting factors and stakeholders. It allows the decision maker to combine both qualitative and quantitative aspects in a single framework and then develop priorities for alternatives based on the judgments of experts. By breaking the problem down into simpler decisions, the AHP provides the decision maker with an analytical tool that can help him/her solve a more complex problem. The aim of this study is to apply the AHP in order to assist parents and their children in the selection of a high school.

The AHP involves 4 steps: (i) the decomposition of the decision problem into a multi-level hierarchy; (ii) data collection by means of pairwise comparisons; (iii) determination of the relative weights, reflecting the relative importance of the elements belonging to each hierarchical level considered with respect to the elements of the level immediately above; (iv) aggregation of the relative weights to obtain the overall priorities, expressing the importance of alternatives with respect to the overall objective of the evaluation (by applying the principle of hierarchical composition). This priority vector provides the ranking of alternatives (Saaty & Vargas, 1982).

In order to choose among the 4 types of high schools, we propose the consideration of 3 criteria: the students' performance during secondary school (high school leaving score, percentage of academic enrolled students, relative difference of academic enrolled students and INVALSI test score), their academic performance (percentage of students passing the first year, relative difference of students passing the first year, percentage of academic credits at the end of first year and average exam score) and the characteristics of that school (the number of students per class and students per teacher and the percentage of teachers employed by the school for more than 6 years). Figure 1 shows the structure of the problem and its 4 hierarchical levels.

We performed the AHP procedure in two steps. First (Model 1), we only considered the 2 criteria accounting for school characteristics and performance in order to capture the "school effect", then (Model 2), we included the students' academic performance in order to identify the "mixed school/academic effect".

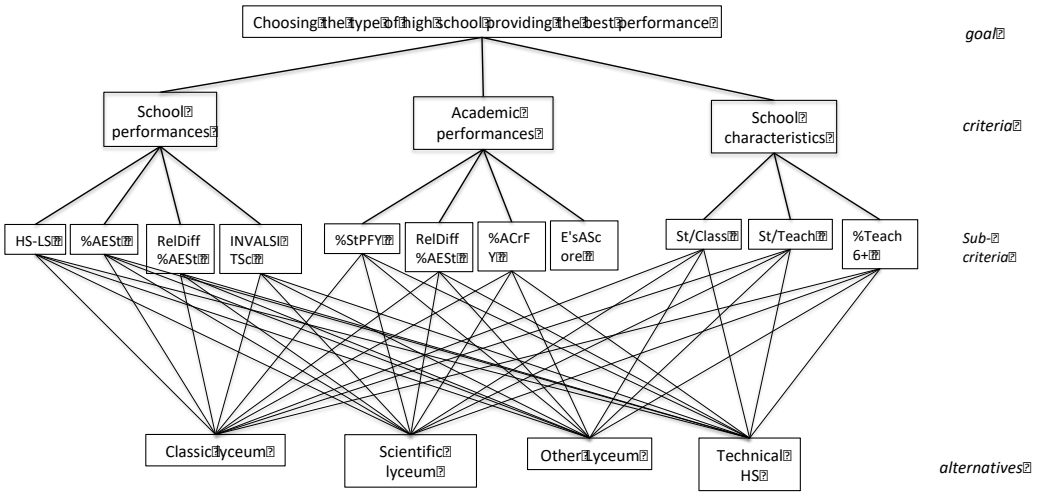

Figure 1 Hierarchy of a school choice problem[2]

3. Findings and discussion

The results from the AHP procedure using only 2 criteria highlight the classic lyceum as the best performer (Table 3 and Figure 2), particularly for leaving score (0.483), academic enrollment (0.400) and students per class (0.520). Scientific lyceums rank second (value=0.268), albeit close to linguistic and human science lyceums (value=0.217), both of which achieved a better performance with regards to the percentage of enrolled students than other HS in the region (0.437 and 0.396, respectively).

[2] ACROYMS: high school leaving score: HS-LS; proportion of academic enrolled students: %AESt; relative difference (compared to the regional average) of proportion of academic enrolled students: RelDiff-%AESt; INVALSI test score: INVALSI TSc; percentage of students passing the first year: %StPFY; relative difference (compared to the regional average) of percentage of students passing the first year: RelDiff-%StPFY; percentage of academic credits at the end of first year: %ACrFY; exams' average score: E'sASc; students per class: St/Class; Student per teacher: St/Teach; percentages of teachers with more than 6 years of service in the school: %Teach6+.

