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Students' Perceptions of Remote Teaching and Learning: The Slovene Minority in Italy during the Pandemic Period of Covid-19

During the second quarantine period in Italy (Oct. '20–June '21), students once again faced a remote teaching and learning format. Much research has been conducted on students' perceptions during the first pandemic period; however, far less is known about the second period, especially in the case of students within the Slovene minority in Italy. We aimed to investigate (1) students' satisfaction with their teachers' teaching methods in remote learning and in-class teaching formats, (2) students' perceptions regarding the main differences between in-class and online mathematics lessons, and (3) whether students' grades in mathematics changed as a result of the pandemic. The findings showed that students' grades during the quarantine period increased compared to their grades before the pandemic. However, students were more satisfied with their teachers' in-class teaching methods and believed that in-class teaching was more efficient. They were also more motivated and concentrated at school than online.

Keywords: remote learning, online lessons, quarantine, Covid-19, Slovene minority, Italy.

Mnenje dijakov o poučevanju in učenju na daljavo: Slovenska manjšina v Italiji v času pandemije covida-19

V 2. obdobju karantene v Italiji (okt. '22–jun. '21) so se dijaki višjih srednjih šol ponovno soočili s poukom na daljavo. Medtem ko je veliko raziskav obravnavalo mnenja dijakov v prvem obdobju pandemije, je bilo v drugem obdobju podobnih raziskav veliko manj, zlasti v primeru dijakov slovenske manjšine v Italiji. Želeli smo raziskati (1) zadovoljstvo dijakov z učnimi metodami njihovih učiteljev pri poučevanju na daljavo in v razredu, (2) mnenje dijakov o glavnih razlikah med poukom matematike v razredu in na spletu in (3) ali so se ocene matematičnega znanja zaradi pandemije bistveno spremenile. Rezultati so pokazali, da so se ocene dijakov v obdobju karantene zvišale v primerjavi z njihovimi dosežki pred pandemijo. Dijaki so bili bolj zadovoljni z metodami poučevanja svojih učiteljev v razredu in so mnenja, da je poučevanje v razredu učinkovitejše. V šoli so bili tudi bolj motivirani in osredotočeni kot na spletu.

Ključne besede: *učenje na daljavo, spletni pouk, karantena, covid-19, slovenska manjšina, Italija.*

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1. Introduction

Italian high school students experienced two quarantines because of the national sanitary emergency connected to the spread of Covid-19. The first began at the end of February 2020 (DPCM 1, 2020; Decreto-legge 25 marzo 2020) and lasted until the end of the school year (i.e., June 2020). During this time, when emergency plans were adopted by the government, elementary, middle and high schools, as well as universities, had to close. Students and teachers had to adapt to remote lessons (Quattrone et al. 2020), which are characterised by temporal and/or spatial separation that is normally compensated for with media and technology (Hodges et al. 2020; Zorčič 2020). Italian teachers used various learning and teaching methods, including not only online lectures, audio-visual material, and conferences, but also books and notes (Tejedor et al. 2020). The Decrees of the Prime Minister (DPCM 1, 2020; Decreto-legge 25 marzo 2020) stated that teachers had to adapt their teaching and assessment methods to remote teaching.

The second lockdown, this time only for high schools, occurred at the end of October 2020 (DPCM 2, 2020) and lasted for two months. The national decree stated that high schools had to adopt remote teaching once again to guarantee students a natural continuation of their educational activities and learning processes. The Ordinance from the Ministry of Health of 24 December 2020 stated that high schools might open at the end of the winter vacation (Ministero della salute 2020). The second quarantine was, nevertheless, much different from the first (Bogatec et al. 2021), as schools were open for a longer period throughout the school year, and teachers were more prepared than during the first quarantine period. Hence, teachers had time to prepare and adjust their teaching methods for the second lockdown.

Similarly to what has been reported in the international literature, remote learning in Italy meant a great change in the way lessons were organised (Basilaia & Kvavadze 2020; Upoalkpajor & Upoalkpajor 2020; Kim 2020). Regarding remote learning worldwide, several issues have been reported, particularly relating to internet connections and technological equipment (Adnan & Anwar 2020), the difficulty of doing assignments during online lectures (Nasution & Ahmad 2020), lower satisfaction with online learning (Gonçalves et al. 2020), and a higher level of anxiety among students (Ardan et al. 2020; Husky et al. 2020; Cao et al. 2020).

Some studies proved that minority students faced additional issues during the pandemic remote-learning period (Eurac Research 2020). For instance, students from the Slovene minority in Italy faced fundamental issues related to the unavailability of digital learning materials in the Slovene language on topics covered in the Italian national curriculum (Bogatec et al. 2021). Additionally, students from non-Slovene speaking families, who encountered the Slovene

language exclusively at school, were deprived of the essential extra help that they would have received at school (Bogatec et al. 2021). Overall, the problem of what minority students thought of the second remote-learning period in Italy remains an open question in the literature.

