AI nella scuola italiana

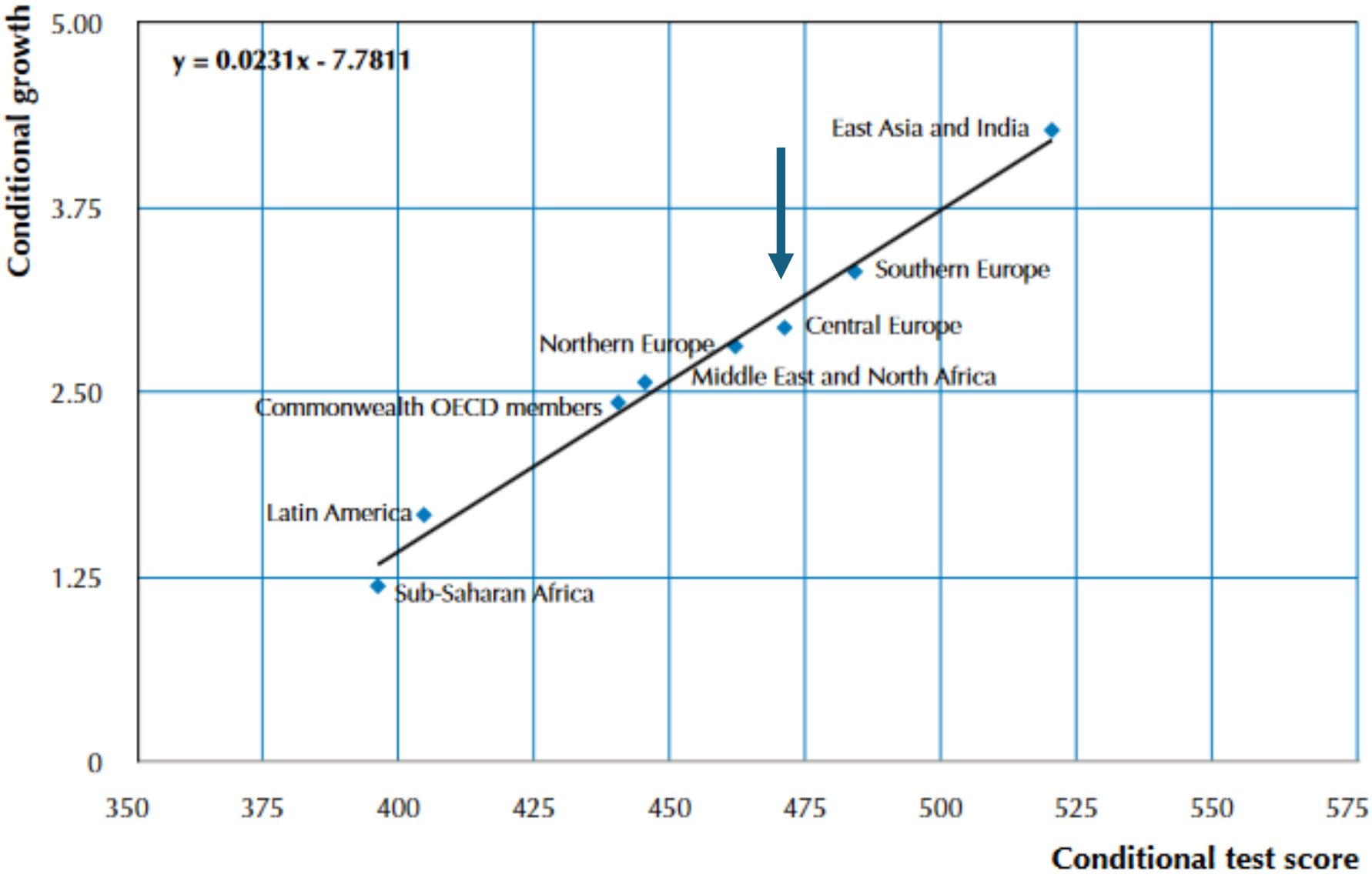
Paolo Branchini INFN Sezione RomaTre

Roma «La Sapienza» 20/11/2024

Argomenti toccati

1) Perche`? Il valore del capitale umano.
2) Le STEM nel mondo.
3) La situazione in Europa.
4) La situazione in Italia.
5) Il problema di Bloom.
6) Nuove opportunita` legate all`utilizzo di AI.

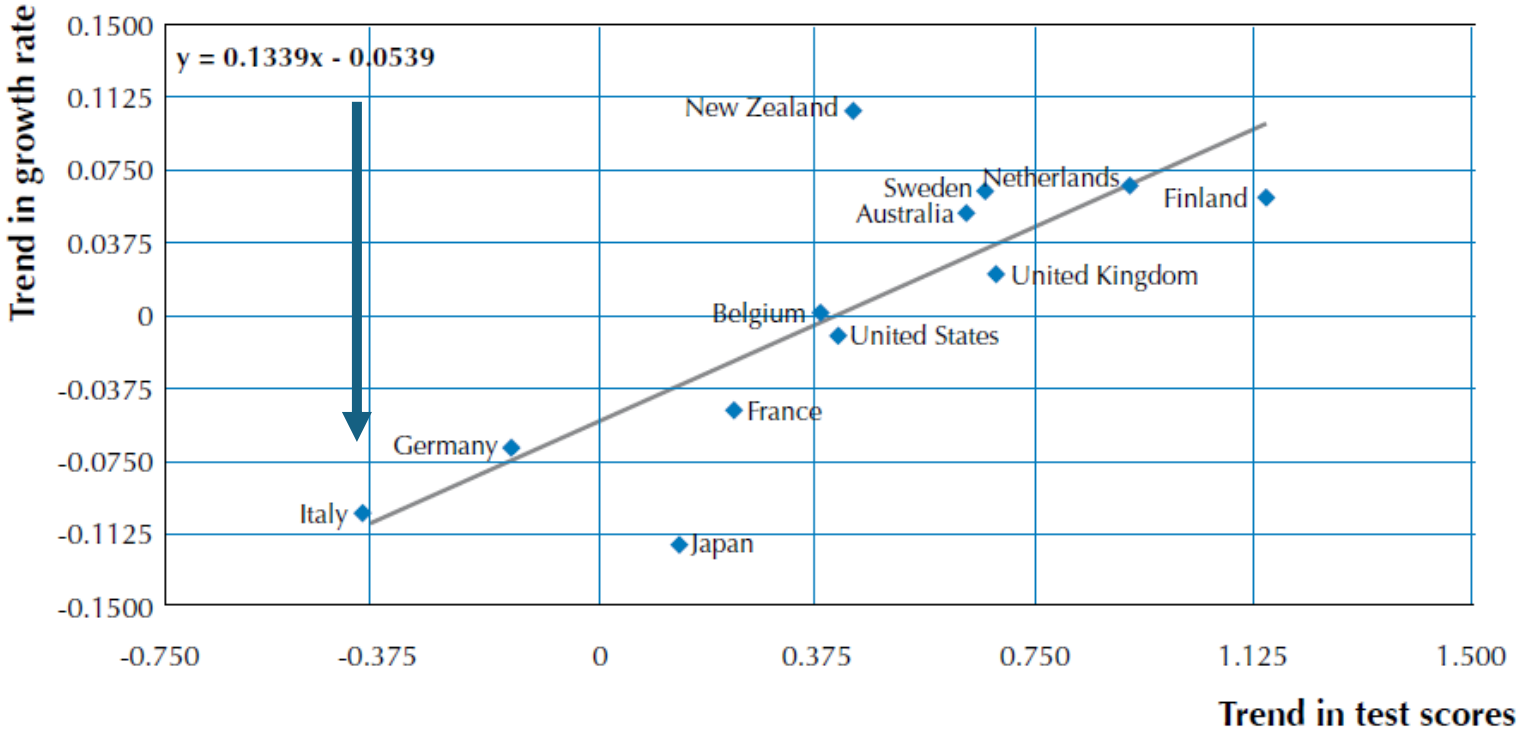
Il valore del capitale umano macroaree



1960-2000
Per macro area
Hanushek and Woessaman
2009

Source: The High Cost of Low Educational Performance THE LONG-RUN ECONOMIC IMPACT OF IMPROVING PISA OUTCOMES 2010