Table 3
Relative and global priorities of the alternatives, results obtained by applying the AHP Model 1

criteria	sub-criteria	criteria weight	sub-criteria weight	Alternatives			
				Classic Lyceum	Scientific lyceum	Other lyceum	Technical HS
School performances	- high school leaving score	0.600	0,213	0.483	0.331	0.158	0.028
	- proportion of academic enrolled students		0,213	0.400	0.381	0.215	0.004
	- relative difference (compared to regional average) of academic enrolled students		0,059	0.136	0.437	0.396	0.031
	- INVALSI's test score		0,115	0.328	0.361	0.206	0.106
School characteristics	- students per class	0.400	0,160	0.520	0.095	0.119	0.266
	- students per teacher		0,160	0.140	0.116	0.125	0.619
	- percentages of teachers employed by the school for more than 6 years		0,080	0.125	0.190	0.641	0.045
FINAL RANKING		1	1	0.349	0.268	0.217	0.166

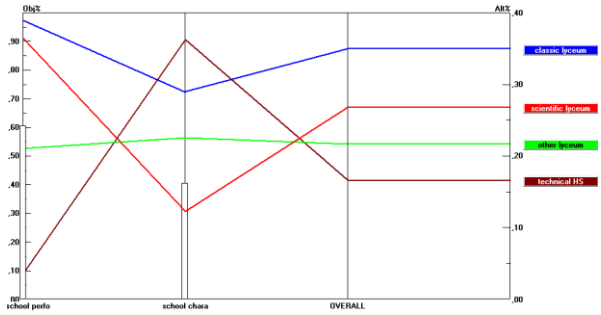

Figure 2 Relative and global ranking of school types for Model 1

Once the results were obtained, a sensitivity analysis was conducted in order to verify the robustness of the preference ranking among the alternatives with respect to changes in the criteria weights.

The sensitivity analysis, according to both school characteristics and school performances, highlights that at first, classic lyceums are the best alternative if the weight assigned to school performance is greater than 0.2; in other words, if the weight of school characteristics is lower than 0.8 (see Figure 3). Indeed, in the 2D[3] plot in Figure 4 the classic lyceum is in the upper right box.

a) b)

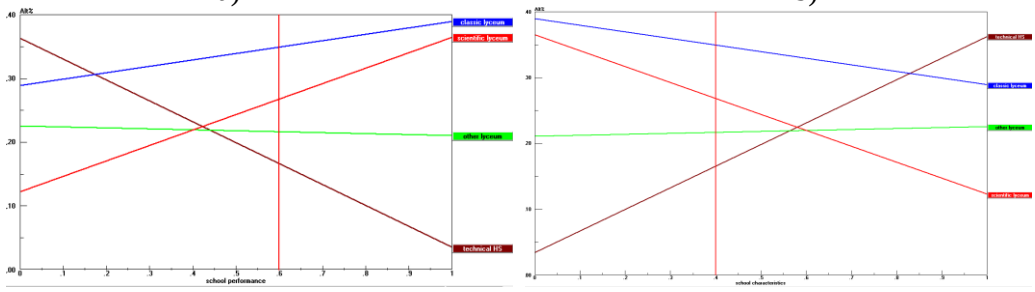

Figure 3 Ranking of school types with regard to the goal on varying the weight assigned to school performance and school characteristics (Model 1)

[3] The 2-dimensional plot simultaneously illustrates the weight of the alternatives with respect to 2 criteria. The best alternatives are in the upper box on the right; the worst alternatives are in the lower box on the left; the alternatives in the upper box on the left or in the lower box on the right highlight a conflict between the two criteria considered on the axis.

