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The Geography of Digital Sovereignty in Education: Data Infrastructure and Platform Dependence across 29 Education Jurisdictions

Abdulhalik Pinar

Harran University, Türkiye (ORCID: [0000-0002-1716-5114](https://orcid.org/0000-0002-1716-5114))

ABSTRACT Over the last two decades, education systems have become increasingly digital. This digitalization goes beyond classroom teaching processes; it also raises a governance issue concerning where educational data is collected, who provides the digital infrastructure, and at what level decision-making authority is exercised. Based on the OECD's report comparing 29 education jurisdictions, the study classifies these jurisdictions along four dimensions: the level of centralization of decision-making authority, public control over educational data, whether the digital infrastructure is provided by the public sector or through private platforms, and the binding nature of data protection rules. In this study, these four dimensions were transformed into a digital sovereignty score and evaluated the jurisdictions under four governance typologies. The findings reveal that digital governance in education is not geographically uniform. In systems with a strong tradition of centralized governance, public control over data and infrastructure is more pronounced, while in systems with high levels of school autonomy, dependence on private providers increases. The study examines this dependence within the framework of data colonialism, arguing that the transfer of educational data to private platforms creates a new problem of digital sovereignty.

Keywords: digital education governance, data colonialism, data governance, platform dependence, digital sovereignty, education policy, digital transformation, EdTech governance

INTRODUCTION

Digital tools have been integrated into education systems since their inception. However, today, with artificial intelligence, these technologies have ceased to be merely tools and have become an integral part of the education and training system. From student information systems to exam applications, many technological tools and platforms are at the heart of a school's daily operations. A student's course tracking, attendance, and grades are entered into these platforms, their progress is monitored, and all these processes take place through a digital infrastructure. This is only the tip of the iceberg. The question of where all this data is collected, who has access to it, and how it is processed is a direct and serious governance question. On one side of this governance question are

Address for reprints: Abdulhalik Pinar, PhD, Department of Public Administration, Faculty of Economics and Administrative Sciences, Harran University, Şanlıurfa, Türkiye. (abdulhalik.pinar@harran.edu.tr)

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governments, while on the other side are large technology companies. During the Covid-19 pandemic, millions of students and faculty members quickly moved to commercial platforms such as Zoom, Microsoft Teams, Google for Education, and Microsoft 365. This transition arose from the circumstances, but its consequences were permanent. Today, universities still conduct many meetings and classes through these platforms. [Williamson \(2021\)](#) emphasizes that this situation created an unexpected opening for the edtech sector and that technology companies turned this crisis into an opportunity. [Kerssens et al. \(2024\)](#), by examining the same situation in three national school systems, show how dependence on commercial platforms is established through various intermediary actors. According to the researchers, platform dependence does not arise spontaneously; it is made possible by the invisible labor of intermediaries who bridge the gap between the public and corporations. [Van Dijck et al. \(2018\)](#) place this transformation within a broader framework, emphasizing that society has now transformed into a platform society, and that public values are increasingly being reshaped according to the logic of private platforms.

At this point, it is necessary to draw attention to the concept of data colonialism. [Couldry and Mejias \(2019\)](#) argue that the big data economy transforms human life into a continuous source of raw materials, and that this carries the same logic as historical colonialism. Because data is not a substance found in nature; it is produced by humans and appropriated by a certain group ([Couldry and Mejias, 2019](#)). However, especially in the context of education, this appropriation process is particularly sensitive and raises ethical issues. Because what is at stake is the data of children and young people, and this data is collected through a public institution. The answer to the question is unclear: does a state keep educational data in its own systems, or does it transfer this data to a commercial platform? And this question is more of a political and sovereignty question than a technical one. In fact, this question is the elephant in the room in most discussions of digitalization; everyone is aware that data is being transferred somewhere, but who actually owns this data and who controls it is rarely discussed.

The word “sovereignty” has been deliberately chosen here. Because if a state cannot control the basic data of its citizens, it means that the power to make decisions about that data has passed to another actor. In education, this actor is often a few large technology companies. The services offered by these companies are usually free or very low-cost, easy to use, and provide schools with both practical and tangible benefits. However, behind these benefits lies the linking of educational data to a commercial infrastructure and the establishment of a long-term dependency. [Couldry and Mejias \(2024\)](#) state that artificial intelligence deepens this dependency and legitimizes it with discourses such as convenience, connectivity, and scientific progress.

The existing literature generally examines this situation mostly through single-country examples. While Williamson's studies focusing on the UK and higher education, [Kerssens et al. \(2024\)](#)'s three-country comparison, or the discussions on pedagogical autonomy in the Netherlands are valuable, they offer a limited comparative framework. While these studies provide significant depth, they are limited in making visible broader geographic patterns by comparing numerous education jurisdictions with the same criteria. However, the digital governance profile of an education system can be understood more clearly when evaluated in conjunction with other systems. This study aims to contribute to this comparative perspective.

The study seeks answers to three questions:

RQ1. Do the education jurisdictions within the scope of the OECD report manage their digital education infrastructure through public means or by delegating it to private platforms?

RQ2. How is this pattern distributed according to geographic and administrative clusters?

RQ3. Which countries exhibit a strong digital sovereignty profile, while which ones tend towards platform dependency?

