

An aerial photograph of Madrid, Spain, taken at sunset. The sky is filled with soft, colorful clouds in shades of orange, pink, and purple. The city below is densely packed with buildings, many of which have red-tiled roofs. In the foreground, a large, ornate building with many windows and balconies is visible. In the background, a tall, modern building with a clock tower stands out. The overall scene is a vibrant and detailed representation of the city of Madrid.

Analysis of Education/Economics **Madrid, Spain**

Jaspreet Lal & Sean Lewis

Recap of Hard Systems: Transportation

- Analysis of the transportation network in Madrid
 - Metro, Bus, Suburban, Light Rail, Eurail
- Fun facts include:
 - Average wait time for a metro is 2.5 minutes
 - 69% of trips in Madrid are not made by cars
 - 3.25 million people in the city
 - Up to 6 million inhabitants in the metropolitan area
- Madrid Nuevo Norte (2016—2024)
- Digital Transformation Strategy (2023 to 2027)

Key Percentages for Understanding Employment and Higher Education in Spain

- Nearly **49%** of residents aged 25–34 hold a tertiary degree
- Graduates entering the labor force reduce unemployment, with higher education lowering youth unemployment to **8.5%**, compared to **28%** for those without tertiary education
- **28%** of 25-34 year-olds do not have an upper secondary degree in Spain, twice as much as the European average (**14%**)

Education as a Social System

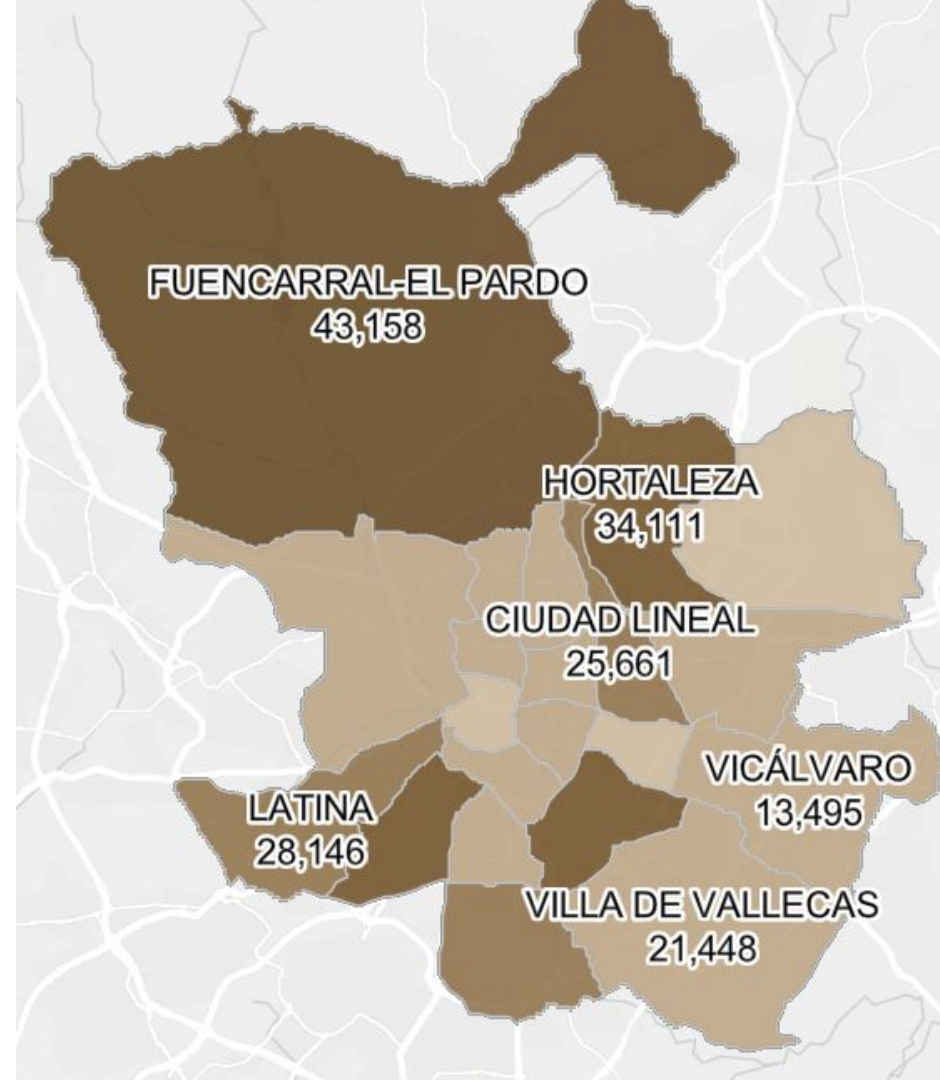
- Mix of public, private, and international schools
 - Diversity fosters a rich cultural environment and social interaction among students and parents
- Prestigious universities
 - ex. Complutense University and Politécnica de Madrid
- Adult education and language schools