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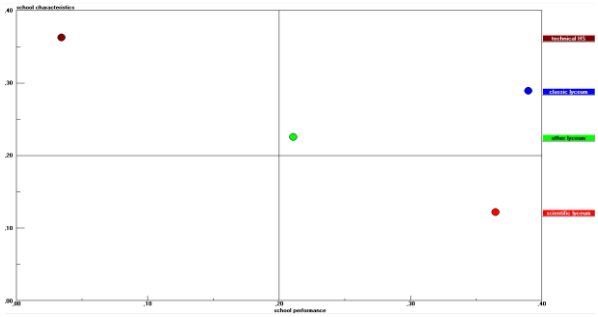


Figure 4 School performances vs. school characteristics (Model 1)

The technical HS alternative is very sensitive to the weight system, becoming the best choice only if school characteristics are taken into account, in particular with regard to students per teacher (see Figure A2 in Appendix), and the worst for school performances (see Figure A1 in Appendix). In fact, in the 2D plot in Figure 4 this type of HS is in the upper box on the left.

Furthermore, other lyceums always assume the same global score regardless of the weight system (close to 0.20-0.25), and are the third choice. Indeed, Figure 4 shows other lyceum type next to the barycentre. Considering the sub criterion accounting for the length of service of the teachers, the relative ranking of the alternatives strictly depends on the weight assigned; other lyceum being the best choice in ensuring teaching continuity with increasing weight (Figure A2 in Appendix).

When entering the academic performances (Model 2) into the model, the ranking of preference changes in favor of the scientific lyceum, whose value is slightly greater than the classic lyceums, and decreases the values of other lyceums and technical high schools (Table 4 and Figure 5).

This is due to the excellent academic performance of scientific school-leavers, mostly in terms of the percentage of credits at the end of the first year and average exam score. The sensitivity analysis obviously confirms the results of Model 1 with regard to school characteristics and performance, and highlights that regardless of the weight system scientific lyceums are always the better choice over classical ones for both academic performance criterion (Figure 6) and for each sub-criterion associated with it (Figure A3 in Appendix). Figure 7 confirms the above results by comparing the performance of the 4 school types when simultaneously considering 2 criteria: school performance vs. academic performance (Fig. 7a) and school characteristics vs academic performance (Figure 7b).

Table 4
Relative and global priorities of the alternatives, obtained by applying the AHP Model 2

criteria	sub-criteria	criteria weight	sub-criteria weight	Alternatives			
				Classic Lyceum	Scientific lyceum	Other lyceum	Technical HS
School performances	- high school leaving score	0.285	0.101	0.483	0.331	0.158	0.028
	- proportion of academic enrolled students		0.101	0.396	0.387	0.213	0.004
	- relative difference (compared to regional average) of academic enrolled students		0.028	0.136	0.437	0.396	0.031
	- INVALSI's test score		0.054	0.328	0.361	0.206	0.106
Academic performance	- percentage of students passing the first year	0.498	0.149	0.379	0.402	0.198	0.021
	- relative difference of students passing the first year		0.050	0.027	0.281	0.074	0.618
	- percentage of academic credits at the end of first year		0.149	0.397	0.521	0.067	0.015
	- average exam score		0.149	0.355	0.424	0.066	0.155
School characteristics	- students per class	0.217	0.087	0.520	0.098	0.116	0.266
	- students per teacher		0.087	0.163	0.153	0.174	0.510
	- percentage of teachers employed in the school for more than 6 years		0.043	0.125	0.19	0.641	0.045
	- FINAL RANKING	1	1	0.346	0.350	0.166	0.138

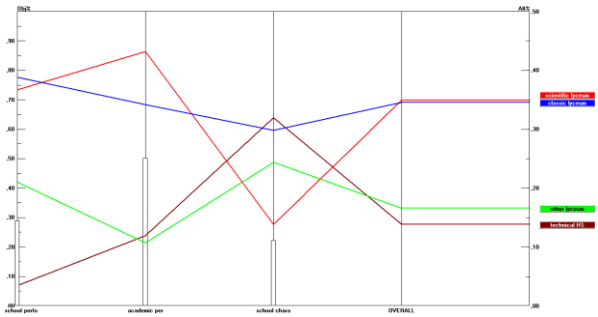
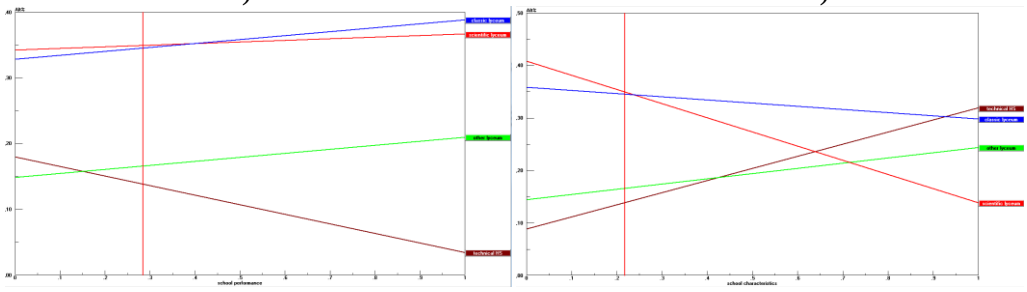