The Covid-19 pandemic also had an important impact on the teaching of mathematics. Maths teachers had to adapt their mathematical communication (i.e., the ways of explaining mathematics to students) to the online environment (Wahyuningrum & Latifah 2020). Math teachers believed that students found it more difficult to understand mathematics delivered through online platforms (Yohannes et al. 2021), and neither students nor teachers had adequate digital skills (Mailizar et al. 2020). Thus, further investigation into students' opinions on mathematics lessons during the remote-learning period is needed.

Considering the teaching and learning of mathematics, Slovene minority students in Italy faced an additional issue. The unavailability of much of the learning material on topics in the Italian national curriculum in the Slovene language (Grgič 2017; 2019), especially in the case of digital materials (Bogatec et al. 2021), represented an issue for students and math teachers. Thus, some students might have experienced additional stress from trying to find explanations of the topics, and the teachers might not have had access to the proper material. Hence, minority students, in comparison to the majority of students, faced additional challenges, so it is reasonable to expect that their perceptions of remote teaching and learning also differed in some aspects.

The aim of the present research was to understand (1) Slovene minority high school students' satisfaction with their mathematics teachers' remote and in-class teaching methods, (2) students' perceived differences between remote and in-class (traditional) maths teaching and learning, and (3) whether students' grades increased during the pandemic period. Since research on the topic of the second remote learning period during the Covid-19 outbreak in Italy is still scarce, we decided to focus on this period, in particular: October–December 2020. Specifically, we examined students' satisfaction with teachers' teaching methods both in class and during the second quarantine. In addition, we present suggestions for educators and policymakers.

2. Theoretical Framework

2.1 Education during the Covid-19 Pandemic

During the Covid-19 pandemic, the learning process changed from in-class to online instruction, which had various impacts on the quality of teaching and learning (Sahu 2020; Dietrich et al. 2020; Aristovnik et al. 2020; Chakraborty et al. 2020). Several online learning tools were used, including communication platforms, such as Zoom and Google Hangouts, and communication facilitators,

such as video chat, conference calls, chatrooms, conferences, emails and communication forums (Gonçalves et al. 2020; Ferraro et al. 2020; Nenko et al. 2020). Remote learning meant a change in the pedagogical techniques used. Students had clarification sessions, video lessons, materials in text format, group work, individual work, group discussions and other forms of learning (Gonçalves et al. 2020). In addition, various evaluation models were used, such as face-to-face assessing, online individual work, online group work and online tests.

The research has highlighted several obstacles and advantages regarding online learning. For instance, students argued that there was a lack of concentration (Gonçalves et al. 2020; Fatonia et al. 2020; Son et al. 2020), a lack of student interaction (Gonçalves et al. 2020; Lassoued et al. 2020; Coman et al. 2020), difficulty in time management (Gonçalves et al. 2020), and a lack of motivation and effort (Gonçalves et al. 2020; Lassoued et al. 2020; Zaccoletti et al. 2020; Aguilera-Hermida 2020). On the other hand, students reported greater time and location flexibility (Gonçalves et al. 2020) and better academic results (Gonçalves et al. 2020; Gonzalez et al. 2020). The latter result could be seen as a positive outcome (i.e., remote learning helps students perform better); on the other hand, students may have cheated during exams and assignments (Bilen & Matros 2020; Nguyen et al. 2020).

Some studies showed that students' overall perceptions of online learning were not good (Gonçalves et al. 2020; Lassoued et al. 2020; Coman et al. 2020). Students felt that online learning hindered the learning process because of various issues with internet access, difficulties in communicating with their teachers, problems carrying out assignments and fewer students participating during online lessons (Nasution & Ahmad 2020; Baloran 2020; Coman et al. 2020; Surani & Hamidah 2020; Giatman et al. 2020). Some students felt that their learning worsened during remote learning (Chen et al. 2020).

The same studies found that students perceived that their institutions were not prepared to organise online lessons or that they did not adapt their teaching methods quickly enough. Some teachers were not able to adapt their teaching styles to the online environment or to maintain their students' attention.

Some researchers showed that students preferred the in-class lesson format and learned better while in class; however, students felt comfortable with online classes (Surani & Hamidah 2020; Gonçalves et al. 2020; Giatman et al. 2020).

Regarding mathematics education, remote learning, resulting from the Covid-19 pandemic, changed the teaching and learning processes of this subject (Mulenga & Marbán 2020). The transition to remote learning greatly impacted students' understanding of specific mathematical concepts, as some teachers adopted asynchronous teaching methods and did not provide additional explanations of the material covered (Mukuka et al. 2021; Murtafiah et al. 2020). Mathematics teachers also faced fundamental issues (Barlovits et al. 2021; Chirinda et al. 2021) related to the use of math-specific technology, such as virtual white-

boards, video recordings and video-editing software, as well as several learning platforms. In particular, the inability to use a blackboard was a major issue when teaching mathematics remotely, as this is an almost indispensable tool in teaching and learning mathematics (Busto et al. 2021). In addition, mathematics lessons specifically require derivation, numerous consolidations, and learning in interaction, and it is very important that teachers react to students' possible gaps in knowledge as promptly as possible, as it is crucial that students master the simpler concepts before moving on to more complex concepts (Bone et al. 2021). This was very difficult to deliver during remote learning.