To answer these questions, a typology was created by classifying 29 educational jurisdictions into four dimensions. The study aims to contribute at two levels. Theoretically, it links the discussions of data colonialism and digital sovereignty to the field of educational governance. In terms of data and findings, it moves the discussion of digital educational governance, which is mostly addressed through single-country examples, to a comparative framework encompassing 29 educational jurisdictions.

CONCEPTUAL FRAMEWORK

Data Colonialism

The theoretical backbone of this study is the concept of data colonialism. [Couldry and Mejias \(2019\)](#) argue that today's data economy transforms human life into a continuous flow of raw materials for capitalist accumulation. This process is based on two fundamental elements. First, data on human life is collected on a large scale; second, digital infrastructures that process this data and transform it into economic value come into play. According to [Couldry and Mejias \(2019\)](#), while historical colonialism established a relationship of appropriation over land and natural resources, data colonialism transforms daily life itself into a source of data production. Although this analogy may seem provocative, the authors' aim is not to belittle historical suffering, but to make visible the logic underlying today's data relations. At the center of the theory is the concept of "data relations". According to [Couldry and Mejias \(2019\)](#), data relations are social and technical arrangements that transform ordinary activities of daily life into continuously traceable, recordable, and processable data streams. This transformation proceeds through such a natural process that it often goes unnoticed. When a student logs into a learning platform, they are often unaware that they will be constantly generating data; they often assume they are simply using a service rather than producing data. And this data is often processed outside the control of the student or the school. The point to emphasize here is that this process is not natural but constructed; the idea that data collection is continuous and rational is actually a product of certain economic interests, and users are unaware of this ([Couldry and Mejias, 2019](#)).

The theory's importance in education stems from the nature of educational data. Schools generate massive amounts of data on students every day: attendance, grades, behavioral records, learning analytics. This data is collected as part of a public duty and is often compulsory; a student has no right to object to the collection of their data. Whoever processes this data gains a certain visibility and influence over the education system. In another study, [Couldry and Mejias \(2024\)](#) note that artificial intelligence deepens this extractive relationship and legitimizes it through "civilizing narratives." Discourses of convenience, connectivity, and scientific progress, much like the civilizing mission in historical colonialism, portray the appropriation of data as natural and beneficial.

Platformization in Education

Our second theoretical layer is the literature on platformization in education. This literature serves as a bridge connecting the theory of data colonialism to the concrete context of education. [Van Dijck et al. \(2018\)](#) state that platforms are more than just tools; they are structures that reorganize both social relations and public values. Platforms shape the interactions that take place on them according to their own operational logic. They collect data, classify this data, and organize the services they offer based on these classifications. In this respect, commercial platforms often enter schools like a Trojan horse: at first glance, they appear as free, useful, and practical tools; however, over time, they can bring risks such as data extraction, supplier dependency, and weakening of public control. The education system also participates in this reorganization process – consciously or unconsciously. [Williamson \(2021\)](#), as one of the pioneering figures in the literature, systematically documents how educational technologies are increasingly falling under the control of large technology companies. The author argues that this surge in activity experienced by the edtech sector during the pandemic

was a form of crisis opportunism. Similarly, [Knox et al. \(2020\)](#) discuss the pedagogical consequences of this process through datafication and the mechanization of learning; they argue that increased data collection in education carries the risk of reducing learning to measurable behaviors. In a study directly related to this discussion, [Kerssens and Van Dijck \(2022\)](#) question how pedagogical autonomy is eroding in platform society and whether schools are being managed by edtech. According to the authors, teachers' decisions regarding education are increasingly limited by the options offered by platforms.

[Nichols and Dixon-Román \(2024\)](#) demonstrate that platform governance does not function uniformly in every country. According to them, platforms are not merely technical tools; they also influence who makes decisions within the education system and how teachers' professional domains are shaped. Therefore, platforms can lead to a redistribution of authority at both the administrative and teaching practice levels. This approach provides an important perspective for the typology developed in this study, because education systems differ not only in whether they are centralized or local, but also in various dimensions such as data ownership, infrastructure provision, and regulatory protection. [Landri \(2018\)](#) states that digital governance in education in Europe is shaped through standards. These standards may initially appear as technical regulations; however, they determine how data is collected, which systems work together seamlessly, and which digital infrastructures schools connect to. Therefore, digital infrastructure should be seen not merely as a technological tool, but as a governance mechanism that brings education systems closer together around specific rules and modes of operation. The common thread running through all these studies is that the infiltration of platforms into education is not merely a matter of efficiency, but a redistribution of authority. Decision-making power shifts from public institutions to private providers. When a school adopts a particular platform, it also becomes tied to that platform's data standards, interface, and workflow. This entanglement can eventually lead to a deadlock. This points to the third conceptual layer: digital sovereignty.

Digital Sovereignty

The third layer is the concept of digital sovereignty. [Floridi \(2020\)](#) discusses why digital sovereignty is particularly important for the European Union, defining it as a struggle for control. The main issue here is an actor's ability to have a say over its own digital infrastructure, data, and processes. On the other hand, [Pohle and Thiel \(2020\)](#) analyze the multi-actor and often contradictory nature of the concept of sovereignty. Digital sovereignty is used in different meanings by different actors. While states often associate this concept with control over national data and infrastructure, for users, digital sovereignty may mean having a say over personal data. For regional actors such as the European Union, the concept expresses the pursuit of creating a common digital capacity and regulatory power against global technology companies. Therefore, digital sovereignty does not mean the same thing to everyone. [Fratini et al. \(2024\)](#) emphasize that despite the increasing use of the concept, its boundaries are still unclear. [Tan et al. \(2023\)](#) clarify the distinction between data sovereignty and digital sovereignty. According to researchers, data sovereignty is primarily concerned with who owns the data and who controls it. Digital sovereignty, however, goes beyond this, encompassing a broader capacity for control over digital infrastructure, technical standards, platforms, and decision-making processes.