Figure 5 Relative and global ranking of school types for Model 2

The results obtained by applying the above models show that, with regard to academic and scholastic performances of the high school students, the classic and scientific lyceums are preferred to other lyceums and technical schools. The ranking depends on the weight that parents assign to these criteria. If parents base the choice only on school performance and on the school characteristics, then they should favour a classic lyceum; if instead they take into consideration academic performance then the choice should be a scientific lyceum.

a) b)



c)

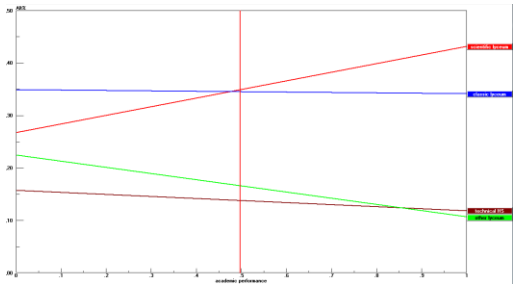


Figure 6 Ranking of school types with regard to the goal on varying the weight assigned to school performance, school characteristics, and academic performance (Model 2)

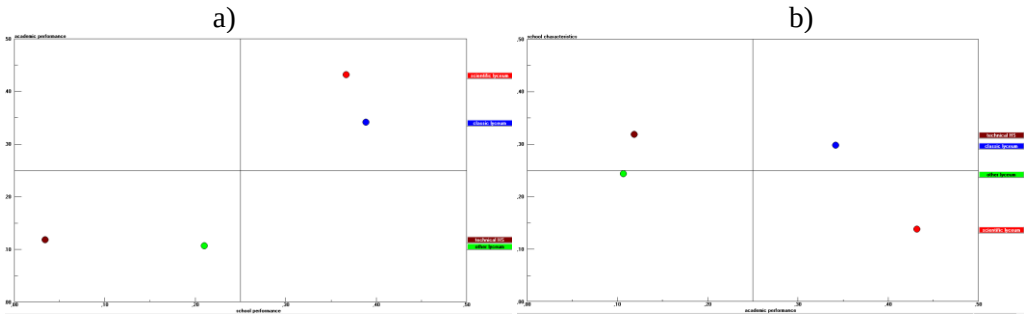


Figure 7 School performance vs. academic performance and school characteristics vs. academic performance (Model 2)

4. Concluding remarks

This paper deals with the problem of choosing a high school in Italy. In order to assist parents with this multicriteria choice, we proposed the application of the AHP. We considered 2 models. One model represented the problem by using only 2 criteria, school characteristics and students' school performance, and the second took into account academic student performance. Relative priority vectors represent the weights of each hierarchical element; that is, the importance that parents devote to each criterion and sub-criterion.

The global priority vector provides the ranking of preferences between 4 types of high schools. The results obtained by our analysis demonstrate that there are 2 separate types of schools. On one side there are the classic and the scientific lyceums, and on the other side there are lyceums and technical schools, in particular with reference to the academic and scholastic performances of the students.

Furthermore, other things, not considered in our analysis being equal (such as income, distance from home and attitude towards certain disciplines), if parents base the choice of high school only on academic performance and on the characteristics of the school they should favor a classical lyceum. If instead they take into consideration academic performance, as Eduscopio suggests, then the choice should be a scientific lyceum.

Finally, the sensitivity analysis highlights that the ranking of preferences between classic and scientific lyceums largely depends on the importance (weight) assigned to each criterion considered in the choice problem. Due to the specificity of the Italian secondary education system (mainly based on public high schools), the results of our analysis (a pilot study) cannot be extended to some international contexts in which private schools are more widespread for example, the US and UK.