Education shapes relationships, cultural exchange, and community cohesion!

Education

Residents that are currently
enrolled in school by region

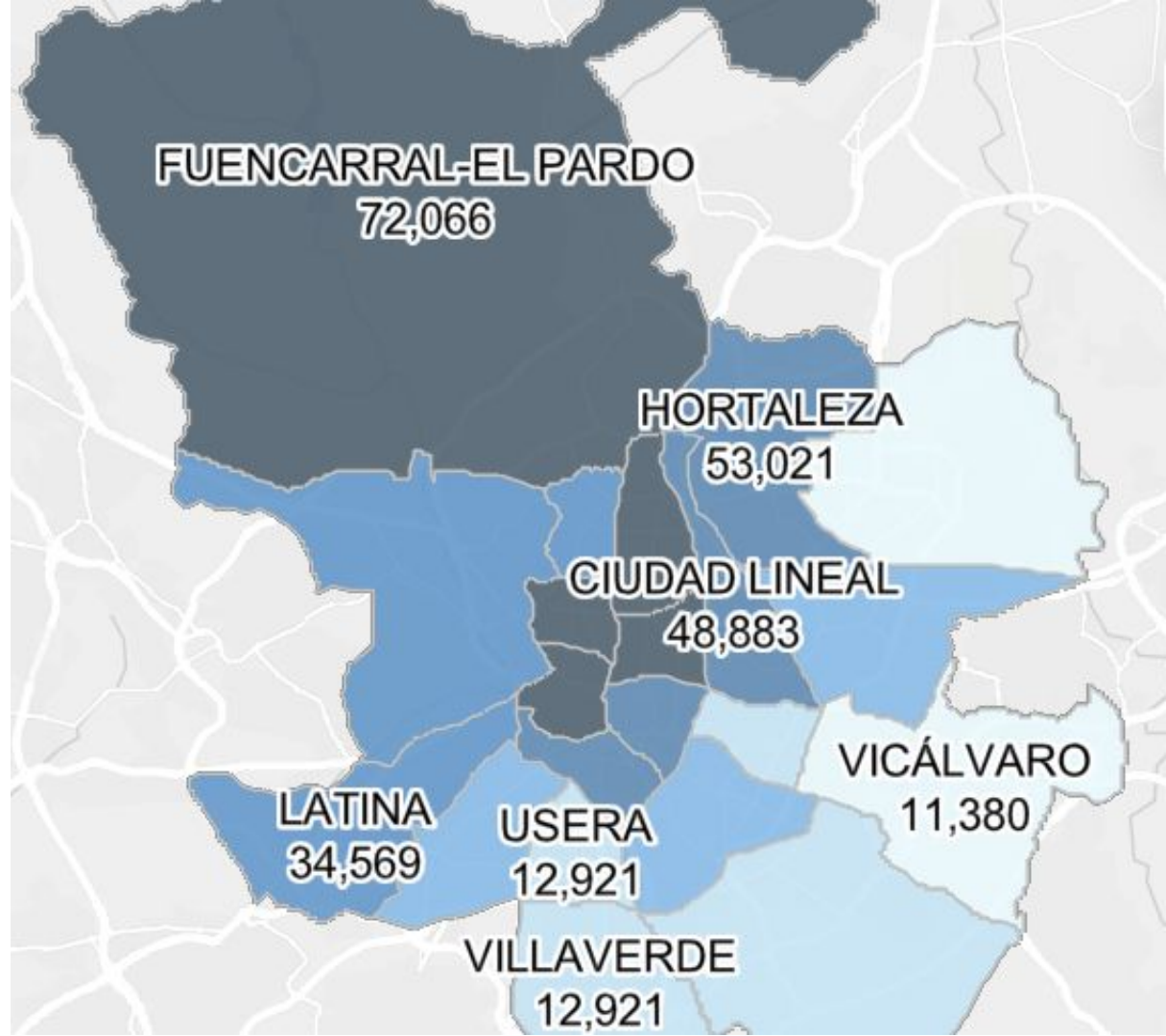
Total: 445,391



Education

Residents who have obtained higher education, bachelor's degree, architect or higher engineer, non-university higher education, doctorate, postgraduate studies by region