Based on this literature, this study defines digital sovereignty as a state's capacity to maintain control over its educational data and infrastructure ([Floridi, 2020](#); [Pohle and Thiel, 2020](#)). A state has high digital sovereignty if it possesses its own student information system, provides infrastructure through public means, and enforces strong data protection rules. Conversely, sovereignty erodes if educational data flows to commercial platforms and infrastructure is acquired from the market. This definition determines how the concept of digital sovereignty will be evaluated within the scope of this study and forms the basis for a four-dimensional coding scheme.

A Critical Note: Mapping Itself

This study classifies countries and proposes a typology map. A self-criticism is necessary here. [Harley \(1989\)](#) shows that maps are never neutral, always a product of power and discourse; a map is defined as much by what it shows as by what it hides. [Crampton \(2010\)](#) reminds us that classification itself is a practice of power. He argues that placing something in a category makes it visible in a particular way and excludes other ways. Therefore, the typology and scores produced by this article are not a reflection of objective reality, but a product of a particular analytical framework. Labeling countries as "sovereign" or "dependent" establishes a representational regime within itself. Accepting this limitation from the outset allows for a more honest reading of the findings, and it should be noted that the reader should be warned that the scores are relative, not absolute.

METHODS

Research Design

The study is based on a comparative and descriptive research design. Qualitative document analysis based on a theoretical framework was used as the method. In this context, the [OECD \(2023\)](#) report was systematically examined through predetermined analytical dimensions, and each education jurisdiction was classified according to these dimensions. Four governance typologies were derived from the resulting classification. This approach has a similar logic to the study by [Keressens et al. \(2024\)](#) comparing three countries; however, in this study, the comparison was extended to 29 education jurisdictions. The aim of this research is not to make a statistical generalization, but to identify the basic patterns in digital education governance and develop a conceptual classification based on these patterns.

Data Source

The primary data source of the study is the comparative report of the [OECD \(2023\)](#) on digital education ecosystems and governance structures. The report was used as the main data source for this study because it addresses 29 education jurisdictions within the same analytical framework. Each education jurisdiction is examined under headings such as general policy context, publicly provided digital education infrastructure, access to digital technology, use of education data, and how this data is managed. This shared structure makes it possible to make comparisons between different countries and sub-national education systems.

Another important aspect of the report is that it not only provides descriptive information but also shows which actors provide digital education infrastructure in countries, the extent to which the public sector plays a role in data management, and how decision-making authority is distributed at central or local levels. Therefore, the report is a suitable resource for applying the four-dimensional coding scheme of the study. The OECD report is based on a systematic examination of survey responses from countries, interviews with national and regional authorities, and relevant policy documents and secondary sources. In this study, the concept of jurisdiction used in the OECD report is used as "educational jurisdiction." This concept refers to countries or sub-national units that have decision-making authority over education policy and management. This was preferred because the report does not always focus on nation-states and in some cases examines smaller administrative units with jurisdiction in the field of education separately. The OECD report examines Belgium not as a single country, but as two separate educational jurisdictions: the Flemish Community and the French Community. Therefore, the expression "educational jurisdiction" is used instead of "country" in the study. This choice ensures that the comparison is made through the units that actually have decision-making authority over education policy.

Coding Scheme

Each education jurisdiction was evaluated based on four core dimensions. A three-level scoring system of 0, 1, and 2 was used for each dimension. The coding scheme is shown in Table 1.

Table 1. *The four-dimensional coding scheme*

Dimension	Level 0	Level 1	Level 2
D1. Centralisation	Decision authority at school or local level	Shared or regional	Central state dominant
D2. Public data ownership	No national system	Partial or devolved	State-owned central student information system
D3. Public provision	Private market dominant	Mixed	Largely public infrastructure
D4. Regulatory protection	Weak or fragmented	Partial	Strong and binding

Table 1 defines what the three levels mean for each dimension. D1 assesses where the decision was made, D2 whether the state has direct ownership of education data, D3 whether the digital infrastructure is primarily provided by public or private providers, and D4 reflects how binding data protection and interoperability rules are. The sum of the four dimensions gives a digital sovereignty score between 0 and 8. A high score indicates strong public sovereignty, while a low score indicates platform dependency. It should be noted that D1 measures only the level at which decision-making authority is exercised; on its own it is not an indicator of public ownership or sovereignty. In federal systems, the delegation of educational authority to states or regions is not a loss of sovereignty but a constitutional feature of how these systems are designed, and ownership by local public institutions is therefore also treated as public ownership. D1 is thus used here not as a sole measure of sovereignty but as a dimension that describes the level of decision-making.