As underlined by many authors, in Italy there are differences across the geographical areas, so it may be interesting to extend our study to other clusters of Italian towns possessing the same characteristics but located in a different geographical area (Agasisti et al., 2012; Masci et al., 2016; 2018). If there was more data, further analysis could be carried out using the DEMATEL (Decision Making Trial and Evaluation Laboratory)

method, in order to study the interrelationships between the criteria and also among their respective sub-criteria (Mumtaz et al., 2018).

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APPENDIX

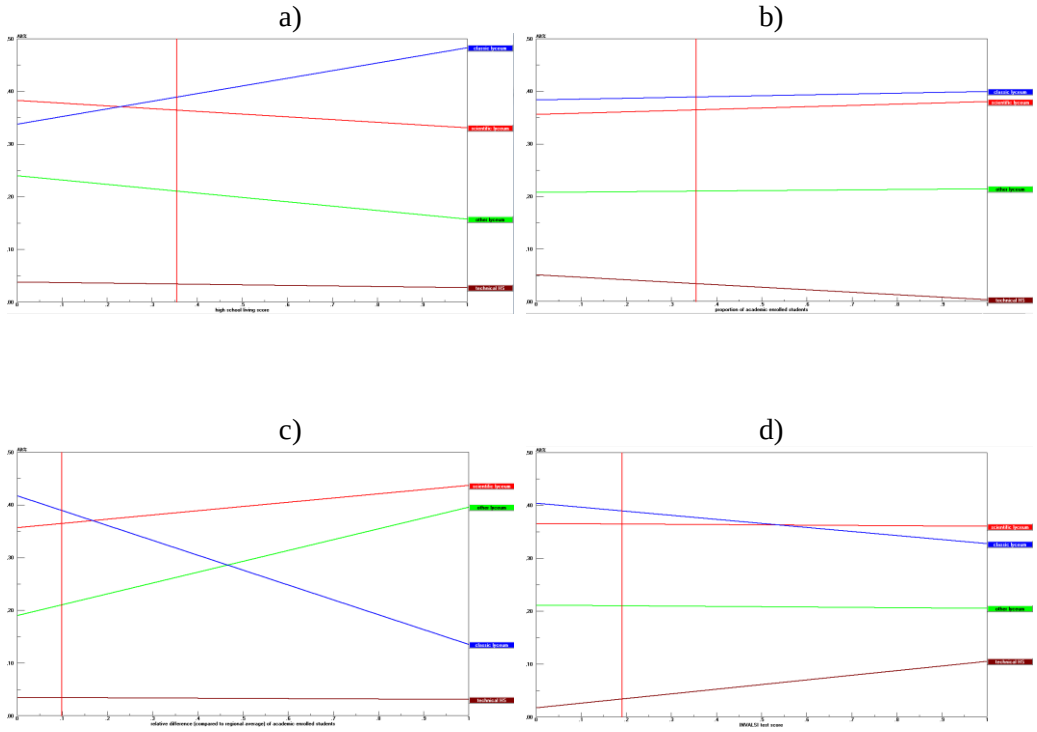

Figure A1 Relative ranking of school types with regard to school performance on varying the weight assigned to high school leaving score, percentage of academic enrolled students, relative difference of academic enrolled students and INVALSI test score (Model 1)