The impact of remote teaching and learning on mathematical knowledge specifically can also be observed in students' achievements in the Italian national assessment of mathematical knowledge, organised by the National Institute for the Evaluation of the Education and Training System (INVALSI – Istituto nazionale per la valutazione del sistema educativo di istruzione e formazione). It was found that students' overall achievements in mathematics in 2021 were 10 points lower than in 2019 (INVALSI 2021). The INVALSI study for Grade 13 (i.e., the last year of schooling; INVALSI 2021) pointed out that 51 % of Italian students did not gain adequate results in the 2021 national assessment of mathematical knowledge, which corresponded to a 9 % increase in under-achieving students in 2019. To our knowledge, no research has investigated the possible reasons underlying this decrease in achievement on the national mathematics test, including the quality of teaching and learning during the Covid-19 pandemic. Therefore, it is important to address the quality of mathematics learning and teaching during the Covid-19 pandemic to have a clear image regarding students' mathematical knowledge and to outline possible measures to overcome their lack of knowledge.

2.2 The Slovene Minority in Italy and the Covid-19 Pandemic

The Covid-19 pandemic posed certain issues for students, who faced a change in the way lessons were delivered. Minority students, however, were more affected by the pandemic in terms of both social and economic aspects, including education (Eurac Research 2020). The Italian minority in Slovenia (Sorgo & Lukanovič 2020) and the Slovene minorities in Croatia (Riman 2020) and Austria (Zorčič 2020) faced similar problems. In the present research, our focus is on the Slovene minority in Italy.

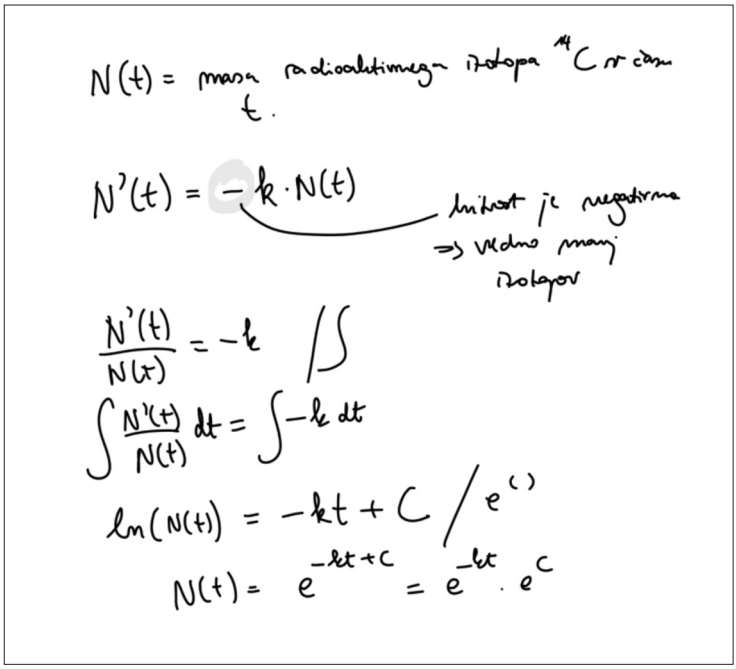
The Slovene minority in the Friuli-Venezia Giulia region of Italy is a national minority, whose members live along the Slovene-Italian border. This is a well-integrated community, both socially and economically (Brezigar 2020). Italy recognises the rights of the Slovene minority in the Trieste, Gorizia and Udine provinces, which are guaranteed by the 2nd, 3rd and 6th articles of the Italian Constitution (Senato della Repubblica 2022) and the 3rd article of Constitutional

Law 38 from 1963 (Norme a tutela della minoranza linguistica slovena della regione Friuli - Venezia Giulia 2001). Students who are part of the Slovene minority have the right to attend schools with Slovene as the language of instruction or bilingual schools (Disciplina delle istituzioni scolastiche nella provincia di Gorizia e nel Territorio di Trieste 1963), which are equivalent to schools in the Italian language. Kindergartens, primary schools, lower and upper secondary schools with Slovene as the language of instruction, and the bilingual (Italian–Slovene) school in Špeter are an integral part of the Italian national school system, and they function in the same way as Italian schools (Bogatec 2015). There are some slight differences in the programs taught, as students from schools using the Slovene language have additional topics in history and geography (Bogatec 2015), such as the history of Slovenes in Italy (USR-FVG 2021).

Schools with Slovene as the language of instruction or bilingual instruction have certain specificities and face additional issues (Baloh 2012; Brezigar & Zver 2019; Strani 2011). For example, students in these schools need textbooks in the Slovene language that cover the topics from the Italian curriculum (Bogatec 2015). Hence, students need specific didactic materials for learning the Slovene language (Grgič 2017; 2019). Moreover, students from these schools have varied knowledge of the Slovene language, and teachers need to adapt their teaching strategies to the students' language skills (Brezigar & Zver 2019; Baloh 2004). Some students only use the Slovene language at school (Bogatec 2015), while they speak Italian or another language at home.