Trend per Paese

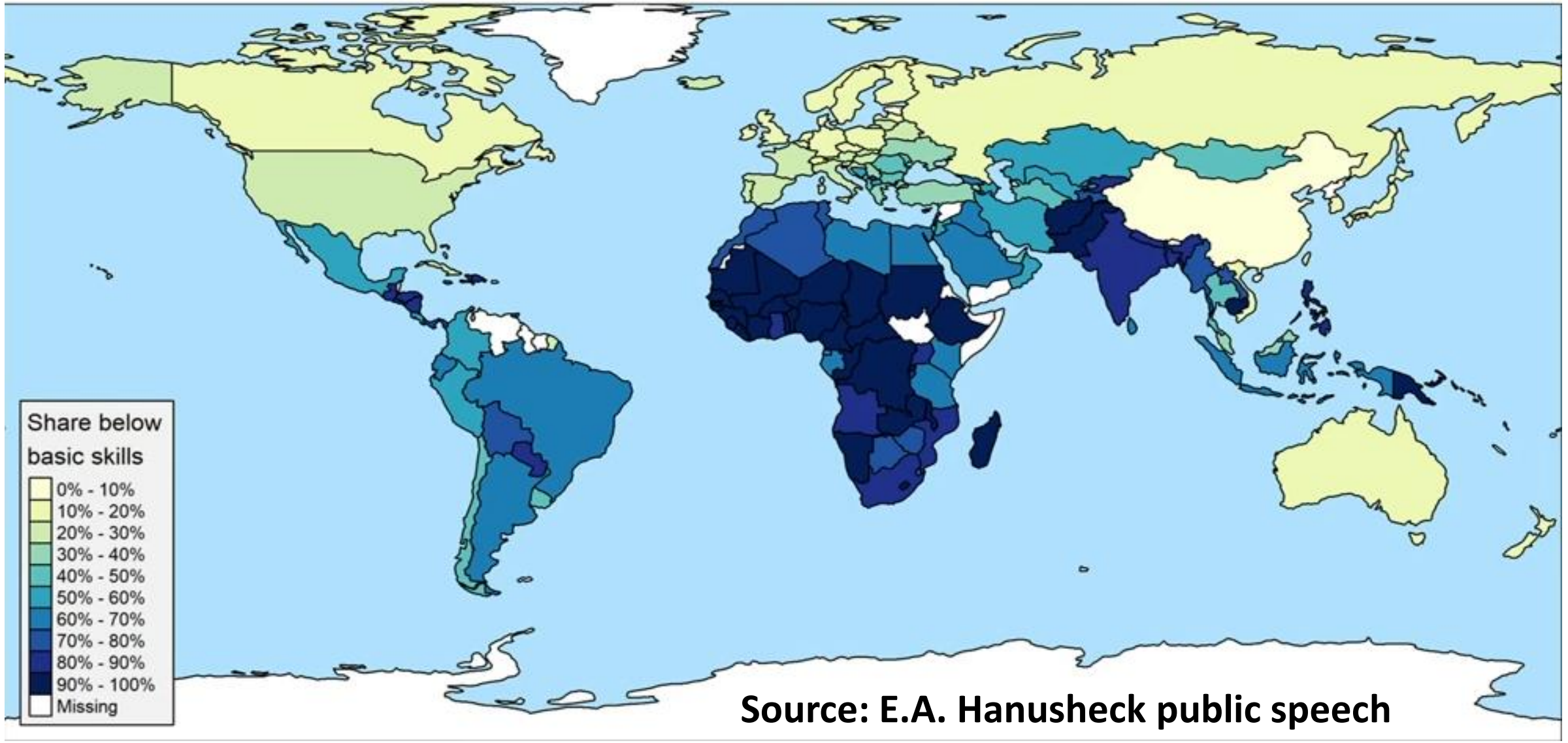


Problema del tasso di cambio

	GDP/pop ($)	School Attendance[a] (%)	Less than Basic Skills (%)
All Countries	24,227	71.0	60.3
High Income	52260	92.4	26.8
Upper Middle Income	17765	78.4	61.1
Lower Middle Income	6844	57.6	82.6
Low Income	1929	28.2	97.8

Source: E.A. Hanusheck public speech

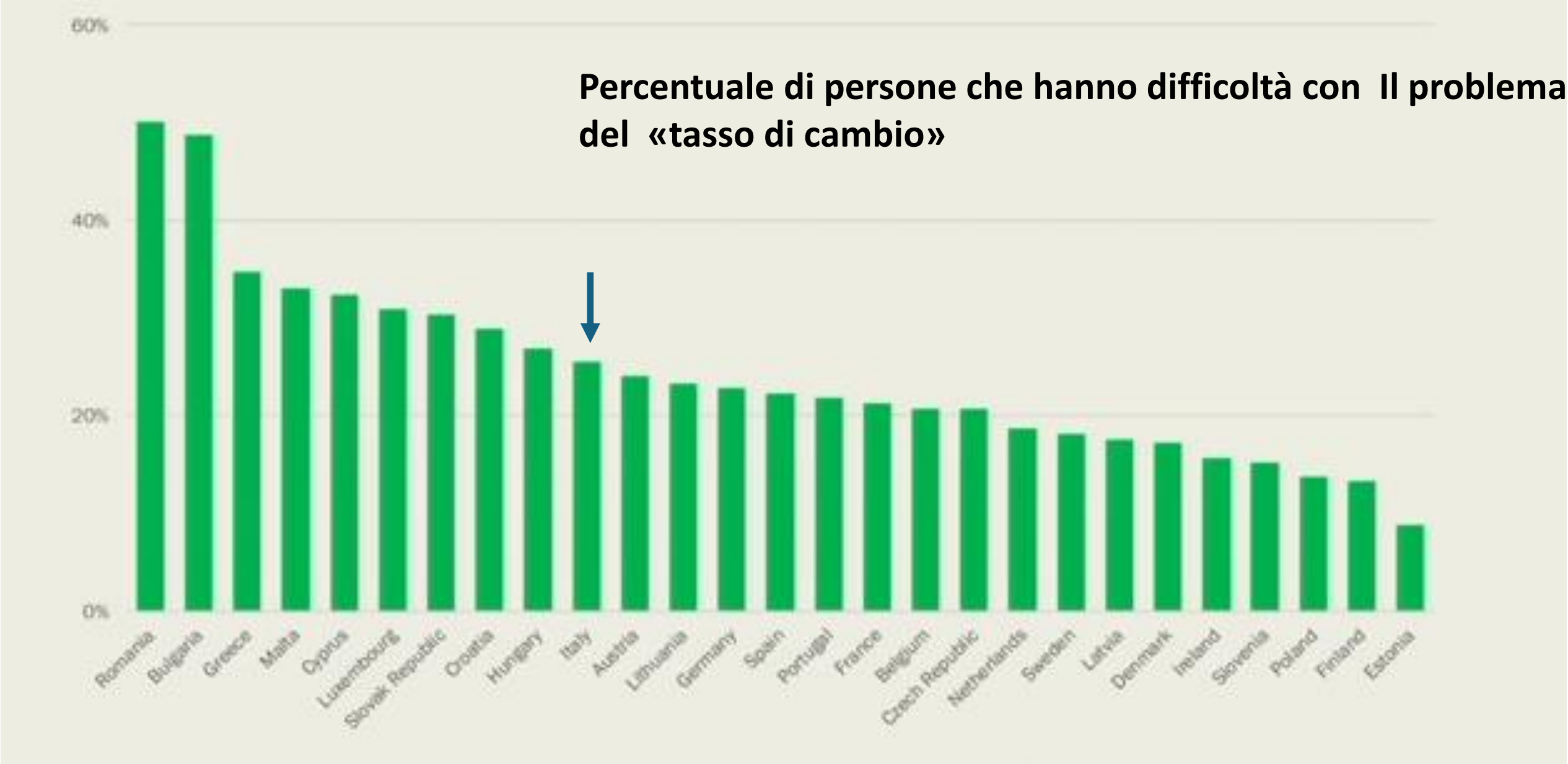
Problema del tasso di cambio mappa mondiale



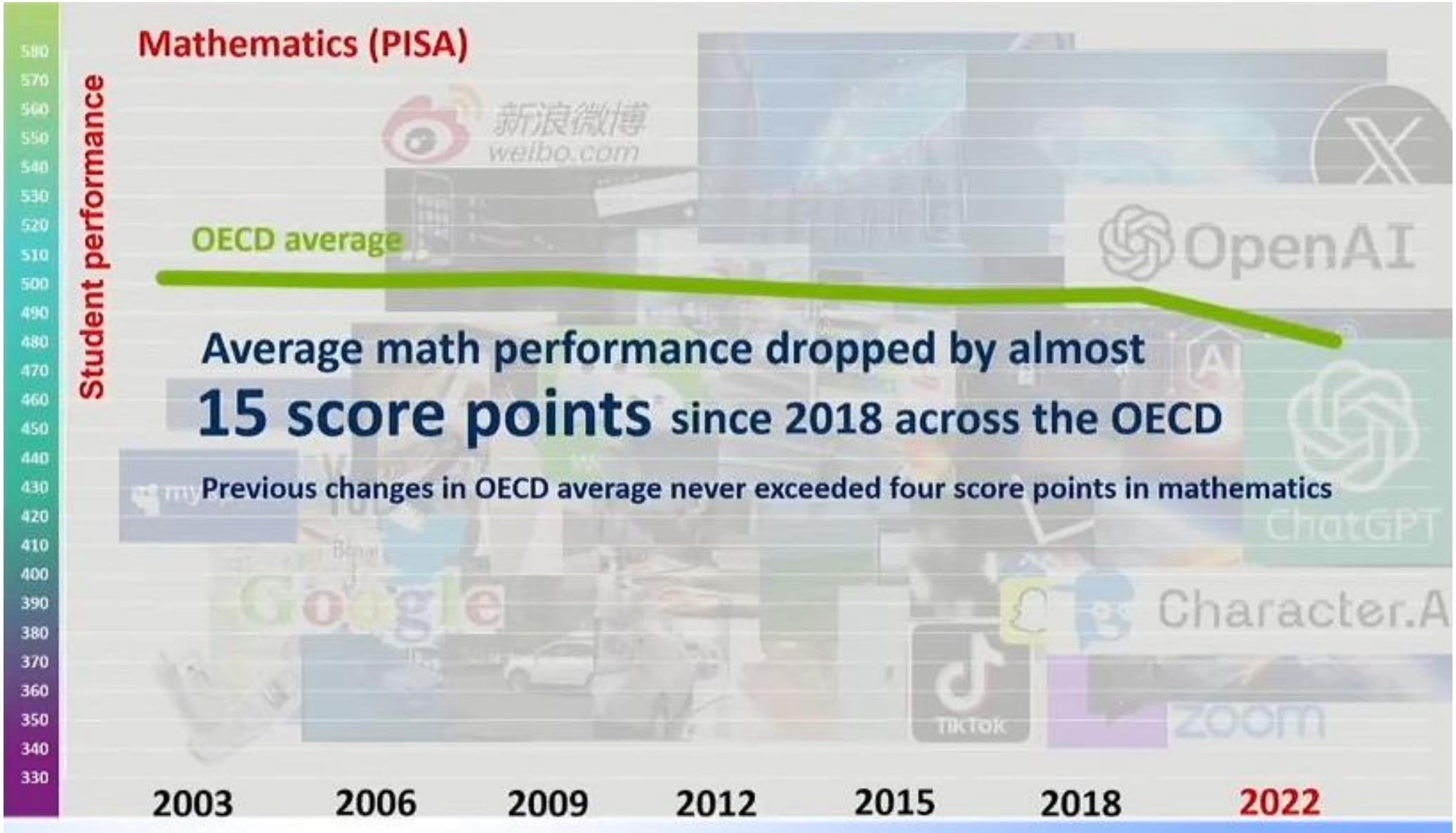
Source: E.A. Hanusheck public speech

Situazione in Europa

Percentuale di persone che hanno difficoltà con Il problema del «tasso di cambio»