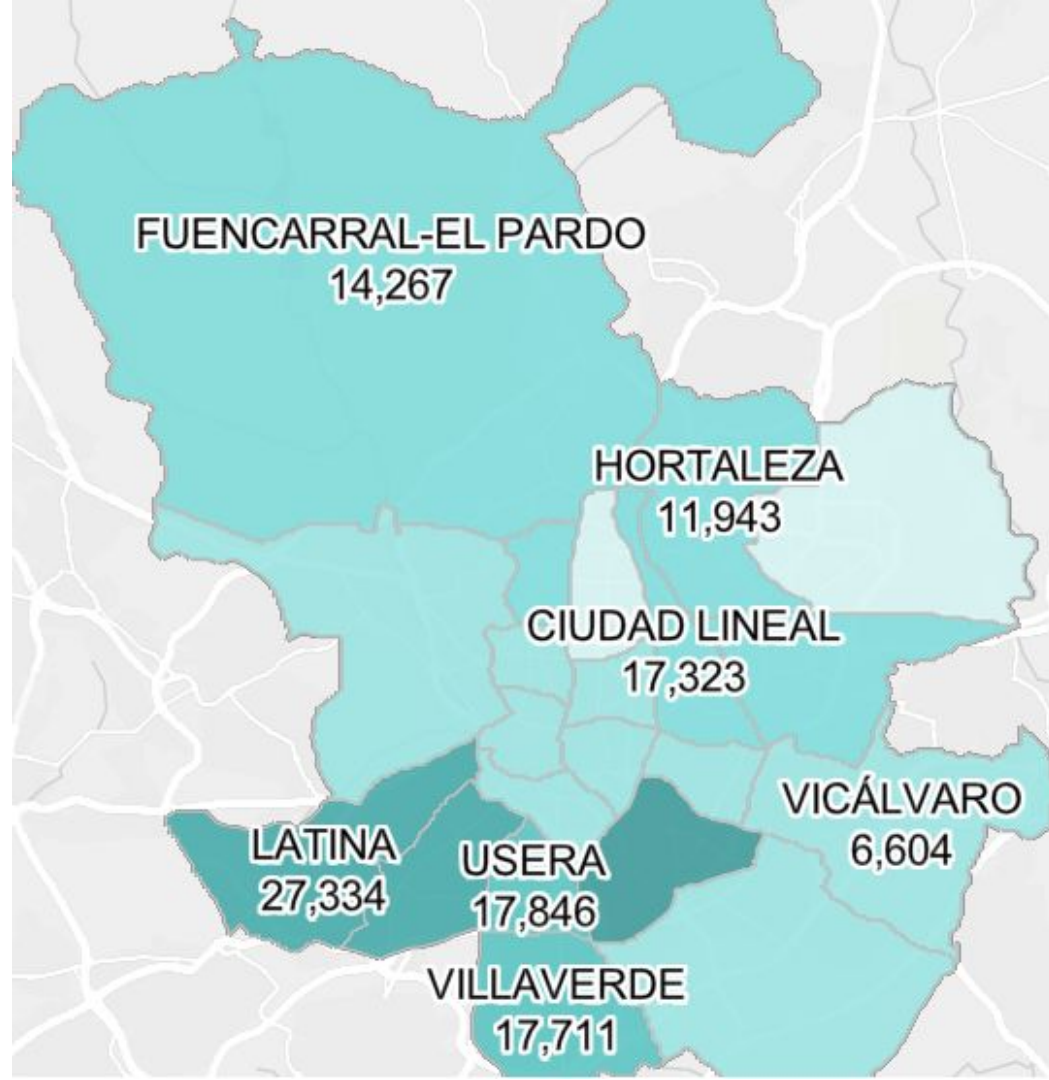
Total: 791,227



Education

Residents that have not completed primary education by region

Total: 258,169



Networks in Education

- Formal Networks
 - Structural interactions within institutions, administrators curriculum
- Informal Networks
 - Peer interactions & community engagements
 - Study groups, school/community events
- Digital Networks
 - Online platforms designed for learning, collaboration, communication, etc.
 - Includes social media networks

Flows in Education

- Information & Knowledge Flows
- Resource Flows
 - Funding, materials, technology
- Social Flows
- Feedback flows

Nodes in Education

- Institutions
 - Schools, universities, vocational institutions, other training centers
- Students
- Teachers, Educators, Facilitators
- Support Systems
 - Parents, families, friends
- Community Organizations
 - NGOs, non-profit organizations, local groups, etc.
- Technology Providers
 - Companies that provide digital tools, platforms, and other hardware tools

Agents in Education

- Students
- Educators
- Families
- Community Leaders
- Tech Representatives



- libraries as educational hubs
- network formed between libraries & institutions
- digital libraries

86.7%

of homes have some type of computer

87%

People who use the internet everyday (at least once a day)

Investing in MOOCs (Massive Open Online Courses)



Project Participants: Six public universities in Madrid and the Universitat Politècnica de València

Funding and Budget: Supported by the Spanish Ministry of Universities with EU funds, totaling over half a million euros

Project Goal: Upgrade Open edX to better support on-campus teaching

Key Enhancements:

- Real-time analytics and new dashboards
- Enhanced exams, grading, and feedback systems
- Improved user interfaces and email functions
- Tools for content creation and student support

Objective: Evolve Open edX from a MOOC platform to a comprehensive on-campus LMS

Human Capital Theory

Investing in education increases a person's skills and productivity, leading to higher wages and contributing to overall economic growth

Jacob Mincer, Gary Becker, Theodore Schultz (1960s)

OECD's Education at a Glance 2023 report highlights the positive relationship between education and economic performance

- Education is crucial to Madrid's labor market, producing skilled workers that fuel economic sectors like technology, finance, and tourism
- Higher education institutions are actively integrated with economic networks through research collaborations and innovation hubs

"IE University has replaced Glasgow Caledonian University as the sole member of Glasgow Caledonian New York College (GCNYC). This US College based in SoHo will be renamed IE New York College (IENYC) upon accreditation approval for the name change." -IE, Original IE University is based in Spain