The specificities of schools with Slovene as the teaching language concern not only the linguistic competencies of the students and their parents, the unique programs and the learning materials (Brezigar & Zver 2019; Brezigar 2020; Grgič 2017; Melinc Mlekuž 2019), but also the availability of digital learning materials (Grgič 2019). In particular, the material on several digital platforms does not fulfil the language or content requirements. For instance, online materials in the Italian language contain topics from the Italian national programs; however, they do not fit the language requirements. On the other hand, materials (e.g., textbooks) from Slovene institutions fit the language requirement but do not fit the requirements of the topics taught. Taking an example from mathematics, the Italian national syllabus for lyceums (Ministero dell'istruzione, dell'università e della ricerca 2010) requires mathematics teachers to present the topic of differential equations in the final year of scientific lyceums; however, this topic is not present in the Slovene national syllabus (Ministrstvo za šolstvo in šport RS 2008). Consequently, this means that the topic of differential equations is not present in high school mathematics textbooks in the Slovene language. Teachers who cover this topic need to rely on self-made materials (Figure 1) or other materials in the Slovene language (e.g., university course notes), which may not be suitable for the specific level of schooling.

Figure 1: A Slovene minority high school teacher's remote class on the usage of differential equations to solve the radioactive decay problem in physics



Source: Empirical data.

Another fundamental issue was the problem of communicating with students and families who have low or no knowledge of the Slovene language (Brezigar 2020). The abovementioned problems represented an even greater obstacle during remote learning. Teachers faced a number of issues with delivering the materials and providing extra help to students who struggle with the Slovene language. Contact with Slovene was provided almost exclusively through video lessons, registered video materials and various forms of digital written materials. The role of parents who do not speak Slovene also changed, as they were unable to help their children (Bogatec et al. 2021).

Social distancing during the pandemic period also meant the inability to interact with peers from the Slovene community, including in cultural and sports events, as well as in other activities that are believed to be crucial in maintaining a community. These activities, as well as education in the Slovene language, are a milestone for the Slovene minority in Italy. The linguistic skills of students who were not involved in social, cultural and sports events were weakened, thus making the minority even more vulnerable to the process of linguistic assimilation (Bogatec et al. 2021).

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3. The Research Problem and Study Objectives

Based on international research results that showed various impacts of Covid-related remote teaching and learning, and considering the special situation of Slovene minority students in Italy, as well as with regard to the peculiarities of maths teaching and learning, we outlined three main research questions:

RQ1: How did students perceive their own satisfaction with the teaching methods in mathematics during remote teaching?

RQ2: How did students perceive the differences between remote and in-class mathematics learning?

RQ3: How did students' grades in mathematics change during the pandemic?

For each research question we controlled for the role of gender.

4. Methodology

4.1 Methods

We used a nonexperimental method of causal analysis. We carried out quantitative research, using an online questionnaire to gather results that were analysed using descriptive and inferential statistical methods.

4.2 Sample

The participants in the present study were 129 high school students, of whom 58 were males (45.0 %) and 71 (55.0 %) were females. There were 85 (65.9 %) students from lyceums, while the remaining 44 (34.1 %) were students from technical schools. In addition, 76 (58.9 %) students attended a high school in Trieste, while 53 (41.9 %) students attended a high school in Gorizia. The average age of the participants was M = 16.0 (SD = 1.60; min = 13; max = 19). There were 44 (34.1 %) first-year students, 23 (17.8 %) second-year students, 36 (27.9 %) third-year students, 15 (11.6 %) fourth-year students, and 11 (8.5 %) fifth-year students.

According to Bogatec (2021), in the 2019/20 school year (data for the 2020/21 school year are presently unavailable), there were 936 students attending Italian high schools with Slovene as the language of instruction, which signifies that the research sample represents 13.8 % of the whole sample from the 2019/20 school year. Moreover, 609 (65.1 %) students attended a high school in Trieste, while 327 (34.9 %) attended a high school in Gorizia. Comparing these percentages with those from our sample, we claim that there is not enough evidence to state that our sample significantly differs from the population ($\chi^2(1) = .922$; $p = .337$), so we considered the sample to be representative of the population (cf. Sagadin 1993).

4.3 Data Collection

Data were collected in June and July 2021 through an online questionnaire. This technique was used instead of a printed questionnaire, as high schools had been closed to students from October 2020, and all lessons were online (DPCM 2, 2020). However, this represented a major problem, as there was a low response rate (66.1 %).

4.4 Instrument

The online questionnaire used was composed of nine questions, among which four were demographic questions, two questions analysed the students' mathematics grades at the end of the first and second semesters of 2020/21, two questions analysed the students' appreciation of the in-class and online teaching methods used by their mathematics teachers, and a question composed of 15 items evaluated students' perceptions of whether they preferred in-class or remote mathematics lessons (see Appendix A).