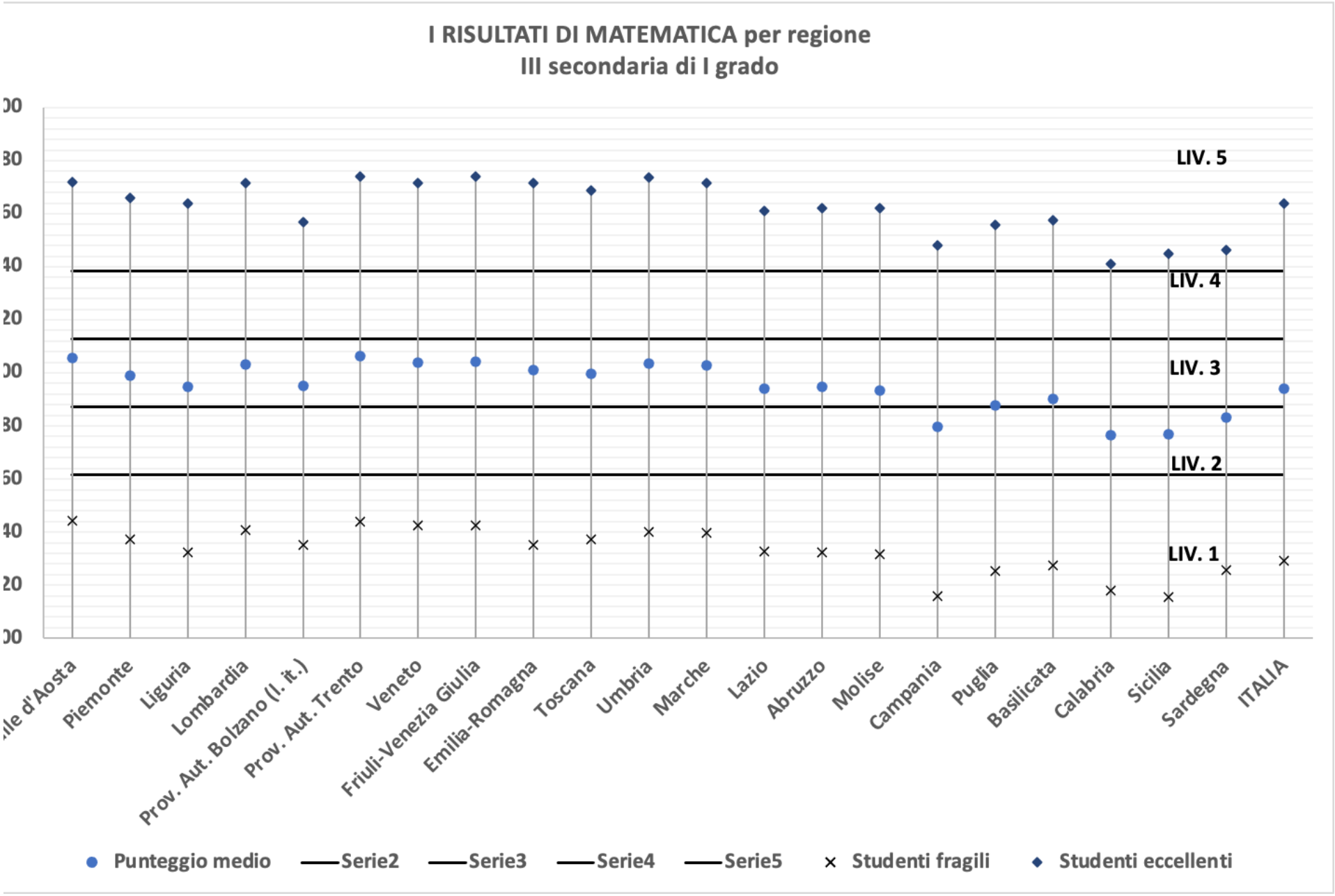
Stato attuale delle STEM nel mondo



Stato attuale delle STEM: la realtà italiana

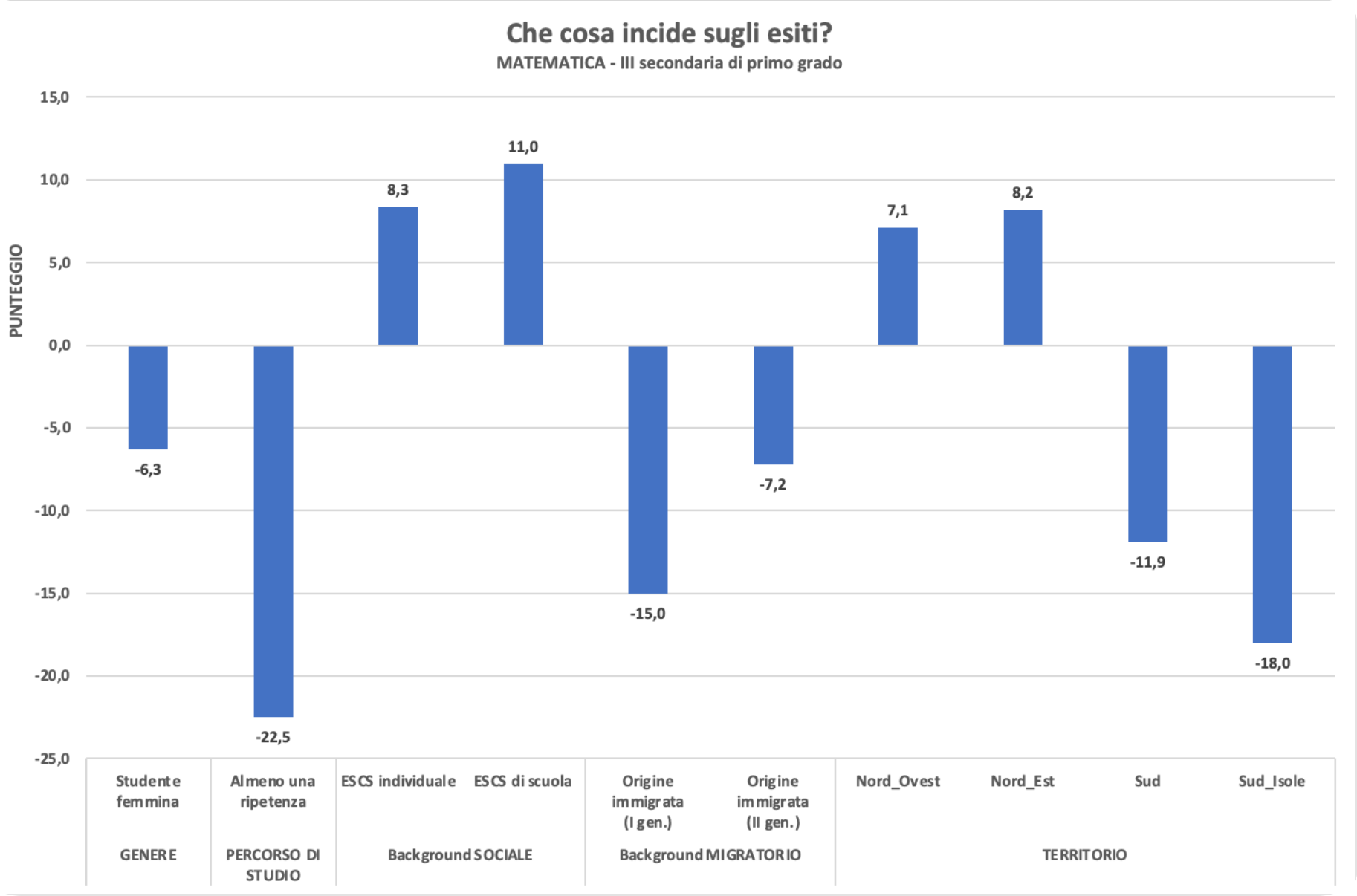
Livello	III secondaria di primo grado	II secondaria di secondo grado	Ultimo anno della secondaria di secondo grado
1	Risultato molto debole, corrispondente ai traguardi di apprendimento in uscita della V primaria	Risultato molto debole, corrispondente ai traguardi di apprendimento in uscita della III secondaria di primo grado	Risultato molto debole, corrispondente ai traguardi di apprendimento in uscita al massimo dalla II secondaria di secondo grado
2	Risultato debole, non in linea con i traguardi di apprendimento posti al termine del primo ciclo d'istruzione	Risultato debole, non in linea con i traguardi di apprendimento posti al termine della classe II sec. di II gr.	Risultato debole, non in linea con i traguardi di apprendimento posti al termine del secondo ciclo d'istruzione
3	Adeguato	Adeguato	Adeguato
4	Risultato buono	Risultato buono	Risultato buono
5	Risultato molto buono	Risultato molto buono	Risultato molto buono

Stato attuale delle STEM: la realtà italiana



Fonte: invalsi 2022
III secondaria
primo grado

Ma il successo da cosa è condizionato?