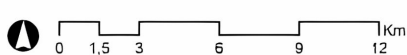


Education at a Glance 2023
OECD INDICATORS

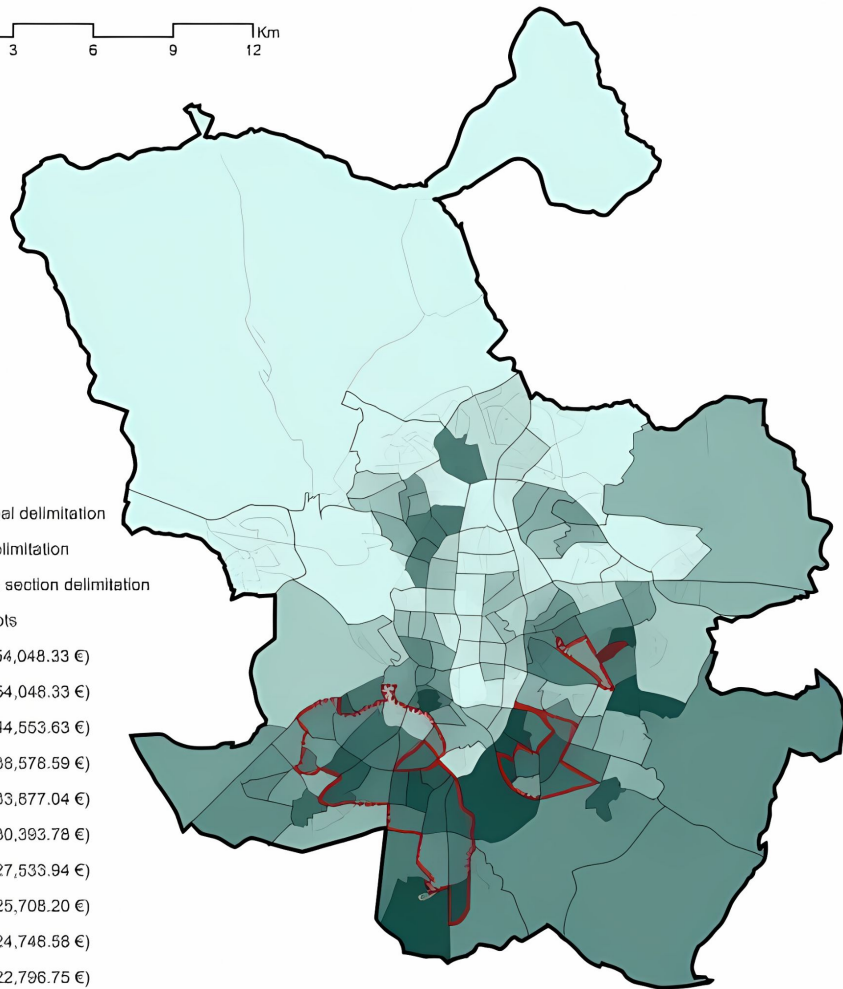
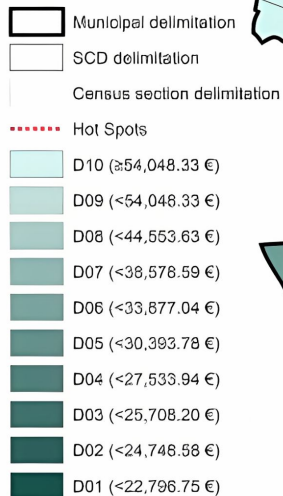


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The Organisation for Economic Co-operation and Development (OECD) is an international organization that works to improve economic and social well-being through policy development



Legend



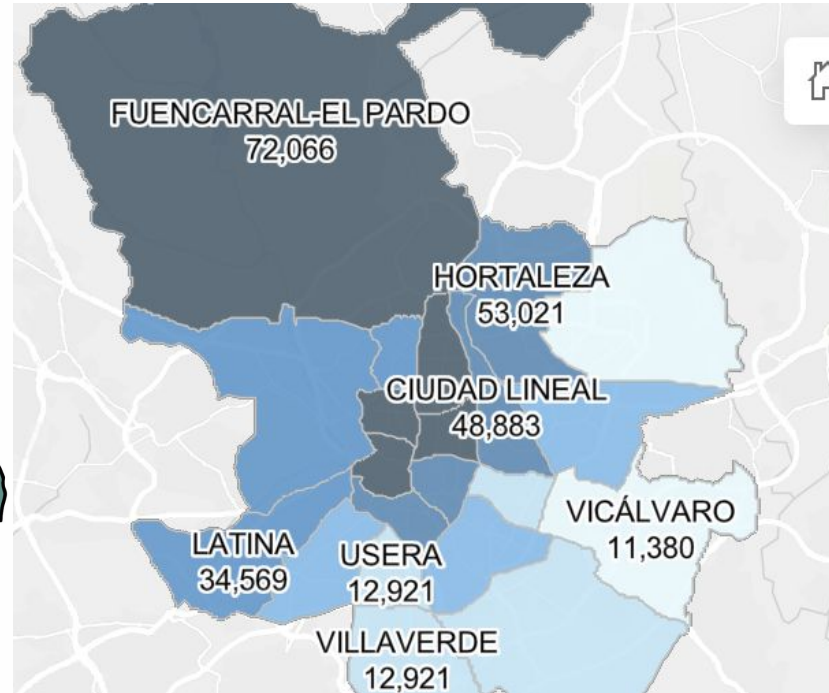
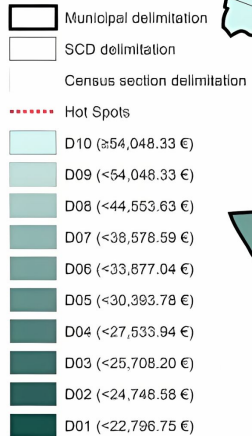
Madrid Economy