The students' appreciation of their maths teachers' teaching methods was measured using a 5-point Likert scale (1 = not satisfied at all, 5 = very satisfied). In the 15-item question, students indicated their agreement with 15 statements with a 5-point Likert scale (1 = absolutely no agreement, 5 = absolute agreement).

4.5 Data Analysis

The collected data were analysed using the Jamovi statistical software.

Principal component analysis (PCA) was conducted to determine the validity of the instrument. Concerning the 15-item questionnaire on the quality of remote learning compared to in-class mathematics lessons, the factorability of the 15 questions was examined. The Kaiser-Meyer-Olkin measure of sampling adequacy was greater or equal to .842, above the commonly recommended value of .600. Bartlett's test of sphericity was significant ($\chi^2(105) = 1102$, $p < .001$). Given these two indicators, factor analysis was deemed to be suitable for all 15 items.

Initial eigenvalues indicated that the first three factors explained 36.1 %, 17.8 % and 13.3 % of the variance, respectively, for a total of 67.2 % of the variance. Solutions for three factors were examined using the varimax rotation of the factor loading matrix (see Table 1). The first factor grouped the questions regarding teaching methods. The second factor was connected to the students' emotions, such as stress. The third factor was connected to the environment, such as the presence of distractors.

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Table 1: Factor loading of the questionnaire

	Component			Uniqueness
	1	2	3	
Item 1	0.616		0.320	0.487
Item 2	0.823			0.251
Item 3	0.707	0.376		0.359
Item 4	0.764			0.304
Item 5	0.822			0.284
Item 6	0.741		0.342	0.311
Item 7	0.617		0.479	0.340
Item 8		0.777		0.265
Item 9		–0.840		0.259
Item 10			0.772	0.293
Item 11	0.529		0.608	0.305
Item 12	0.761	0.310		0.287
Item 13	0.346	0.649	0.332	0.348
Item 14	0.562			0.532
Item 15	0.504	0.582	–0.328	0.300

Source: Empirical data.

Note: Varimax rotation was used.

The reliability of this piece of the questionnaire was checked with Cronbach's alpha coefficient, which indicated that the questionnaire had excellent validity ($\alpha = .90$). Moreover, the two-week test-retest reliability was excellent ($r = .833$).

The analysis of singular variables was done using descriptive statistical methods (i.e., mean and standard deviation). While it is common in psychological and pedagogical research to consider Likert-scale items as continuous variables (De Winter & Dodou 2010), we decided to use non-parametric tests instead (i.e., Spearman's correlation coefficient ρ, the Mann-Whitney U test to prove differences between two categories, the Kruskal-Wallis H test for the differences among three or more categories, and the Wilcoxon rank Z test for the comparison between two variables). Moreover, Levene's test for equality of variances and the Kolmogorov-Smirnov test for normality were violated in most cases, thus confirming the usage of non-parametric statistical tests.

5. Results

5.1 Students' Satisfaction with In-Class and Online Classes

In Table 2, we present the frequencies and percentages of the students' satisfaction with their maths teachers' in-class teaching methods.

Table 2: Frequencies of the students' class satisfaction.

Levels	f	% f
Not satisfied at all	6	4.7 %
Not satisfied	23	17.8 %
Neutral	25	19.4 %
Satisfied	42	32.6 %
Very satisfied	33	25.6 %

Source: Empirical data.

As can be observed, 22.5 % of students were unsatisfied or very unsatisfied with their teachers' teaching methods during in-class lessons. In contrast, 58.2 % of students were satisfied or very satisfied. These frequencies were statistically different ($\chi^2(4) = 27.7; p < .001$).

Concerning students' satisfaction with their maths teachers' teaching methods during remote learning, we present the frequencies and percentages in Table 3. We can see that 27.2 % of students were unsatisfied or completely unsatisfied with the teaching methods; however, 54.3 % of students were satisfied or very satisfied. These frequencies were statistically different ($\chi^2(4) = 44.4; p < .001$).

Table 3: Frequencies of the students' satisfaction with remote learning and teaching.

Levels	f	% f
Not satisfied at all	10	7.8 %
Not satisfied	25	19.4 %
Neutral	24	18.6 %
Satisfied	54	41.9 %
Very satisfied	16	12.4 %

Source: Empirical data.

No statistically significant differences between genders were revealed regarding in-class satisfaction with the teachers' methods ($U = 1915; p = .908$): boys ($R = 63.40$) and girls ($R = 62.66$) had similar perceptions concerning their satisfaction with their teachers' teaching methods. Moreover, boys ($R = 61.78$) and girls ($R = 64.02$) had similar perceptions in terms of their satisfaction with the teaching methods adopted during the second quarantine; the differences in perceptions were statistically non-significant ($U = 1869; p = .720$).

The students' satisfaction with in-class lessons and remote learning were positively and statistically significantly correlated ($\rho = .495; p < .001$). This means that the students who were more satisfied in class were also more satisfied with the teachers' online methods. There were, however, statistically significant differences in the students' satisfaction with their teachers' teaching methods before and during the pandemic ($Z = 2.290; p = .022$; Cohen's $d = .26$): the students

were more satisfied with in-class ($R = 137.31$) than online ($R = 121.69$) lessons.