The coding is based on the relevant passages in the country section of the report. The level of a dimension was determined according to the specific information given in the report for that country. For example, if it is explicitly stated that a country has a state-owned centralized student information system, a level of 2 was assigned in the D2 dimension. In cases open to multiple interpretations, the overall narrative of the report was decisive. The typology assignment was not based solely on the total score. How the scores in the four dimensions combined was also taken into account. In particular, the dimensions of public data ownership (D2) and public provision (D3) were found to be important in determining whether an education jurisdiction is closer to a centralized or mixed model. Therefore, education jurisdictions with the same total score can be placed in different typologies. For example, Estonia, Austria, and Finland all have a total score of 6. However, centralized data ownership and a strong regulatory structure are more prominent in Estonia. In Austria and Finland, the provision of digital infrastructure and decision-making authority show a more shared structure. Therefore, Estonia was evaluated within the centralised public model, while Austria and Finland were evaluated within the mixed model. The decision rules used in typology assignment are summarized in Table 2.

Table 2. *Decision rules for typology assignment*

Typology	Decision rule
Centralised public	D1 or D2 high, D3 at least 1; total usually 6-7
Mixed	Public data ownership strong, but provision or decision authority shared; total usually 4-6
Devolved public	D1 low, D2 and D3 partial; infrastructure not entirely left to the market; total 2-3
Market-dependent	D1 low, D3 low; school or local level dependent on private providers; total 0-2

Table 2 shows the rules according to which education jurisdictions are divided into four different typologies. According to this table, the classification was not based solely on the total score. The

status of each education jurisdiction in all four dimensions was evaluated together. Thus, education jurisdictions with the same total score but different characteristics could be placed in different typologies. Examples that fell between two typologies in terms of total score or some characteristics were classified according to which model they most closely resembled. A sensitivity analysis was conducted to assess the validity of the coding. First, the four dimensions were calculated with equal weights. Then, the D2 dimension, which shows public control over education data, and the D3 dimension, which shows who provides the digital infrastructure, were given double weight. Centralization (D1) and regulatory protection (D4) dimensions were kept with one weight each. The rankings resulting from these two different calculations were compared. The Spearman rank correlation between the two rankings was found to be 0.99. Furthermore, the top five education jurisdictions with the highest scores and the bottom four education jurisdictions with the lowest scores remained unchanged in both calculations. This result demonstrates that the classification is not solely dependent on the selected weights and that the typology is generally robust.

Typology and Tools

The obtained digital sovereignty scores were evaluated under four governance typologies: centralised public model, mixed model, devolutionary government model, and market-dependent model. In this study, devolution is used, in accordance with its usage in the OECD report, to mean the transfer of education-related responsibilities from the central government to subordinate administrative units such as regions, municipalities, or schools (OECD, 2023). In such systems, local units have more authority to select and procure their own digital tools. The devolutionary public model differs from the centralised public model in that it distributes authority at the local level. However, in this model, digital infrastructure is not entirely left to the private market. Therefore, the devolutionary public model has been considered as a separate category from the market-dependent model. When determining typologies, not only the total score was considered, but also how the scores in the four dimensions combine. Therefore, two educational jurisdictions with the same total score can be placed in different typologies because they are strong or weak in different dimensions. Data organization and analysis were performed in Python. The pandas library was used to prepare the dataset, and bar graphs and typology scatter plots were created with matplotlib. A choropleth map was prepared to show the geographical distribution of digital sovereignty scores. This map was produced using the geopandas library and Natural Earth country border data. The digital sovereignty score of each educational jurisdiction was matched with the relevant country geometry. In the Belgian example, although the Flemish Community and the French Community were coded separately, the two scores were combined under a single value because a single country geometry was used in the map. This choice can be considered a technical limitation of the map.

FINDINGS

Overall distribution

Digital sovereignty scores calculated for twenty-nine education jurisdictions show marked differences between countries. Each education jurisdiction's score on the four dimensions and its total digital sovereignty score are presented in Table 3.

Table 3 shows the scores for each education jurisdiction across four dimensions and its overall digital sovereignty score. Scores range from 1 to 7. Education jurisdictions with moderate scores tend to be grouped within a mixed model. The nine education jurisdictions with the highest scores are in the centralised public model, while the four education jurisdictions with the lowest scores are classified within the market-dependent model. It is noteworthy that no education jurisdiction achieved a perfect score of 8. This indicates that even in systems with strong public oversight, deficiencies can exist, particularly in the dimension of regulatory protection.

Table 3. *Coding of the 29 education jurisdictions across four dimensions*

Education jurisdiction	D1	D2	D3	D4	Total	Profile
Luxembourg	2	2	2	1	7	Centralised public
Korea	2	2	2	1	7	Centralised public
Türkiye	2	2	2	1	7	Centralised public
France	2	2	1	2	7	Centralised public
Hungary	2	2	2	1	7	Centralised public
Estonia	1	2	1	2	6	Centralised public
Italy	1	2	2	1	6	Centralised public
Chile	1	2	2	1	6	Centralised public
French Community (BE)	2	2	2	0	6	Centralised public
Austria	1	2	1	2	6	Mixed
Finland	1	2	1	2	6	Mixed
Slovenia	1	2	1	1	5	Mixed
Latvia	1	1	1	2	5	Mixed
Lithuania	1	1	1	2	5	Mixed
Brazil	1	2	1	1	5	Mixed
Mexico	1	2	1	1	5	Mixed
Flemish Community (BE)	1	1	1	2	5	Mixed
Ireland	0	1	1	2	4	Mixed
Denmark	1	1	1	1	4	Mixed
Czechia	1	1	1	1	4	Mixed
New Zealand	1	1	1	1	4	Mixed
Iceland	0	1	1	1	3	Devolved public
Canada	0	1	1	1	3	Devolved public
Japan	0	0	1	1	2	Devolved public
Spain	0	0	1	1	2	Devolved public
Sweden	0	1	0	1	2	Market-dependent
England	0	0	0	1	1	Market-dependent
United States	0	0	0	1	1	Market-dependent
Netherlands	0	0	0	1	1	Market-dependent