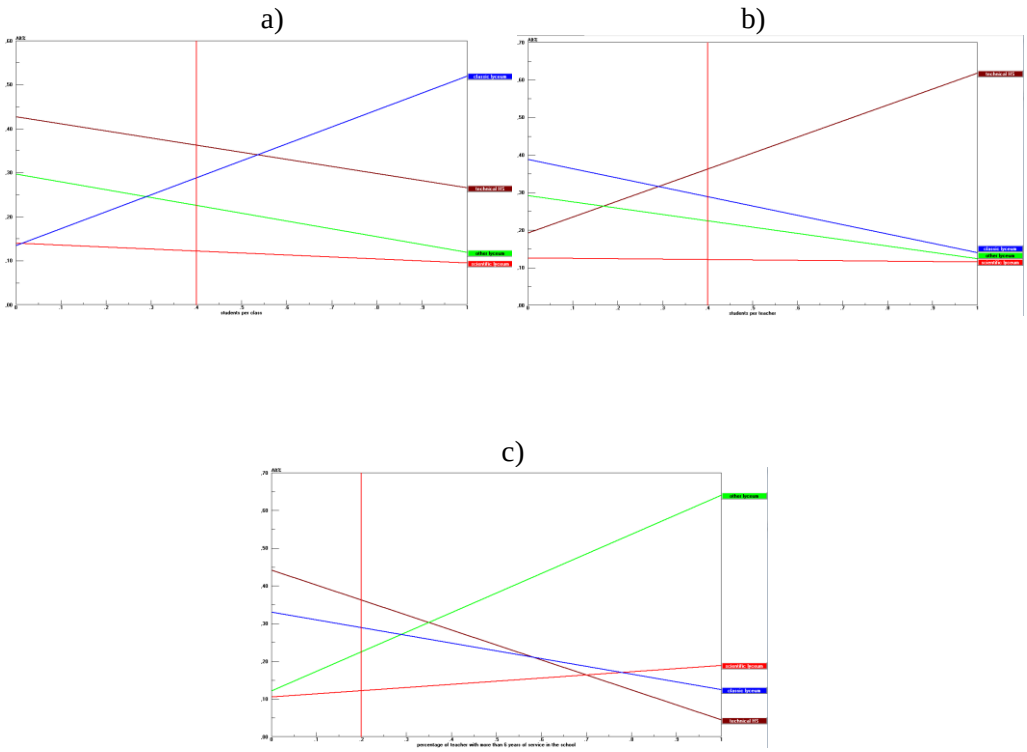

Figure A2 Relative ranking of school types with regard to school characteristics on varying the weight assigned to student per class, student per teacher and the percentage of teachers employed in the school for more than 6 years (Model 1)

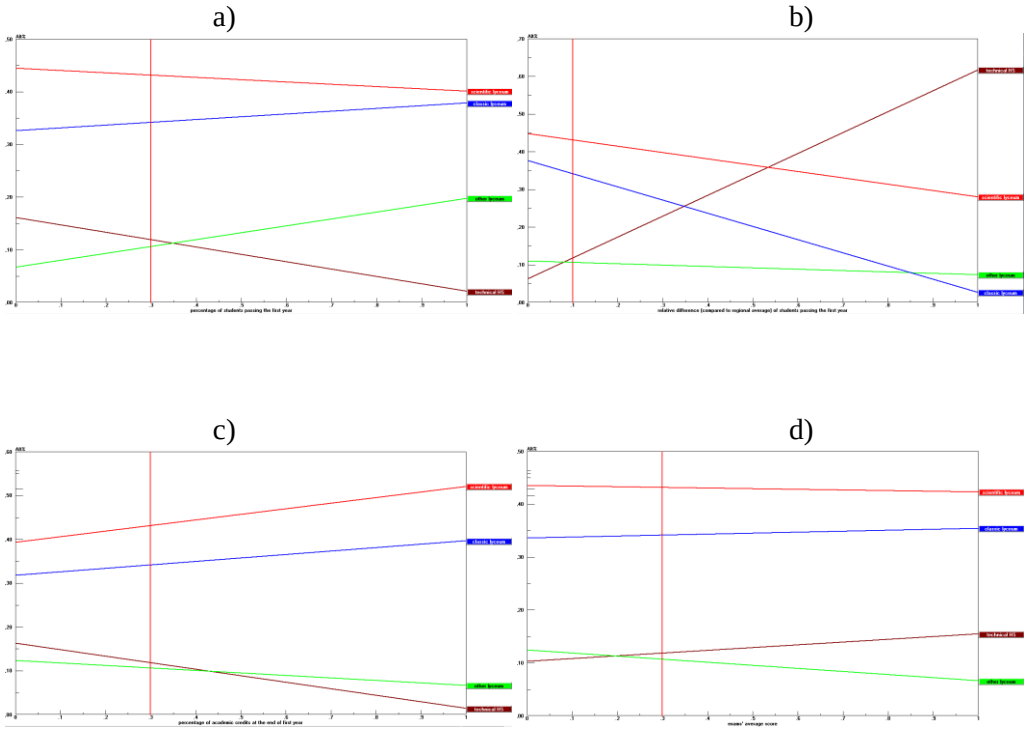

Figure A3 Relative ranking of school types with regard to academic performance on varying the weight assigned to percentage of students passing the first year, relative difference of students passing the first year, percentage of academic credits at the end of first year and average exam score (Model 2)