- Median income is about €32,217 per family and the three lowest income deciles are under €27,251
- Neighbourhoods whose income is below the third decile are located in the south while the wealthiest ones are found in the northern parts of the city

Comparison to Education Map



Legend

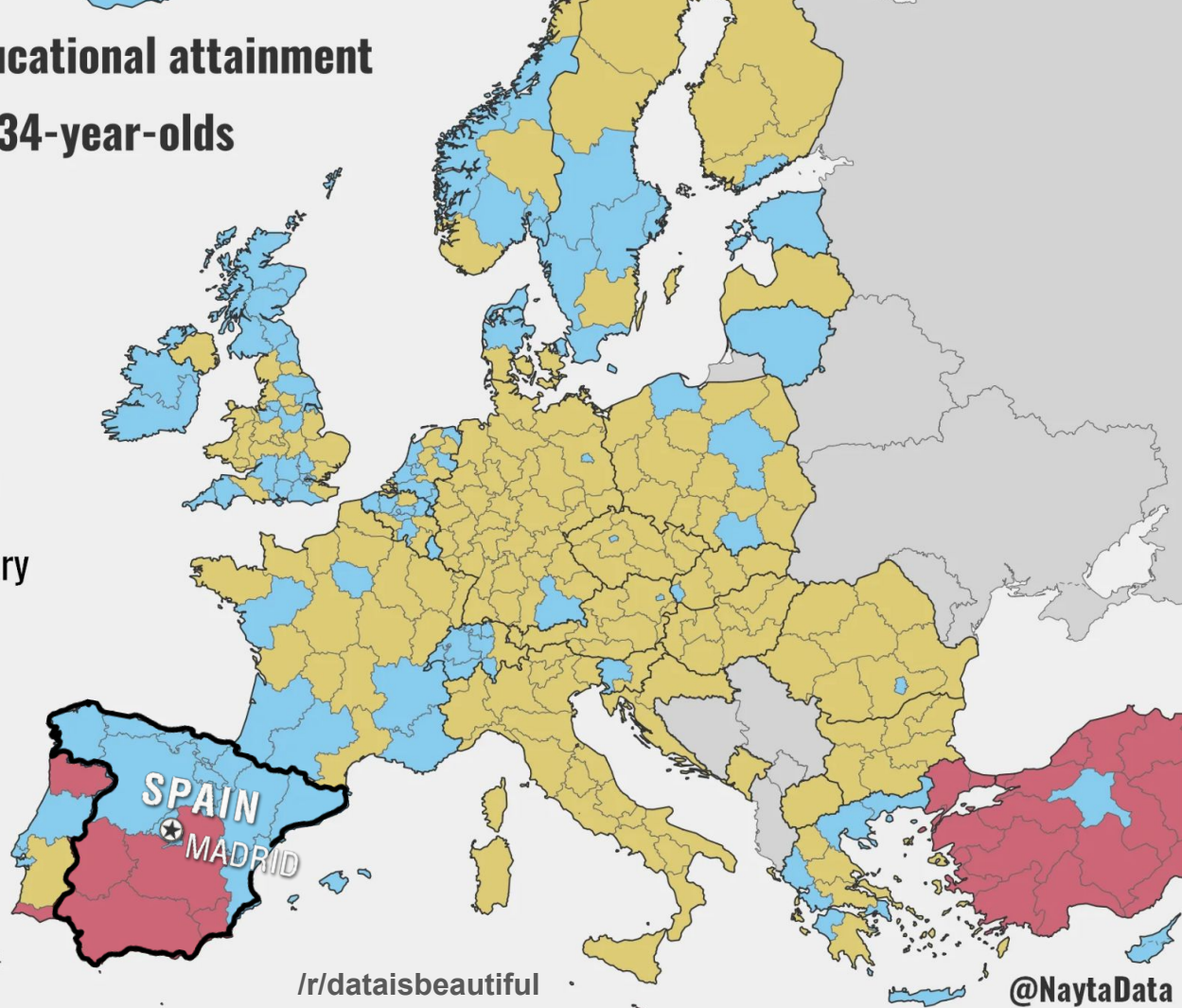
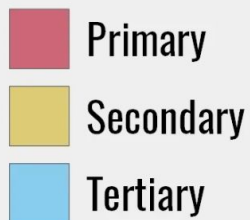