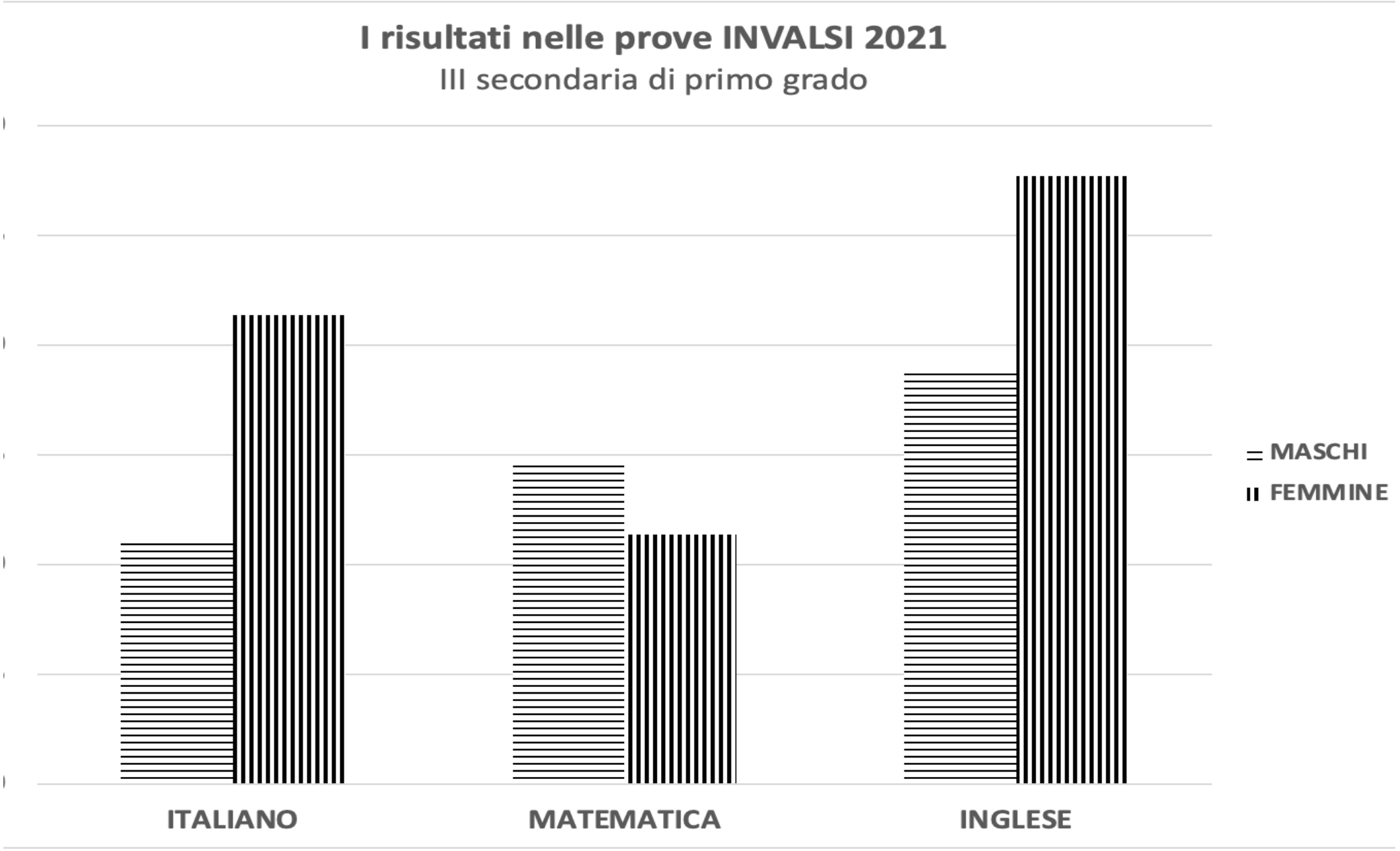


Il peso di alcuni fattori sull'esito della prova di Matematica al termine del primo ciclo d'istruzione

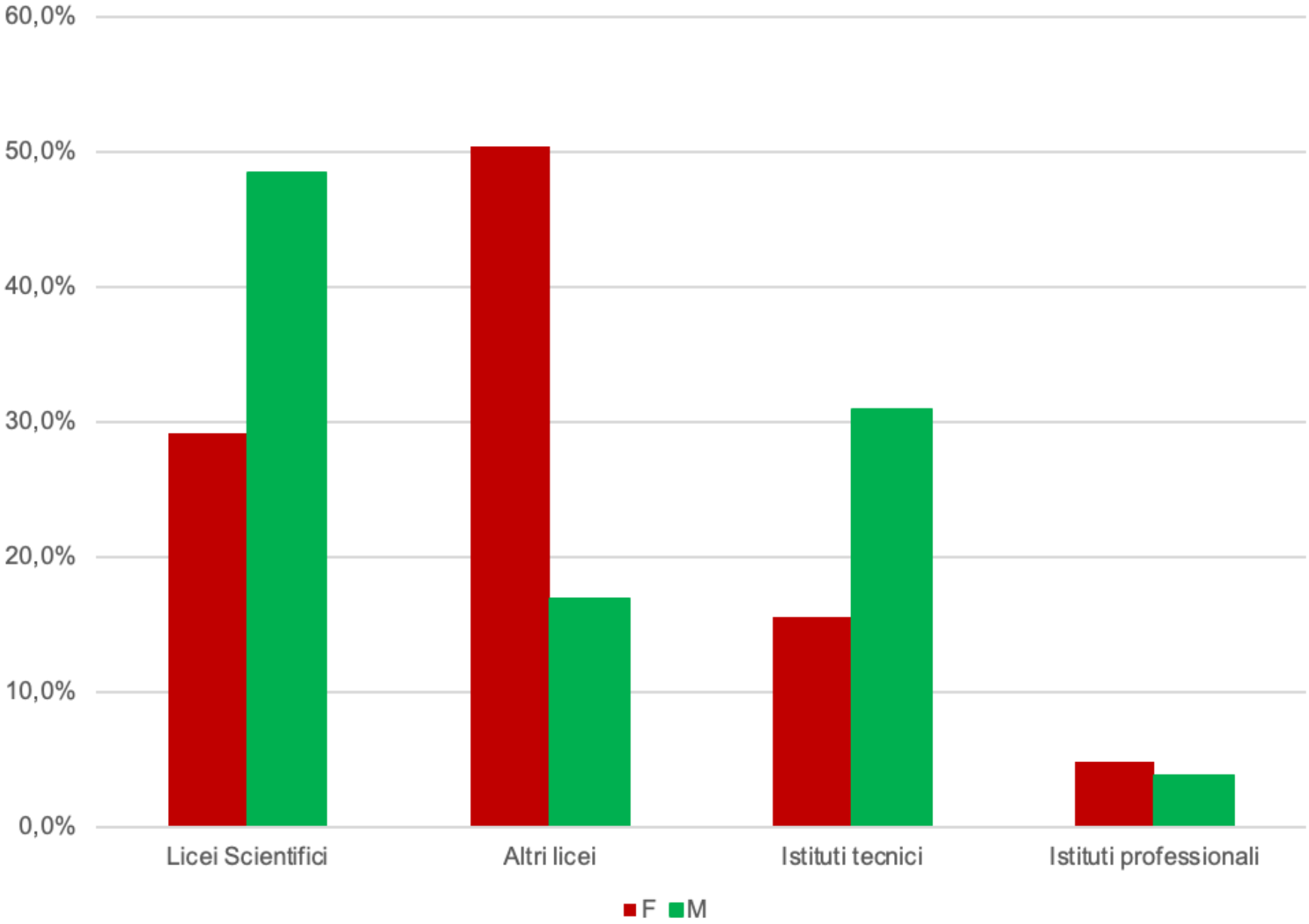
(fonte: INVALSI 2022)

19 punti sono circa equivalenti alla preparazione di un anno.