Moreover, the students' grades correlated positively and statistically significantly with their satisfaction with the teaching methods used both during quarantine ($\rho = .196$; $p = .029$) and in class ($\rho = .263$; $p = .003$). This means that students who were more satisfied with their teachers' methods had higher grades and vice versa. The correlations found were, however, small.

No statistically significant differences in satisfaction with the teachers' teaching methods were found among different classes either before quarantine ($\chi^2(4) = 2.56$; $p = .633$; $\varepsilon^2 = .020$) or after it ($\chi^2(4) = 8.40$; $p = .078$; $\varepsilon^2 = .066$).

5.2 Differences between In-Class and Remote Learning

In Table 4, we present the frequencies and percentages for the answers regarding the differences between in-class and remote learning of mathematics. For the sake of simplicity and interpretation, the means and standard deviations for each category are reported.

Table 4: Frequencies of the answers to the first part of the questionnaire.

	Completely disagree	Disagree	Neutral	Agree	Completely agree	Mean	SD
Item 1	5 (4.0 %)	10 (8.0 %)	32 (25.6 %)	28 (22.4 %)	50 (40.0 %)	3.86	1.15
Item 2	4 (3.2 %)	10 (8.0 %)	26 (20.8 %)	40 (32.0 %)	45 (36.0 %)	3.90	1.08
Item 3	8 (6.4 %)	23 (18.4 %)	31 (24.8 %)	33 (26.4 %)	30 (24.0 %)	3.43	1.22
Item 4	1 (0.8 %)	14 (11.2 %)	27 (21.6 %)	40 (32.0 %)	43 (34.4 %)	3.88	1.04
Item 5	5 (4.0 %)	9 (7.2 %)	31 (24.8 %)	42 (33.6 %)	38 (30.4 %)	3.79	1.08
Item 6	5 (4.0 %)	12 (9.6 %)	15 (12.0 %)	40 (32.0 %)	53 (42.4 %)	3.99	1.14
Item 7	8 (6.4 %)	15 (12.0 %)	31 (24.8 %)	28 (22.4 %)	43 (34.4 %)	3.66	1.24
Item 8	18 (14.4 %)	46 (36.8 %)	35 (28.0 %)	11 (8.8 %)	15 (12.0 %)	2.67	1.19
Item 9	9 (7.2 %)	23 (18.4 %)	31 (24.8 %)	43 (34.4 %)	19 (15.2 %)	3.32	1.15
Item 10	2 (1.6 %)	17 (13.6 %)	32 (25.6 %)	48 (38.4 %)	26 (20.8 %)	3.63	1.01
Item 11	3 (2.4 %)	14 (11.2 %)	23 (18.4 %)	41 (32.8 %)	44 (35.2 %)	3.87	1.09
Item 12	4 (3.2 %)	21 (16.8 %)	31 (24.8 %)	37 (29.6 %)	32 (25.6 %)	3.58	1.14
Item 13	8 (6.4 %)	39 (31.2 %)	28 (22.4 %)	28 (22.4 %)	22 (17.6 %)	3.14	1.22
Item 14	12 (9.6 %)	20 (16.0 %)	28 (22.4 %)	38 (30.4 %)	27 (21.6 %)	3.38	1.26
Item 15	11 (8.8 %)	25 (20.0 %)	25 (20.0 %)	30 (24.0 %)	34 (27.2 %)	3.41	1.31

Source: Empirical data.

Regarding the stress students felt in school, Item 8 showed that more than half of the students (51.2 %) felt more relaxed at home than at school, which was confirmed by Item 9 (49.6 %), with the correlation between these two variables

being negatively and statistically significant (ρ = –.623; p < .001). As seen in Table 4, 28.0 % and 24.8 % had a neutral position towards stress in Item 8 and Item 9, respectively. This means that approximately a quarter of the students found in-class and remote lessons equally stressful or did not notice any differences in levels of stress between these two lesson modalities.

More than half of the students (62.4 %) believed that maths in-class lessons were better than online lessons (Item 1), since they learned better (68.0 %, Item 2), the lessons were easier (50.0 %, Item 3), they learned more (66.4 %, Item 4), and the teachers' explanations were better (64.0 %, Item 5) and easier to follow (74.4 %, Item 5). Moreover, the students felt more motivated at school than online (56.8 %, Item 7); however, they were more stressed (51.2 % and 49.6 %, Items 8 and 9). The results showed that students participated more at school than online (59.2 %, Item 10) and were more concentrated (68.0 %, Item 11). They also felt that taking tests at school was better than taking them online (51.2 %, Item 15).

Students' perceptions that in-class lessons were better than those online were correlated with their satisfaction with their teachers' teaching methods in class (ρ = .318; p < .001) but not with their satisfaction with their teachers' teaching methods during remote learning (ρ = –.120; p = .177).

Regarding the differences between genders and singular questionnaire items, the Mann-Whitney U test was computed for every variable with no statistically significant differences found between boys and girls in their perceptions concerning the differences between online and in-class lessons.