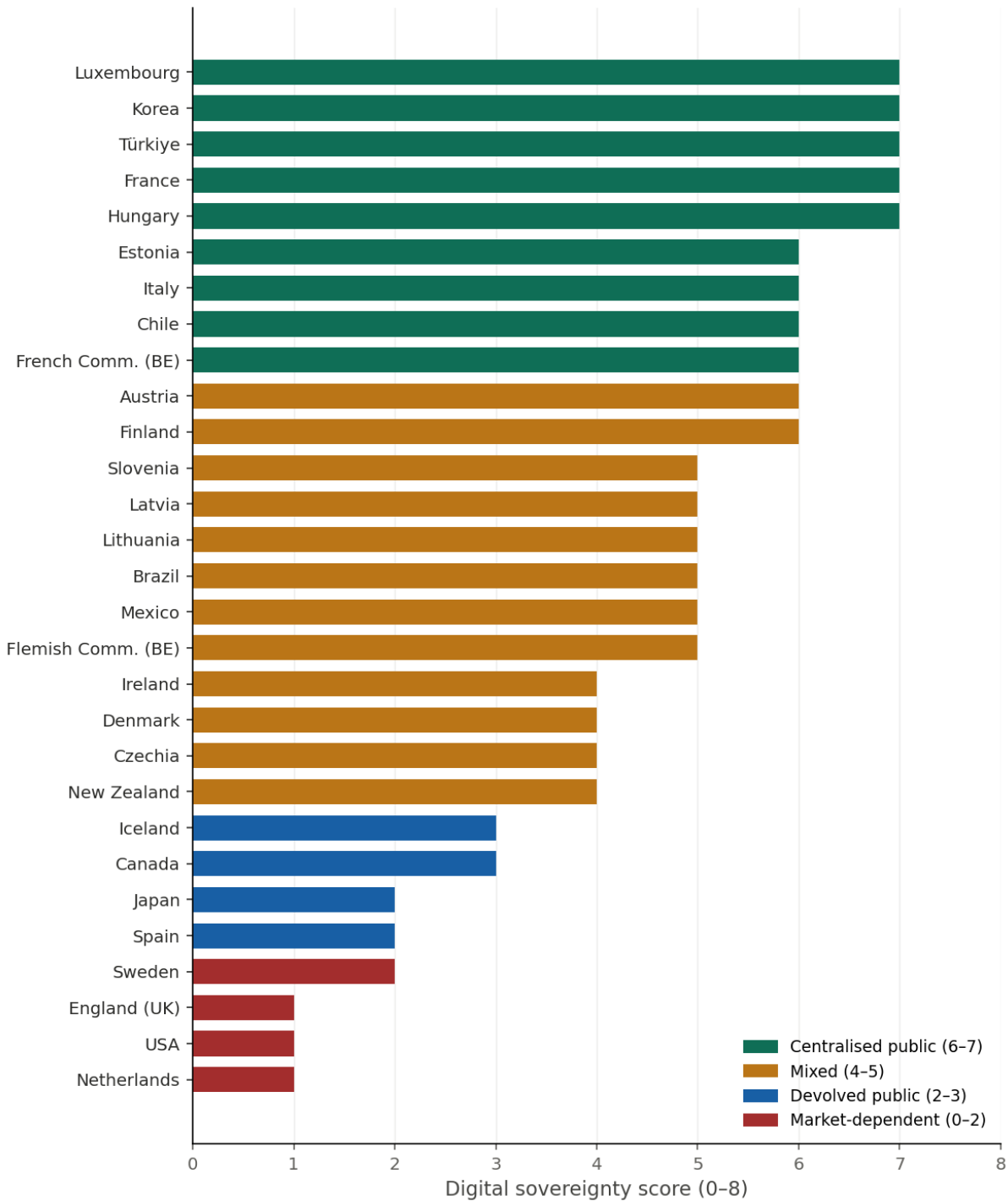


Figure 2. The 29 education jurisdictions ranked by digital sovereignty score

separate groups, but rather as examples located at different points on the same scale. Sweden is a notable example in this ranking. While Nordic countries are generally associated with strong public services, in Sweden the provision of digital infrastructure is largely left to municipalities and the market. This distinguishes Sweden from other Nordic examples such as Finland and shows that geographical proximity does not always mean similar digital governance model.

Centralised public model

The countries with the highest scores constitute the centralised public model. A common feature of these countries is their tradition of centralized administration and the direct provision of educational infrastructure by the state. In Luxembourg, the central government owns and develops system and

school management software for all levels of education (OECD, 2023). This is the opposite of the situation described by van Dijck et al. (2018), where platforms shape public values according to their own interests. In these countries, public values have not been surrendered to the logic of private platforms, and the infrastructure has remained in public hands. Korea stands out as one of the most advanced examples of this model. The Ministry of Education and the public agency KERIS operate many infrastructures themselves, primarily the national education information system NEIS (OECD, 2023). NEIS covers a wide range of areas from personnel matters to student registration, and the budget system K-EduFine and the teaching resource center Edunet T-Clear are also provided by the public sector. This structure is noteworthy in terms of the data appropriation relationship described by Couldry and Mejias (2019). Data is again collected on a large scale, but the infrastructure processing it is public, not commercial. A data relationship exists; however, the actor appropriating the data is not a private company, but the state itself.