Residents who have obtained higher education by region

Most common educational attainment level* among 30–34-year-olds (2017)

By NUTS 2 regions

Source: Eurostat



*Primary education = ISCED levels 0–2
Secondary education = ISCED levels 3–4
Tertiary education = ISCED levels 5–8

/r/dataisbeautiful

@NaytaData

However...

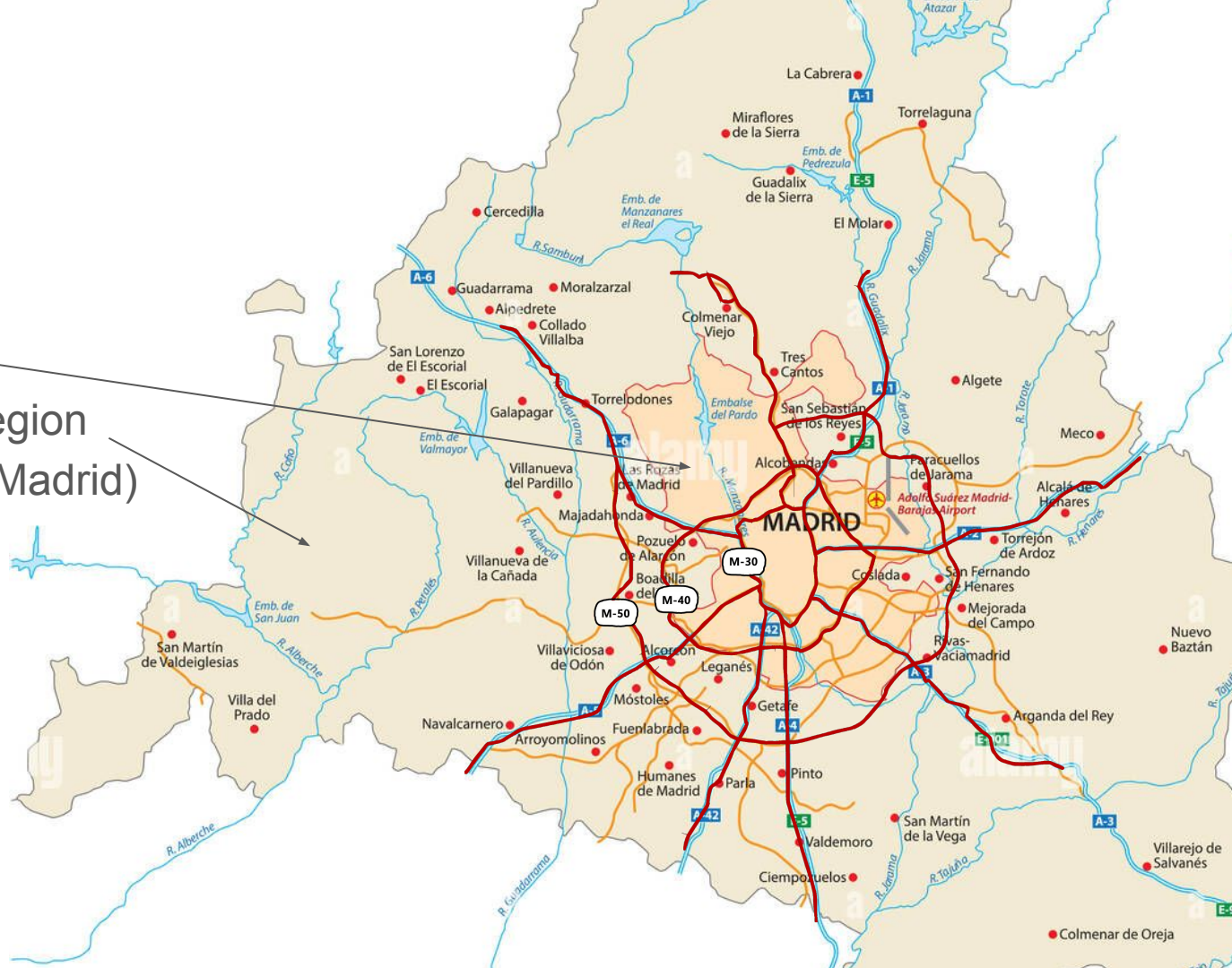
Contingent on Brain Drain*

- Emigration of highly trained or intelligent people from a particular country
- Think of ETH Zurich or Cornell Tech
 - How many international students will remain after graduation?
 - ETH Zurich stats: ~50% of international students return to country of origin
- Then, is comparing the education map with the economics accurate?



Highway Map of Madrid

- City of Madrid
- Madrid Metro-region
(Community of Madrid)



M-30 Ring Road Separation

- Darker green colors represent wealthier areas, while darker yellow represents poorer areas
- Correlation with the education maps



(The map does not reflect any income below 2,897 euros or above 29,364 euros in order to respect statistical confidentiality by the INE (Instituto Nacional de Estadística) does not offer information that exceeds these thresholds)

Networks and Agents in Education and Economy

- **Formal Networks:** Universities like Complutense University and Politécnica de Madrid collaborate with tech firms and public institutions to bridge education with economic needs
- **Digital Networks:** Platforms like Coursera, Edx are integrated into university curricula, preparing students with skills for the digital economy
- **Agents:** Public authorities, universities, and businesses (e.g., Google Campus Madrid) which together help educational outcomes with labor market demands

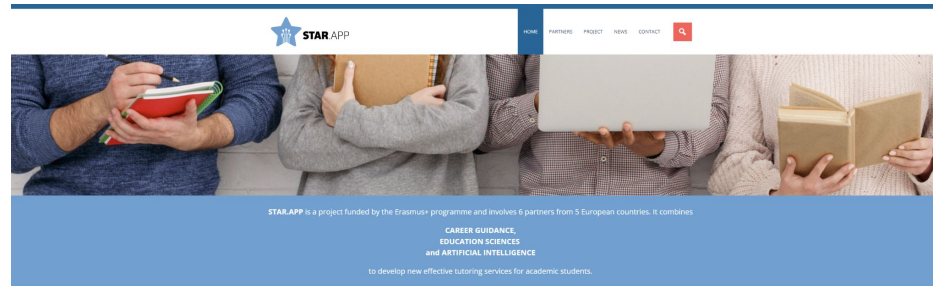
Flows and Nodes of Talent and Resources

- **Talent Flows:** Graduates from local universities enter high-demand sectors like finance and technology, contributing to Madrid's labor market