5.3 The Changes in Students' Grades

At the end of January 2021, the students had an average mathematics grade of M = 7.73 (SD = 1.49; min = 3; max = 10), while their average grade at the end of the school year (i.e., in June 2021) was M = 8.22 (SD = 1.35; min = 4; max = 10). The Wilcoxon rank test indicated differences between the students' January (R = 39.09) and June (R = 40.88) grades: the end-of-year grades were higher than those in the first semester (Z = –4.689; p < .001; Cohen's d = .471).

At the end of the first semester, the boys had an average grade of M = 7.56 (SD = 1.44; min = 5, max = 10), while the girls had an average grade of M = 7.87 (SD = 1.52; min = 3; max = 10). At the end of the school year, the boys had an average of M = 8.02 (SD = 1.38; min = 6; max = 10), while the girls had an average of M = 8.38 (SD = 1.32; min = 4; max = 10). Concerning the differences between the boys (R = 57.94) and the girls (R = 67.24), no statistically significant differences were found at the end of the first semester (U = 1650; p = .145). Similarly, no statistically significant differences between the boys (R = 57.39) and the girls (R = 67.71) were found at the end of the second semester (U = 1618; p = .105). Hence, the boys and the girls had almost the same grades in mathematics at the end of both semesters.

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The students' maths grades at the end of the first semester and those at the end of the school year were positively and statistically significantly correlated ($\rho = .772$; $p < .001$). That is, higher school grades at the end of the first semester also indicated higher grades at the end of the second semester.

6. Discussion

The Covid-19 pandemic has had a strong impact on education (Sahu 2020; Dietrich et al. 2020; Aristovnik et al. 2020; Chakraborty et al. 2020), especially among minority students (Eurac Research 2020; Riman 2020; Zorčič 2020; Sorgo & Lukanovič 2020). Studies concerning the Slovene minority in Italy (Brezigar 2020; Bogatec et al. 2021) have highlighted fundamental issues, such as communication problems related to the delivery of the class materials in the Slovene language (cf. Bogatec 2015; Grgič 2017; 2019). Concerning mathematics specifically, this subject represents an additional issue for Slovene students in Italy. In particular, since the Italian mathematics program differs from the Slovene one, the availability of materials in the Slovene language that cover topics included in the Italian program are scarce or non-existent, so teachers need to prepare their own materials or translate materials that are available in the Italian language. The unavailability of digital materials (cf. Grgič 2019), which also affects mathematics, could be an additional issue for minority students. Therefore, exploring students' perceived differences between in-class and remote learning is important to gain a clearer picture of the quality of students' learning in this subject.

Considering these issues, the first aim of our research was to investigate students' satisfaction with the maths teachers' teaching methods both before and during the pandemic. Our study confirmed the findings of previous research (Gonçalves et al. 2020; Lassoued et al. 2020; Coman et al. 2020), showing that students were more satisfied with their teachers' teaching methods in class than online, since during the remote learning period, the students' satisfaction decreased.

In terms of the teaching and learning of mathematics specifically, previous studies have shown that students learn mathematics more effectively in class than during remote learning (cf. Chen et al. 2020; Yohannes et al. 2021). The students felt that their teachers' explanations in class were better than those given during the remote learning period, and it was easier to follow traditional lessons than online lessons, which might be related to the students' attention span during in-class and remote-learning teaching formats, as well as the teachers' readiness to switch from one teaching format to the other.

In addition, the present study, which focused on a specific group of Slovene minority students in Italy, showed that the students expressed lower levels of satisfaction with their teachers' methods during remote learning in comparison

to in-class learning. This might be connected to the fact that these teachers and students found themselves in the situation of not having the appropriate digital learning materials in the Slovene language for the topics studied (Grgič 2019; Bogatec et al. 2021). Also, some students could not rely on their parents' help, as many of them did not speak Slovene or understand specific Slovene mathematical expressions. Moreover, they could not take advantage of interaction with their peers from the Slovene community. As Bogatec et al. (2021) stressed, students' linguistic skills worsened during the pandemic. It is also necessary to emphasise that the results also showed that students with higher grades expressed a higher level of satisfaction with the teaching methods, compared to students with lower grades. In summary, the results supported the need to create the necessary paper and online resources for mathematics lessons, which would serve as a bridge between the Italian syllabus and Slovene learning materials, thus providing teachers and students with the possibility of gaining better learning outcomes. Special attention needs to be paid to the design of the necessary resources for improving learning outcomes, including those of lower achievers.