Gli esiti per genere



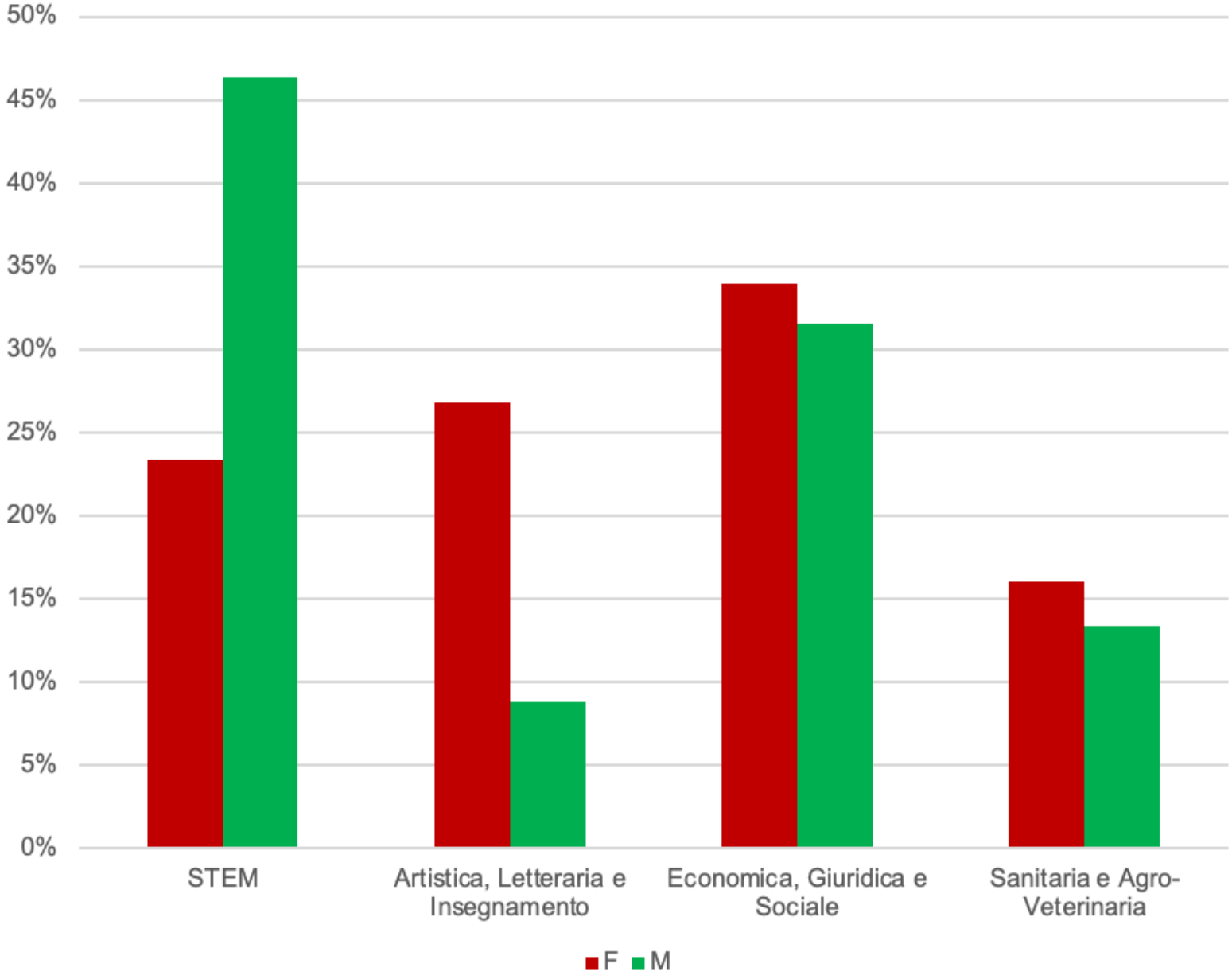
Accesso al liceo



Distribuzione per genere negli indirizzi scolastici di studio

Fonte: MIM, elaborazione INVALSI, a.s. 2018-19

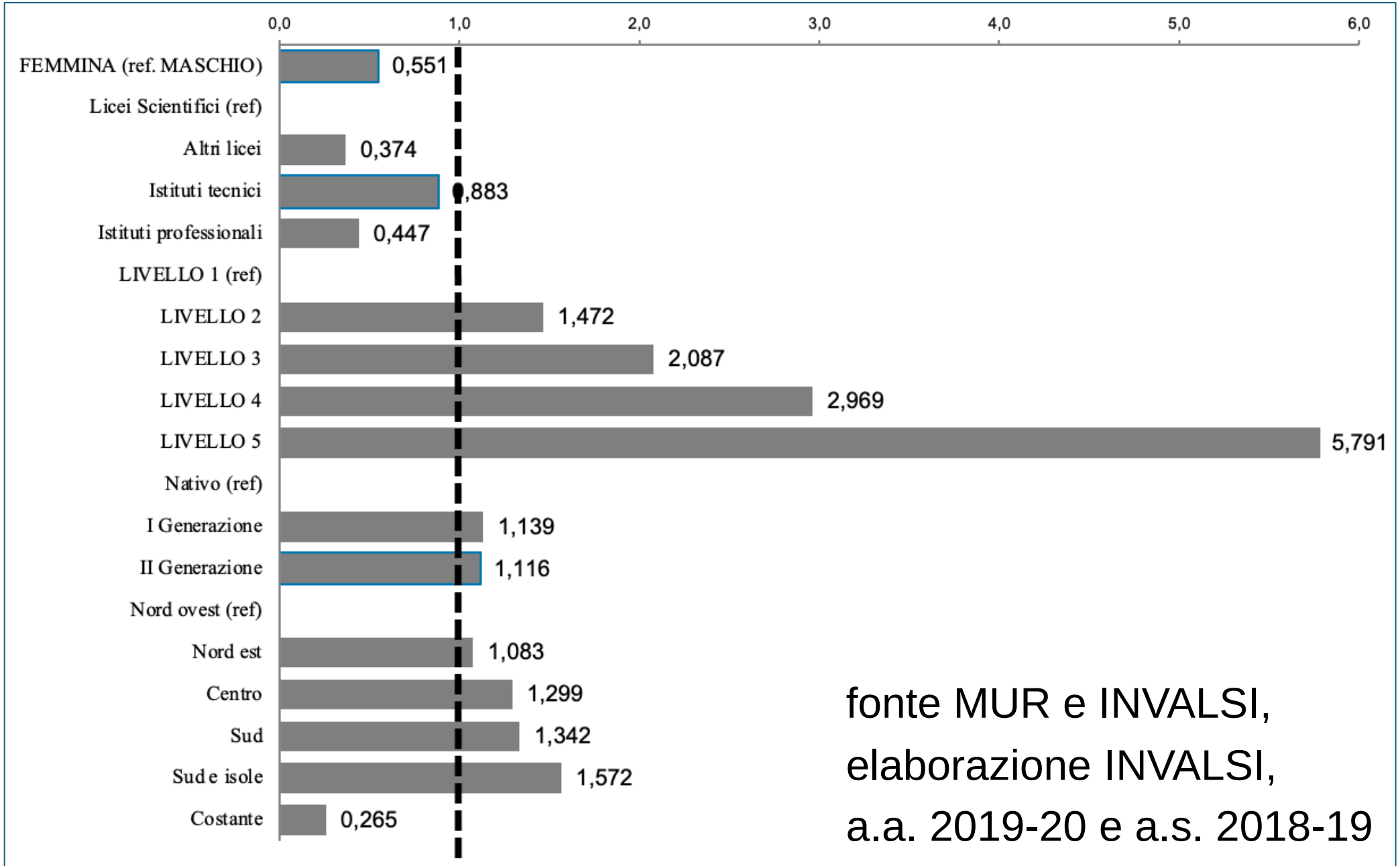
Accesso all'Università



Distribuzione per genere negli indirizzi universitari di studio

fonte MUR, elaborazione INVALSI, a.a. 2019-20

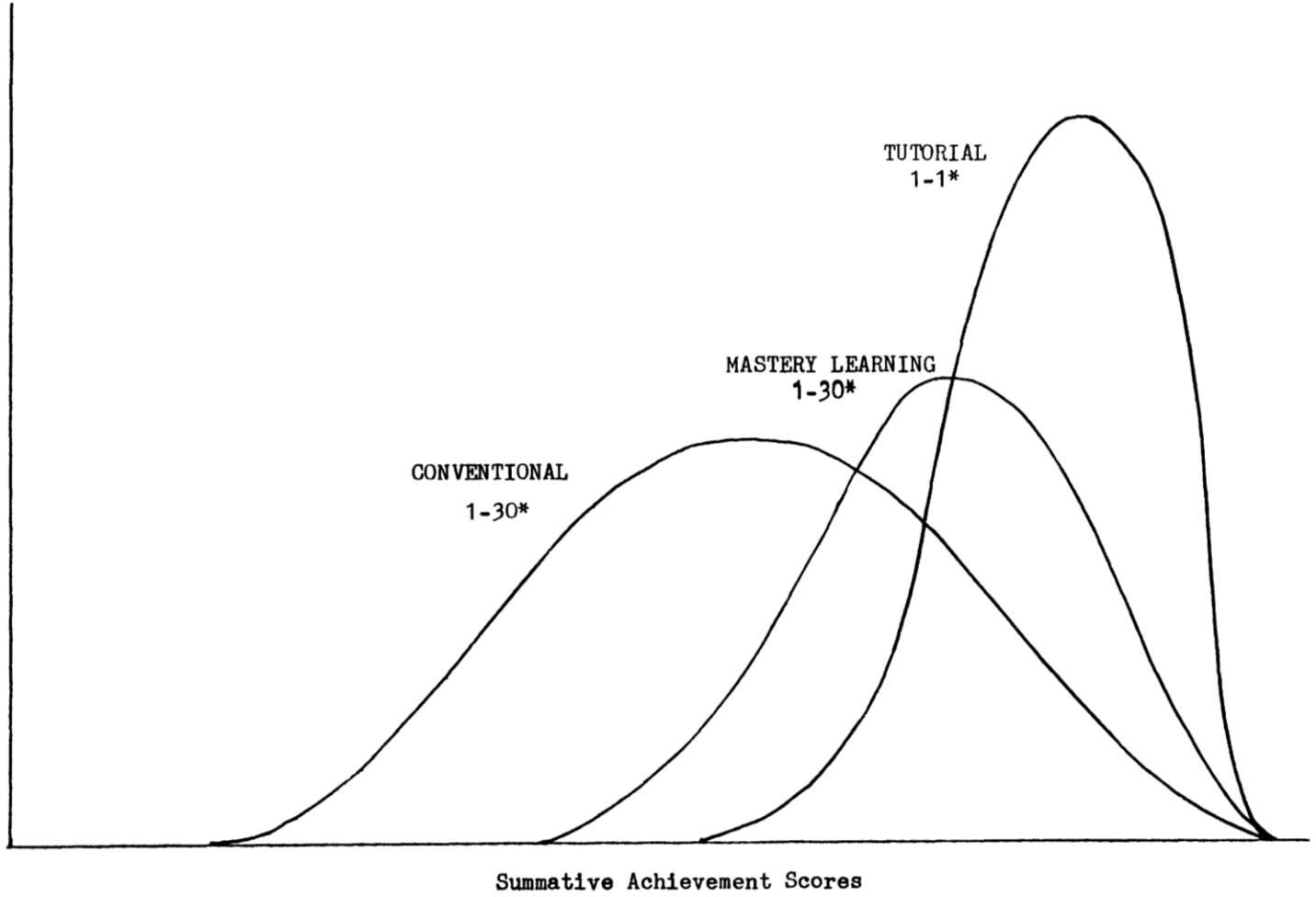
Fattori che incidono sulla scelta STEM



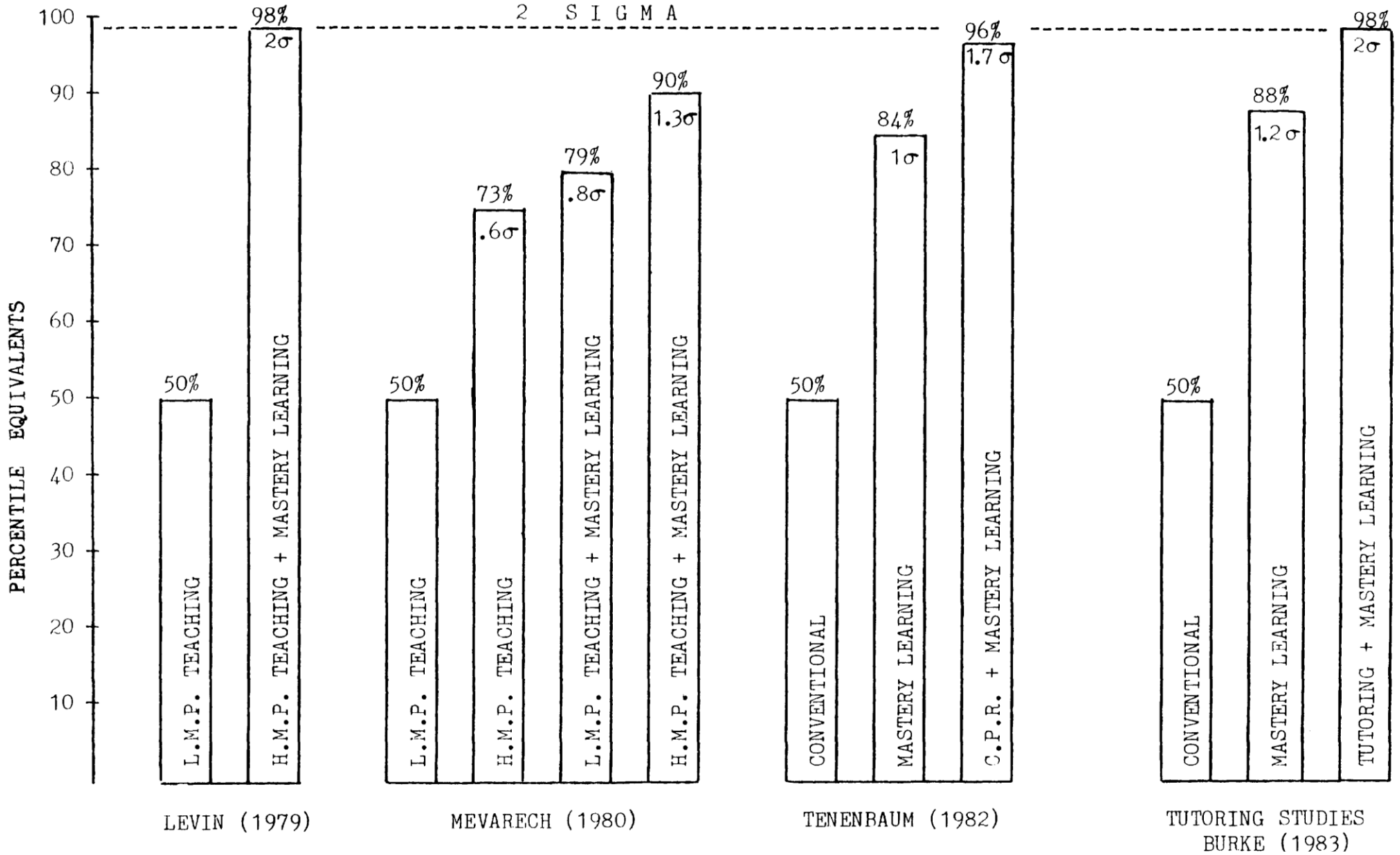
fonte MUR e INVALSI,
elaborazione INVALSI,
a.a. 2019-20 e a.s. 2018-19

Il test di Bloom in pillole

Source: The 2 Sigma problem: The Search for Methods of Group Instruction as Effective as One-toOne Tutoring



Quantificazione

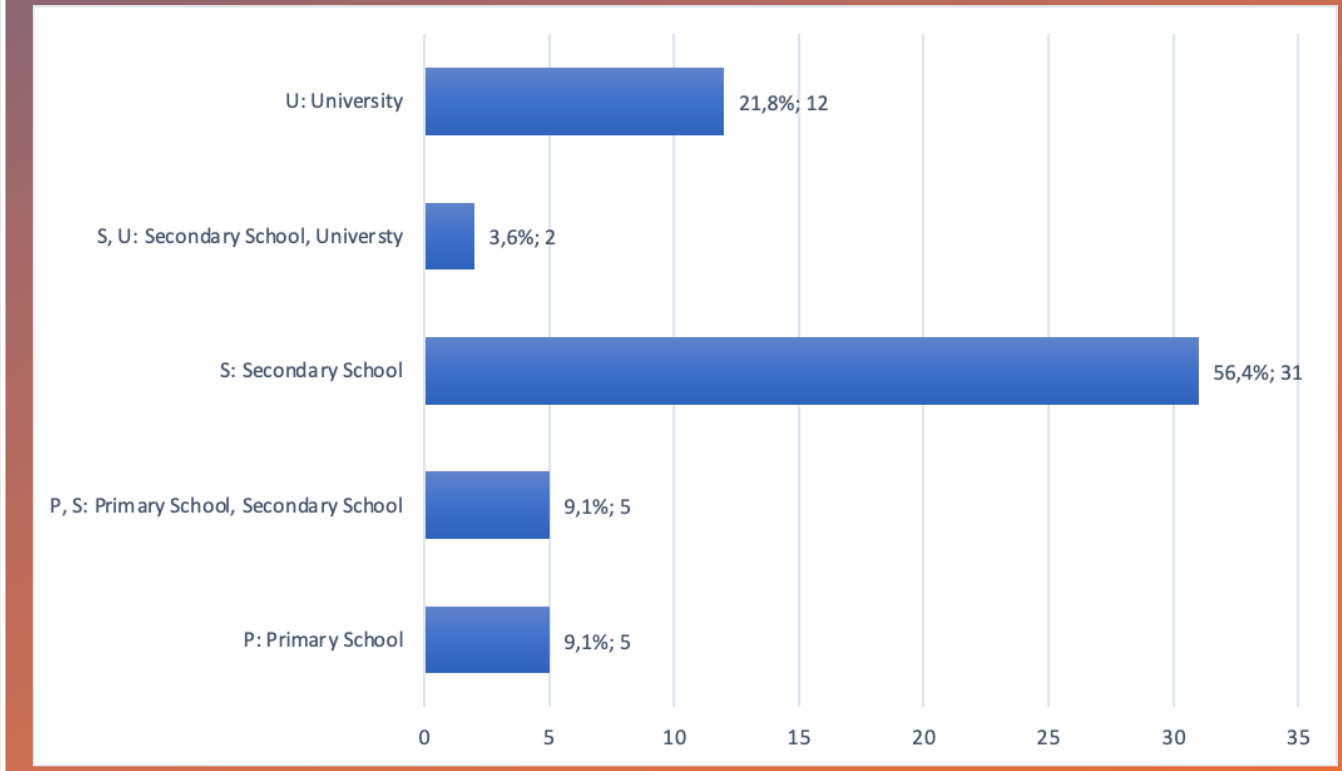


Ma internazionalmente cosa è stato fatto?

Techniques and applications of Machine Learning and Artificial Intelligence in education: a systematic review

DOI: https://doi.org/10.5944/ried.27.1.37491

Quali classi sono state coinvolte?



Quali sono le opportunità evidenziate in questi studi?

- the opportunities for improvement in teaching-learning processes and educational management can be grouped into the following categories: prediction of academic performance and school dropout, analysis of student and teacher perception, development of virtual robotics, learning on generative models, implementation of AI and ML, insertion of computational thinking at all levels, strengthening the legal framework in education, efficiency of school management, social robotics intervention, computer security training, incorporation of AI in clinical education, STEM for forensic analysis and AI support in students with special educational needs (SEN), among others.

Cosa è stato fatto?

A livello di utilizzo di AI, AI è stata usata per argomenti specifici.

Un solo curriculum di informatica 30 ragazzi è stato potenziato per intero.