Türkiye is also part of the centralised public model. In Türkiye, the Ministry operates the student information system and provides schools with digital education platforms such as EBA. According to the OECD report, the use of these tools is mandatory (OECD, 2023). The Turkish example also demonstrates the impact of geography on governance. The report states that the digital divide is largely geographically based, with less industrialized rural areas in the east having lower access to high-speed internet (OECD, 2023). The Ministry responds to this with spatially targeted measures such as EBA TV and EBA Support Centers established in schools. This shows that the centralised public model can be a tool not only for data control but also for equality; However, this same centralization also carries the risk of reducing education to measurable data through a single national platform, as Knox and colleagues (2020) warn.

This cluster directly answers the study's first research question: whether the education jurisdictions included in the report manage digital education infrastructure through public means or by delegating it to private platforms. The centralised public model represents the public management pole. In these countries, the state produces the infrastructure through its own institutions rather than purchasing it as a market service, thus maintaining its sovereignty over educational data.

Mixed Model

The broad cluster in the middle forms a mixed model, encompassing the majority of European systems. These countries have a balance between the public and the market. The state provides some basic tools, but allows schools the freedom to acquire their own tools from the market. Austria is a typical example of this model. There is a shared structure at the federal and state levels; the central database BilDok is publicly owned, but the infrastructure is developed by a private company, and schools can also use commercial tools such as Google Classroom and Microsoft 365, which are acquired through public tenders (OECD, 2023). This is an example of mediated dependency as defined by Kerssens et al. (2024); the relationship between the public and large technology companies is established through tender processes and public institutions. The dependency is indirect, not direct. Although Finland is within the mixed model, it is an example of strong public oversight. The country has a centralized student information system called KOSKI. This system provides strong public oversight over educational data. In contrast, the choice of institutional governance and teaching tools is largely left to municipalities and schools (OECD, 2023). This situation is related to Kerssens and Van Dijck's (2022) discussion of pedagogical autonomy. Granting schools the freedom to choose digital tools seems to increase autonomy at first glance, but this freedom is often limited to choosing from a few large commercial platforms. Therefore, school autonomy may, in some cases, increase rather than decrease, platform dependency. Estonia, however, presents a different example of balance. In the country, the national education database, EHIS, is centrally managed, and educational institutions are required to enter data into this system. The collected data is presented through a publicly accessible data dashboard called HaridusSilm

(OECD, 2023). In contrast, learning management systems used at the school level are developed by private companies and purchased by municipalities. This shows that public control over education data is strong in Estonia; however, the market still plays a significant role in the provision of digital tools.

The remaining countries with a mixed model demonstrate the diverse forms the balance between the public and the market can take. In Brazil, the federal government acts as a mediator between private sector actors and the public education system, maintaining public resources such as TV Escola (OECD, 2023). Here, the state assumes an intermediary role rather than a direct provider; this is a public-led version of the mediation work described by Kerssens et al. (2024). In Mexico, the federal government provides a comprehensive student information system for the entire country while leaving the institutional governance tools to the states (OECD, 2023); this is a split where data ownership is centralized and provision is local. On the other hand, Chile stands out as a notable example where public oversight is strong but data use can create new risks. In 2020, the Chilean government established an early warning system called SAT. This system uses students' demographic and socioeconomic information, attendance records, and academic performance data to predict the risk of school dropout (OECD, 2023). This example concretely demonstrates the datafication process highlighted by Knox et al. (2020). Here, educational data is used not only for record keeping but also for making predictions about the future of students. Data is not only collected for administration but also processed to make predictions about students. For Couldry and Mejias (2019), this is the most advanced form of inference; data is not merely recorded but transformed into a prediction about the future. The Chilean example reminds us that public sovereignty alone is not sufficient; how the state uses the data in its possession is also important.

Italy, Latvia, Lithuania, Slovenia, Denmark, Czechia, New Zealand, and Ireland are also part of a mixed model. In these countries, the state has not completely withdrawn from digital education; however, it does not provide all the infrastructure alone. Italy can be cited as an example. In the country, the public research agency INDIRE provides digital libraries and educational resources. However, schools have the freedom to decide which digital tools to use their budgets for (OECD, 2023). In Latvia, the ministry has made the Moodle-based skolo.lv platform available. However, the state's role in providing teaching resources is more limited (OECD, 2023). In Denmark, the Aula platform was developed in collaboration with KOMBIT, a joint venture of municipalities. In this respect, Denmark offers a model based on cooperation between public institutions in digital education infrastructure (OECD, 2023). The common point of these examples is that the state has not completely withdrawn from the field of digital education. However, the state does not provide all the digital infrastructure alone. Therefore, these countries are considered to be within a mixed model. Ireland is an example where high school autonomy coexists with strong data protection controls. While schools have considerable freedom in choosing digital tools, this freedom is limited by data protection regulations (OECD, 2023). This cluster sheds light on the second research question: how the pattern is distributed across geographical and administrative clusters. The mixed model shows that neither a purely public nor a purely market model is an exception, and that most systems find themselves at an equilibrium point. The key is where this equilibrium is established; some countries keep data in the public sector and open up provider services to the market, while others do the opposite.