The second aim of the research was to establish students' perceived differences between remote and in-class mathematics learning. Previous research (cf. Gonçalves et al. 2020; Lassoued et al. 2020; Surani & Hamidah 2020; Gonzalez et al. 2020; Giatman et al. 2020) illustrated that students were more motivated for learning and more involved in class activities in class than online, but they felt more relaxed at home. The drop in students' motivation during remote learning might be the result of less interaction with peers and schoolmates, including the lack of certain lesson activities (e.g., pair work, group work and project work; cf. Cerbara et al. 2020). Considering the specific case of the Slovene minority in Italy, as emphasised by Brezigar (2020), students normally participate both in sports and cultural clubs, where they meet their schoolmates and friends, and actively use the Slovene language. However, Covid-19-related remote learning impeded the students from having quality face-to face interactions in Slovene (Brezigar 2020). During remote lessons, the students mostly had their microphones and cameras off, which made interaction even more difficult (Giatman et al. 2020; Lassoued et al. 2020). Considering the specific situation of the participants in this study, we believe the teachers should put more effort into planning and delivering online mathematics lessons that increase interactive activities (e.g., in pairs and in groups), thus providing students with the opportunity to interact in Slovene on mathematical issues in a physical or virtual environment, supported by constant teacher scaffolding.

Thirdly, we wanted to find out whether students' mathematics grades before and after the second remote learning period changed. We found statistically significant differences, demonstrating that grades in June 2021 were higher than those in January 2021. Students thus achieved higher grades at the end of the school year. However, we did not detect any gender differences in grades. More-

over, the students' grades were positively correlated, meaning that students with higher grades at the end of the first semester also achieved higher grades at the end of the school year. The results are not surprising, since earlier studies (Gonçalves et al. 2020; Gonzalez et al. 2020) also reported that students achieved higher grades after the first pandemic period in comparison to their achievements before the remote learning period. At this point, we must highlight that all these results do not correspond to students' achievements at the Italian national assessment of mathematics knowledge (INVALSI), which revealed that students' attainments in 2021 were lower than in 2019 (INVALSI 2021). This discrepancy might reflect the possibility that students may have cheated during online exams and tests (Bilen & Matros 2020; Nguyen et al. 2020), which could have contributed to their higher grades. However, it is also possible that teachers, as a result of their understanding and sensibility towards students who were not given the opportunity to learn mathematics in class, lowered their expectations, resulting in higher grades. The question is whether this evident lack of knowledge will impact students' further mathematical learning.

7. Limitations and Recommendations

The present study is not without limitations. Firstly, the present research is based on an online survey, with certain limitations associated with this context. Secondly, the sample might not be large enough, as the Covid-19 pandemic required researchers to contact students via e-mail, thus decreasing the possibility of generating a larger sample. Lastly, the since students were contacted via e-mail, there was no way of knowing who was answering the questionnaire.

Despite obvious limitations, our work provides some insights from the very specific context of Slovene minority students in Italy. It also considers the second pandemic period, which needs to be studied in further detail by the international scientific community.

Based on our findings, we recommend that legislators and school authorities continue researching the problem of students' perceptions of remote learning, especially among minority students, and in terms of its connection to mathematics teaching and learning. Such research has the potential for increasing the quality of remote learning. We suggest enriching our results from quantitative research with qualitative research to gain a deeper understanding of the second quarantine period. Finding more efficient teaching methods for remote classes would permit students to be both more active and more concentrated during online lessons, which would lead to greater achievements and more knowledge.

Remote learning has been an emergency attempt to continue educational activity during the pandemic period. However, based on students' perceptions, we state that students feel that remote learning is not as effective as traditional, in-class mathematics learning.

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Appendix A

1. Gender
   a. Male
   b. Female
2. Age
3. Year
   a. 1st year of high school
   b. 2nd year of high school
   c. 3rd year of high school
   d. 4th year of high school
   e. 5th year of high school
4. School
   a. Lyceum France Prešeren (TS)
   b. Lyceum Anton Martin Slomšek (TS)
   c. Technical school Jožef Stefan (TS)
   d. Technical school Žiga Zois (TS)
   e. Lyceum Simon Gregorčič (GO)
   f. Lyceum Primož Trubar (GO)
   g. Technical school Žiga Zois (GO)
   h. Technical school Jurij Vega (GO)
5. Grade in mathematics at the end of the 2020/21 school year [1–10]
6. Grade in mathematics at the end of the first semester of the 2020/21 school year [1–10]
7. How satisfied were you with your mathematics teacher's teaching method in class? [Likert scale]
8. How satisfied were you with your mathematics teacher's teaching method during the remote teaching and learning? [Likert scale]
9. Please, indicate to what extend you agree with the following statements [Likert scale]:
   a. [Item1] Lessons in class are better than lessons online.
   b. [Item2] I have a better grasp of the topics that we do in class.
   c. [Item3] Lessons in class are easier than those online.
   d. [Item4] I learn more in class.
   e. [Item5] The explanations in class are better than those given during quarantine.

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f. [Item6] It is easier to follow the lesson in class than online.
g. [Item7] At school I was more motivated than online.
h. [Item8] At school I was more relaxed than online.
i. [Item9] In class I was more stressed than online.
j. [Item10] I participate more in class than online.
k. [Item11] In class I am more concentrated than at home.
l. [Item12] At school the studied topics were clearer than online.
m. [Item13] At school I had more energy.
n. [Item14] At school we did more of the program than at home.
o. [Item15] Taking tests at school is better than at home.