- **Economic Flows:** Investment from both public budgets and private sectors fuels innovation hubs and educational advancements
- **Strategic Nodes:** Educational institutions and business schools act as pivotal nodes. Ex. IE Business School supports startup ecosystems, helping flow of ideas and capital

Combating High School Dropout Rates

- **STudent's Academic perfoRmance (STAR.APP) project**

- European initiative involving several Spanish institutions which uses ML to assess the risk of student dropout at start of the academic year and develops targeted interventions to prevent it
- Aims to enhance academic achievement and reduce dropout rates by applying AI to create profiles of at-risk students and implementing preventive measures early in the academic cycle



The project aims at exploring the potential of **AI** to predict academic performance. AI technologies will be used to early detect academic students at risk for dropping out. Innovative **tutoring** services will be developed to provide early and **personalised** support to students.

We plan to develop:



Toolkit for tutors and researchers



Online platform for risk assessment



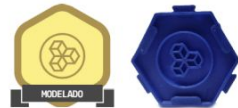
Handbook: New frontiers for prevention in academic dropout

Site: <https://star-app.eu>

Combating High School Dropout Rates

- **3D Printed Badges**

- The Universidad Politécnica de Madrid has experimented with using 3D printed badges to enhance student motivation and performance in STEM fields.
- Explored the impact of both physical and virtual badges on student engagement and dropout rates, finding that these incentives could potentially improve educational outcomes



(a) Data modeling



(b) Relational model



(c) Structured Query Language



(d) Databases management



(e) Programming with databases



(f) Files-based storage

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