Devolved Public and Market-Dependent Models

The devolution-based public model refers to systems where decision-making authority is delegated from the center to local units, but digital infrastructure is not entirely left to the private market. Canada can be given as an example of this model. In Canada, the main authority over education lies with the provinces and territories. Therefore, the selection and supply of digital tools are largely dependent on the decisions of school districts (OECD, 2023). In Spain, a large part of the responsibilities related to education have been delegated to autonomous communities. Therefore,

there is no central student registration system in the country. Japan is also one of the examples where there is no central student information system. In Japan, many decisions related to education are made by prefectures and municipalities (OECD, 2023).

The main feature that stands out in these countries is that with the distribution of decision-making authority at the local level, education data also becomes fragmented. Instead of being collected in a single central system, education data is kept in different local systems. This situation shows that dependence on private providers is not always obvious and visible. Dependency can occur in a dispersed manner across numerous local procurement decisions and contracts. From the perspective of Couldry and Mejias' (2019) data extraction discussion, this structure demonstrates that control over data is not centralized but shaped within numerous local relationships.

The market-dependent model includes the countries with the lowest scores. In these countries, schools acquire their digital tools largely from the private market, with the state providing only funding and guidance. In the Netherlands, the independence of educational institutions is a constitutional right and there is no centrally managed student information system (OECD, 2023). However, the Dutch example carries a nuance: the public agency DUO operates a registration system for finance and statistics and uses the citizenship number as a student ID. So, the data is not completely privatized, but the school management tools are left to the market. In England, the Department for Education does not mandate certain products; schools can freely choose their own systems (OECD, 2023). In the United States, the provision and governance of infrastructure is primarily at the state and school district level, and the federal government does not directly develop tools. These three countries are the geographical equivalent of the platform dependence documented by Williamson (2021); The door to commercial platforms during the pandemic was already wide open in these systems. Couldry and Mejias' (2019) relationship of appropriation also operates here most visibly, because the infrastructure in which educational data is processed is largely in the hands of the private sector.

Together, these two clusters answer the third research question. The question was which countries pursued a strong digital sovereignty profile, and which tended towards platform dependency. The findings show that it is a paradox that the lowest-scoring countries are high-income and technologically advanced systems. Dependency does not arise from technological backwardness, but from political choices that organize education as a market.

The shape of the typology

The previous analyses examined digital sovereignty through rankings and geographical distribution. To integrate these findings, Figure 3 presents the overall governance typology by positioning educational jurisdictions according to the degree of centralisation of decision-making authority and the extent of public provision of digital infrastructure. This visualisation illustrates how the four governance models relate to one another and highlights the clustering of educational jurisdictions within the proposed framework.

Positioning countries along two main axes reveals four typologies. The horizontal axis shows the centrality of decision-making authority, and the vertical axis shows the degree of public provision. The scatter plot shows how education jurisdictions are positioned according to their levels of centrality and public provision. The upper right section shows examples where decision-making authority is more centralized and digital infrastructure is more strongly provided by the public sector. Korea, Luxembourg, Türkiye, and Hungary are prominent examples of this centralised public model. The lower left section shows examples where decision-making authority is more distributed among schools or local units, and digital infrastructure is largely provided by the market. The Netherlands, the United Kingdom, and the United States are examples close to this market-dependent model. The middle section of the graph shows mixed models that combine public and market elements. This distribution shows that even countries in the same geographical region can have different digital governance models.

The second pattern is the deceptive nature of geographical proximity. Uniform categories such as the "Nordic model" or the "European model" do not align with the findings. Finland, with its centralized student information system, presents a profile close to the public sector, while Sweden, leaving provision almost entirely to municipalities and the market, is shifting towards the market edge. Denmark occupies a mixed position between these two. Similarly, even the two communities in Belgium exhibit different regulatory profiles. This shows that educational governance depends not on geography, but on each system's own historical and institutional choices. While [Landri's \(2018\)](#) thesis of convergence through Europeanization holds true at the level of infrastructure standards, a significant diversity persists at the level of governance models. The third and most important pattern is significant from the perspective of data colonialism theory. The appropriation relationship described by [Couldry and Mejias \(2019\)](#) operates more clearly in market-dependent systems. When educational data is transferred to commercial platforms, the state's sovereignty over this data erodes, and its capacity to control the flow of data decreases. However, the findings also show that this relationship is not one-dimensional. As seen in the Dutch example, an education system can largely procure school management tools from the market; yet it can keep basic student registration data under public control. This demonstrates that digital sovereignty is not a completely present or completely absent state. Digital sovereignty consists of different layers such as data ownership, infrastructure provision, and regulatory oversight. Therefore, data colonialism theory offers a useful framework for understanding digital governance in education. The real issue is not simply whether data is collected or not. More importantly, it is the infrastructure in which this data is processed, who uses it, and under whose control it is held.