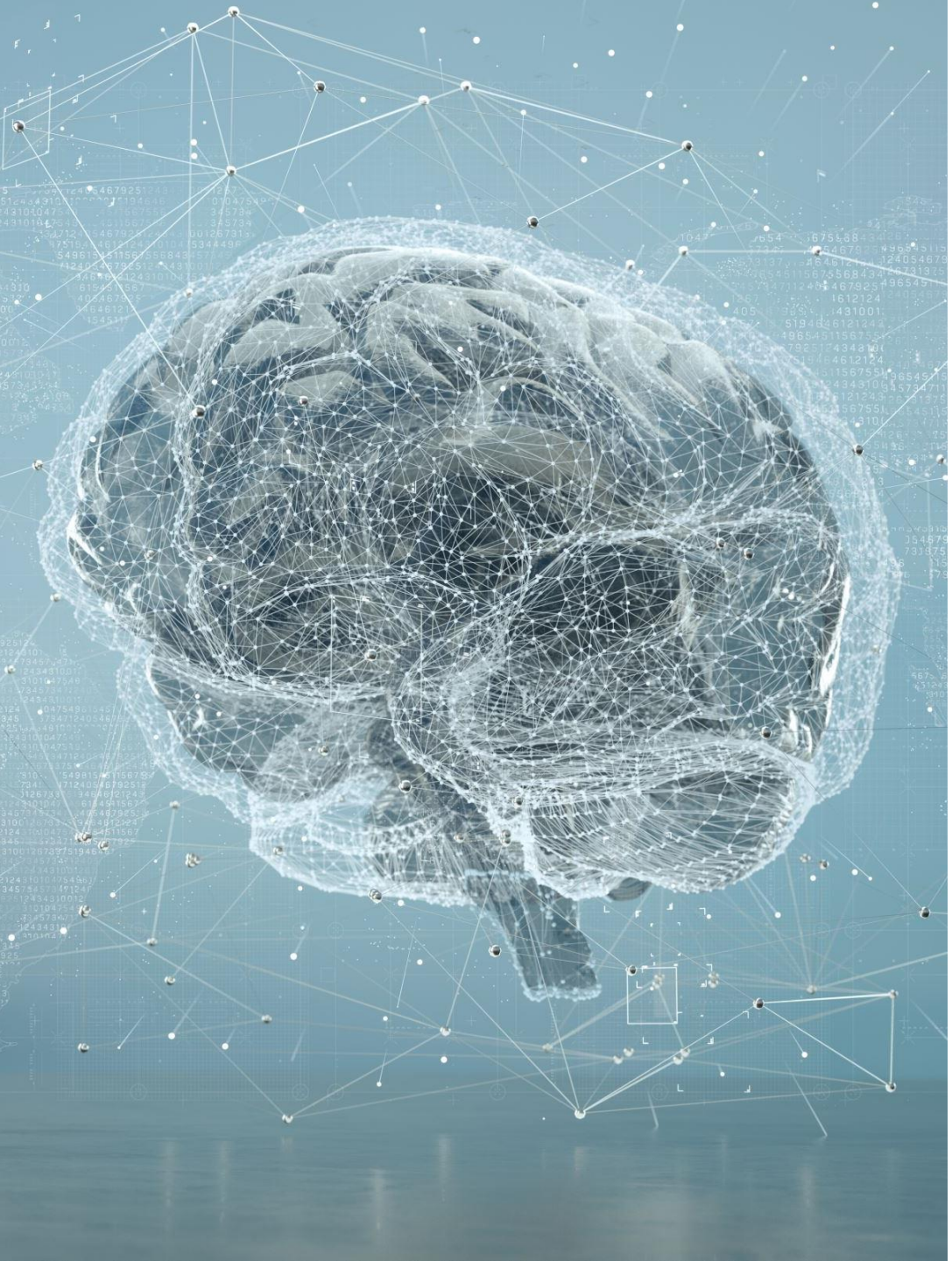
Cosa si può fare

- Detect students' academic performance early.
- Improve the educational skills of teachers.
- Facilitate the learning of students with autism spectrum disorders (ASD).
- Predict school dropout and make decisions about it.
- Improve and generate educational content.
- Close educational gaps.
- Implement AI teaching at all educational levels.
- Strengthen the information security of the educational community.
- Motivate learning through mobile devices.
- Strengthen the field of robotics.
- Improve academic and career guidance for students.
- Prevent the spread of fake news on social networks.
- Understand and reflect on the relationship between humans and machines.
- Develop critical thinking based on computational thinking.

Cosa vogliamo fare noi?

Utilizzare la tecnologia per potenziare sia lingue che STEAM.

Avviare uno studio sistematico per valutare i risultati.



Progetto IMPAR-AI

Intelligenza Artificiale (IA) per il Potenziamento dell'Apprendimento

Il progetto in pillole

L`idea è di ripetere il test di Bloom utilizzando degli assistenti virtuali basati su AI

E` un progetto pilota sono coinvolte poche classi 15 e le relative gemelle che utilizzeranno una didattica Standard.

Sono state selezionate 4 regioni in modo da poter avere un campionamento della realtà italiana.

Sono coinvolte le USR delle relative regioni.

Le fasi del progetto

Una prima fase prevede la formazione dei docenti con almeno 2 sessioni entrambe di 3 ore: si conclude entro la fine di novembre 24

Una seconda fase di utilizzo delle suddette tecnologie sia in aula che nell'assegnazione dei compiti e da parte degli alunni a casa.

Saranno previsti checkpoint ed eventualmente ulteriori sessioni di formazione anche a seguito del lancio da parte di altre tecnologie o di aggiornamenti.

Strategia

Al momento sono coinvolte classi di seconda media oppure primo anno di scuola superiore o quarto anno di scuola superiore.

Essendo il progetto biennale ci sarà un controllo utilizzando il sistema invalsi sul campione selezionato alla fine dei due anni.

Ci saranno anche controlli intermedi per poter comprendere la validità dei tool utilizzati.

E` stato scelto di fare un pilot su poche classi per poter meglio controllare nel corso dell`evoluzione il progetto.

Il progetto è completamente gratis per lo stato e le scuole.

La formazione degli insegnati è prevista entro Ottobre.

Breve descrizione dei tool

Il tool consente una completa personalizzazione dell'apprendimento ed un controllo con feedback immediato delle attività proposte per la classe.

Il docente può utilizzare contenuti già noti o contenuti presenti nella sua libreria. Quando viene proposto un esercizio al discente in caso di errore c'è un esame immediato da parte dell'AI dell'errore e lo studente viene guidato attraverso il materiale di supporto che il docente ha definito.

Tutto questo permette una didattica agile e personalizzata in modo da poter sostenere lo studente.

È anche possibile per lo studente scrivere la risposta ad un quesito utilizzando la penna direttamente sul device informatico.

Inoltre gli Insegnati avranno anche a disposizione la possibilità di generare contenuti trami AI generativa.

Back up

	Nº	Study	Sample	Methodology	Results
	1	(Araya & Sossa- Rivera, 2021)	4 teachers and first grade students	Basic heuristics	It is possible to estimate the direction of the teacher and the orientation of the head and body of students with ML.
	2	(Dai et al., 2022)	23 primary school computer science teachers	Triangulation between ethnographic observation, interviews, and artefacts with teachers.	Influences for curricular incorporation of AI faculty at a partner university
	3	(Almeida Pereira Abar et al., 2021)	11 teachers	Qualitative and action-research	Computational thinking in basic education helps children in solving all kinds of problems.
	4	(Ceha et al., 2022)	5 primary school and secondary school teachers	Participatory design, qualitative method, Engeström's Activity System Model	The teachers answered positively to the idea of introducing a social robot as a technological tool for learning activities.
	5	(Luo et al., 2021)	1,306 primary school students on an online learning platform	Application of ML algorithms	Students with shy behavior, cognitive and emotional problems have unique characteristics in language style.
	6	(Costa Mendes et al., 2021)	362,261 scores of pre-schools, primary and secondary school student	Mixed (Quantitative and Qualitative)	Socio-economic indices have inherently limited predictive power.
	7	(Aljabri et al., 2021)	3,200 tweets in Arabic	Analysis of people's tweets about distance learning in Saudi Arabia	This result can be used by the Ministry of Education to further improve the distance learning education system.
	8	(Van Brummelen et al., 2021)	47 students	Student perception workshops	The students felt that Alexa was very intelligent and they felt closer to her.
	9	(Zafari et al., 2021)	246 secondary school students in open-ended physics questions.	Correlation Coefficient for Feature Selection and Application of ML Algorithms	ML models are influential in assessing students and improving the educational factor.
	10	(Bellas et al., 2022)	30 students from 6 schools	Proactive learning (Learning by doing)	Fully practical curriculum based on the concept of the intelligent agent.

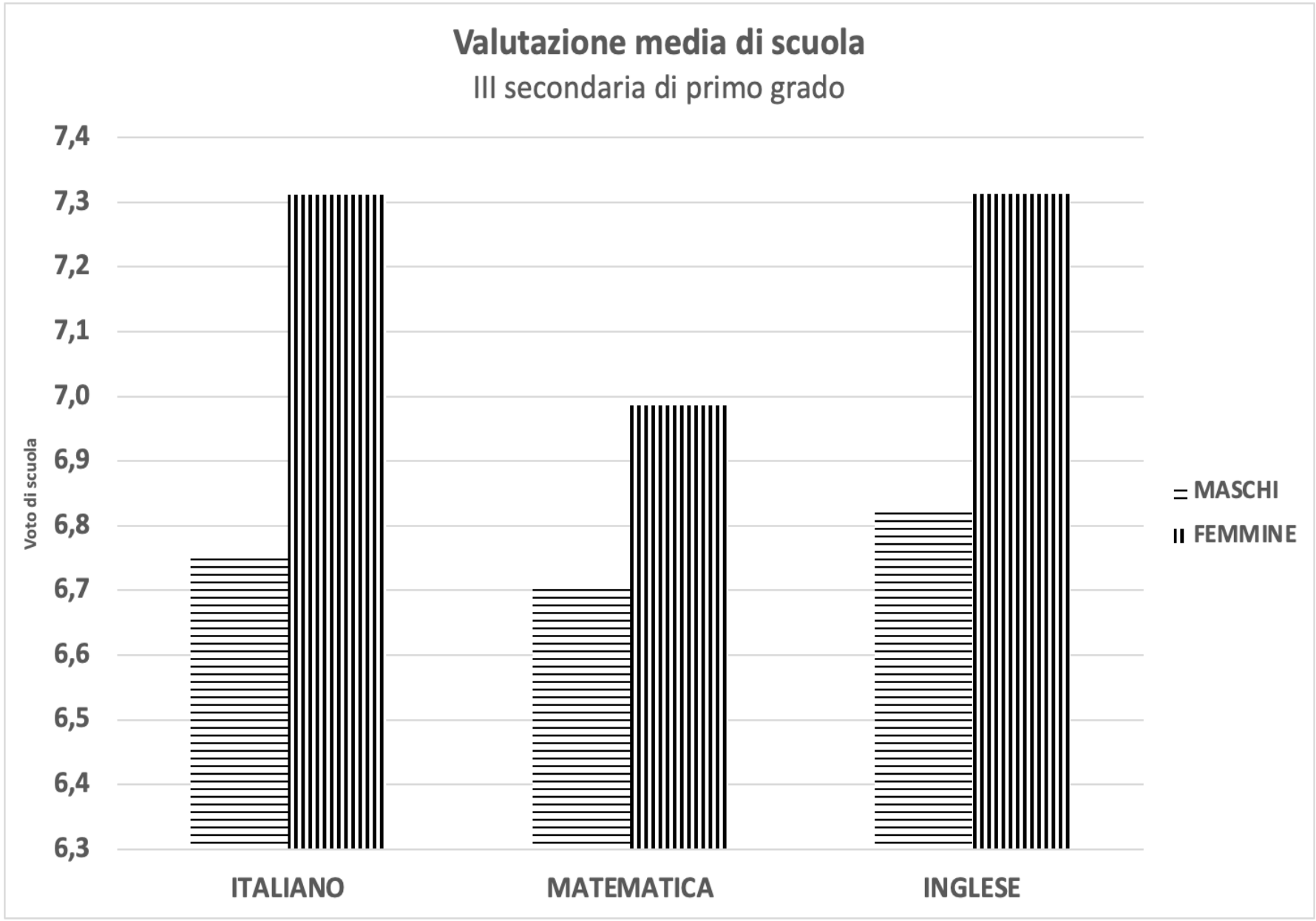
Nº	Study	Sample	Methodology	Results
11	(Horanai et al., 2022)	An educational tool with AI	Software development with ML	Students have a better understanding of the fundamentals of AI and ML, increasing their interest in the future development of AI applications.
12	(Houngue et al., 2022)	325 grades grade 6 to grade 9	Application of ML algorithms	The performance of five ML algorithms in predicting students' scientific or literary ability was compared.
13	(Tarik et al., 2021)	72,010 students between 2,000 and 2015	Application of ML algorithms	The best model for predicting high school Grade Point Average GPA using an RF regression algorithm.
14	(Dietz et al., 2022)	15 students with learning difficulties or low resources between 11-14 years old	Mixed Research (qualitative and quantitative)	Educational robotics tools, training and programming of simulated robots is attractive and educational for the participants.
15	(Ali, DiPaola, Lee, Sindato et al., 2021)	38 secondary school students aged 10 to 15 years, 18 females and 20 males	5-day virtual workshop to teach about generative ML.	Students demonstrated an understanding that deep- fakes can contribute to the spread of misinformation.
16	(Eegdeman et al., 2022)	9 teachers and 95 students	Teacher survey and use of ML algorithms	ML could help advance the use of evidence to make decisions and predictions in the education sector.
17	(Eguchi et al., 2021)	Teachers and curricula	K-12 student learning experiences.	70% of teachers felt insecure about implementing AI in their classrooms.
18	(Demir & Güraksın, 2022)	339 seventh and eighth grade students from 4 middle schools	Qualitative method analyzing metaphors	Most participants associated IA with humans, technology, and the brain.
19	(Fernández-Martínez et al., 2021)	84 students	Application of didactic unit with IA	It is necessary to rethink the planning for the introduction of AI in the curriculum.
20	(Ali, DiPaola, Lee, Hong y Breazeal, 2021)	72 students (grades 5-9)	Four online workshops	We found that the workshops enabled the children to understand what generative models are.
21	(Temitayo et al., 2022)	12 secondary school computer science teachers	Semi-structured interview	The need to train teachers to use introduce ML in their classes.
22	(Dogadina et al., 2021)	Course contents and 250 assignments	Pareto set and Application of ML algorithms	Minimizes student effort while maximizing the effectiveness of the educational process.
23	(Yamamoto & Alverson, 2022)	393 in 2017 and 387 in 2018 students with ASD	Two methods of predictive analytics (PA): Multilevel logistic regression and ML	The ML model with the best MLR performance in PSO prediction.

Nº	Study	Sample	Methodology	Results
24	(Yu et al., 2022)	Grades de 100 students	Application of ML algorithms	The proposed method works well in predicting the grades of high school students.
25	(Bosch, 2021)	16,310 students from 76 schools in grade 9	Implementation of 2 ML models	The intervention was most effective for students with low academic achievement.
26	(Chen et al., 2021)	68 students	Six classes at school No. 1 in the city	Students and teachers are very satisfied with the algorithm-based teaching
27	(Duncan et al., 2022)	3000 participants	Conferences and Workshops (Webinars)	Students from the beginning of their education should have knowledge and skills in ML and AI related topics.
28	(Pimentel et al., 2021)	5,095,270 students	Massive data set analysis	Using seven input variables, it is possible to accurately predict a student's average grade.
29	(An et al., 2022)	470 English teachers	Survey	Provide educators with policies to encourage AI teaching.
30	(Oskotsky et al., 2022)	18 in 2019, 29 in 2020, 27 in 2021 students admitted to the program UCSF AI4ALL	Evaluation of student transcripts, letters of recommendation and short essay responses.	More students were familiar with working with data and evaluating and applying ML algorithms.
31	(Ahajjam et al., 2022)	72,010 students enrolled between 2,000 and 2,015	Rating prediction using ML and data mining techniques.	The best results for good academic and career guidance were with the neural network algorithm which provided good scores and predictions.
32	(Suzuki et al., 2022)	381 students from 6 secondary schools	Application of ML algorithms	Early detection and intervention allow for the improvement of students' academic performance.
33	(Giam et al., 2022)	119 teachers from middle schools belonging to some cities in Vietnam	Likert-type survey, Quantitative analysis	Secondary teachers are aware of the need for AI implementation in secondary education.
34	(Cheng et al., 2021)	30 teachers	Integrated Model for Convergent Careers, Mixed Method	STEM CareerBuilder program had a positive impact on teachers and students.
35	(Ayanwale et al., 2022)	368 primary and secondary school teachers	Quantitative Structural Equation Modeling	Confidence and relevance in teaching AI predicts intention and readiness to teach AI in institutions.
36	(Angara et al., 2022)	Grade 9 - 12 students in Victoria and Broomfield	Unplugged activities designed to teach basic concepts of quantum computing.	Quantum computing, through its various avenues, is also accessible to people beyond high school.

Nº	Study	Sample	Methodology	Results
37	(Liu et al., 2022)	80 students	Comparative analysis of pre-test and post-tests, action research.	**AI technology can act as a learning companion, indicating the problems faced by teachers during the teaching process.**
38	(Byun & Kim, 2022)	96 secondary students	Art subject design based on trends, policies, and cases of AI education due to COVID-19.	**Educational activities using AI had a positive impact on student participation and interest in class.**
39	(Burgess et al., 2021)	10,649 students from 63 schools	Random selection of groups for financial incentives and non- financial incentives (travel).	**Incentives in schools predicted to help close gaps.**
40	(Santos García et al., 2021)	248,252 student records	Application of ML algorithms	**High academic achievement was mainly related to responses related to academic environment and cognitive skills.**
41	(Ahmed et al., 2023)	29 secondary school children (12 boys and 17 girls) from 13 to 17 years of age	Cross-sectional observational study to assess physical activity at various times of the day.	**Need to design effective programs and strategies to improve physical activity in students.**
42	(Bhavana & Vijayalakshmi, 2022)	597 secondary and higher education students	ARCS (attention, relevance, confidence, and satisfaction) model for analyzing Augmented Reality Education	**The use and application of reality for smartphones would help students to learn and be more motivated.**
43	(Bruno, 2021)	Robot Erwhi Hedgehog	Computer vision and ML	**Accelerate and simplify the development of robotics for researchers, educators, students, and professionals.**
44	(Demchenko et al., 2021)	129,666 students and 17,923 teachers in higher education	The chi-square test was used to test statistical hypotheses.	**It is recommended to introduce tools to improve the digital skills of law students in the curricula.**
45	(Bogina et al., 2022)	20 primary and secondary school teachers	Description and evaluation of some educational activities	**Educational needs of professionals who produce algorithmic systems, should cover FATE aspects.**
46	(Chrysafiadi et al., 2022)	140 undergraduate students	Quasi-experimental research	**The intelligent tutor significantly improves student performance and achieves learning goals.**
47	**(Baashar et al., 2022)**	**635 master's degree students**	**Regression algorithms using MATLAB, model performance and predictive decision making.**	**Variables such as research, marital status and living conditions would have improved the accuracy of ML models.**

Nº	Study	Sample	Methodology	Results
48	(Blease et al., 2021)	120 clinical psychology students in the master's program.	Mixed (Quantitative and Qualitative)	**Formal education is limited on how AI/ML tools might affect psychotherapy.**
49	(Almoqbil et al., 2021)	251,000 accounts of students, faculty, staff, alumni, and retirees, all over 18 years of age.	Information from phishing emails to the network administrator.	**Phishing increased in the summer and vacation season, staff and students were the main target audience.**
50	(Ban & Ning, 2021)	Primary school students	3 months of teaching in 6 classes.	**The unique data of the educational system includes not only the conversation data generated by teacher- student interaction, but also educational management data.**
51	(Bakker et al., 2023)	101 students with ASD at the Vrije Universiteit Amsterdam	Application of ML algorithms	**Institutions can reduce the risk of dropout and increase school completion for autistic students.**
52	(Alvarado Uribe et al., 2022)	121,584 secondary school and undergraduate students	Data life cycle	**An appropriate model would benefit students with timely and personalized strategies to support their career retention.**
53	(Salas Rueda et al., 2022)	54 teachers from the National Autonomous University of Mexico	Quantitative research	**CVWs and MOOCs positively influence student learning and engagement.**
54	(Gerlache et al., 2022)	4,522 records with data from master's degree students	Application of ML algorithms	**AI can predict educational situations with an accuracy of over 96%.**
55	**(Alshaikh et al., 2021)**	**960 student registrations in science, medicine, computer science and engineering**	**Collaborative filtering technique was used to build the recommender system.**	**The specialization to be studied for each student was predicted with good accuracy.**

Esiti scolastici



La valutazione di scuola per genere in III sec. di I gr.

Differenza tra la valutazione scolastica rispetto a quella invalsi.