It is important to make a distinction here. A high digital sovereignty score does not directly imply democratic data governance. This study examines the extent to which education systems are dependent on private platforms and the level of public control over data and infrastructure. However, it does not measure how transparently, participatively, or in a way that protects student rights the data is managed. Therefore, strong public control can have a twofold consequence. On the one hand, this structure can protect educational data from commercial platforms; on the other hand, the collection of all data in centralized public systems can lead to increased student surveillance and the risk of insufficient oversight of this process. As seen in the examples of Türkiye, Hungary, and Korea, keeping educational data in public systems reduces platform dependence. However, this alone does not guarantee the existence of a democratic data regime. Therefore, digital sovereignty and democratic data governance are two distinct axes that should be considered separately. This study only maps the levels of digital sovereignty; it views the dimension of democratic, transparent, and rights-based data governance as a separate and complementary research area. When these three patterns are considered together, it becomes clear that digital governance in education constitutes a unique geography. In this region, while some education systems maintain public control over data, others are becoming increasingly dependent on large technology companies for their digital infrastructure and data processing processes. This dependency often doesn't manifest as an overt policy choice. Rather, it arises from the accumulation of small decisions made over time under pressure to prioritize convenience, cost, and rapid digitalization. Therefore, the narratives highlighted by [Couldry and Mejias \(2024\)](#) are crucial. These narratives can make existing dependency relationships invisible by portraying the use of digital platforms as natural, beneficial, and inevitable. The discourse of convenience, speed, and efficiency offered by these platforms can lead to dependency being seen as a normal and even necessary process. At this point, education systems enter a kind of Red Queen Effect; that is, they are constantly forced to adapt to more and more digital tools, updates, and platforms even to remain in place. This mobility does not always mean progress in terms of data sovereignty. In some cases, as systems become more digitalized, they fail to maintain control over data and may even regress.

Why these different trajectories emerge is itself worth examining. The findings suggest that the position of an education system is shaped less by its level of economic or technological development

than by its institutional history and its prevailing model of public administration. Systems built on a centralist administrative tradition already possess the bureaucratic capacity and the legal habit of providing infrastructure directly, so extending this logic to digital tools is a natural continuation. Systems with a long tradition of local autonomy or market-based service provision, by contrast, tend to treat digital infrastructure as something to be procured rather than produced, and the entry of commercial platforms simply follows the path that public administration had already laid down. In this sense the geography of digital sovereignty is also a geography of administrative traditions.

This helps explain one of the most striking findings of the study: that several high-income and technologically advanced systems sit closest to the market-dependent model. At first glance this seems paradoxical since these systems clearly have the capacity to build public infrastructure. The explanation is not capacity but choice. In these systems education has long been organised around school autonomy and a competitive market of providers, so dependence on commercial platforms is not a technological failure but the expression of a deliberate governance preference. This refines the theory of data colonialism rather than simply confirming it. The findings show that dependence is not a single condition but comes in degrees and forms; a system may surrender its tools to the market while retaining its core data or disperse its data across many local contracts while keeping nominal public control. Data colonialism is therefore better understood as a layered and uneven process than as a binary between sovereign and colonised systems.

POLICY RECOMMENDATIONS

The findings of this study have important implications for governments, education authorities, and policymakers responsible for digital education governance. The recommendations below build directly on the comparative analysis and are intended to support the development of digital infrastructures that strengthen public oversight while allowing innovation and collaboration with private providers.

For Governments and Ministries of Education

Based on the comparative evidence presented in this study, that digital infrastructure should be treated as a strategic component of educational governance rather than merely as a technical service. Governments wishing to maintain greater control over educational data should invest in public digital infrastructure and avoid excessive dependence on a single commercial provider. At the same time, procurement policies should promote interoperability so that schools can move between digital systems without becoming locked into one platform. The Estonian case illustrates that strong public ownership can coexist with effective regulation and innovation, demonstrating that governments do not have to choose between digital development and digital sovereignty.

For Education Authorities and School Systems

Education authorities should recognise that decisions regarding digital platforms are also governance decisions. Although commercial platforms may provide efficient and cost-effective services, repeated local procurement decisions can gradually create long-term dependence on private infrastructures. Decision-makers should therefore evaluate digital platforms not only according to cost and functionality but also according to data governance, long-term sustainability, and public accountability.

For future policy development

The study demonstrates that maintaining public ownership of educational data alone is insufficient. Equal attention should be given to regulatory frameworks, interoperability standards, and transparent governance arrangements that ensure educational data remain under appropriate public oversight while allowing innovation and collaboration with private providers where appropriate.

Future digital education policies should therefore balance technological efficiency with the protection of public values and digital sovereignty.

Limitations and Future research directions

This study has some limitations. First, the data used in the study is largely based on information submitted by countries to the OECD. Also, this data reflects the situation in 2023. Since digital education policies change rapidly, this picture may change over time. Second, the limitation of the coding process is that the scoring was done by a single researcher. Therefore, no comparison with a second coder was made, and inter-coder agreement was not calculated. To mitigate this limitation, representative OECD baselines showing the institutional rationale for the classification of each educational jurisdiction are presented in the Appendix. This allows the reader to see the information on which the classification decisions are based and to more easily follow the coding process. Third, the classification used in this study is based on four dimensions determined by the researcher. Therefore, the typology facilitates understanding digital governance in education; However, it does not show the situation of each country in all its details. Fourthly, the digital sovereignty score expresses a complex structure with a single score. Two educational jurisdictions that receive the same score may have reached that score for different reasons. Therefore, the scores should not be evaluated in isolation, but together with the institutional characteristics of each country. Fifth, this study shows where countries stand in terms of platform dependence and public data control. However, it does not measure how democratically, transparently, or in a manner that protects student rights educational data is governed. Future research can examine whether digital sovereignty strengthens in countries by following this picture over time. Despite these limitations, the study addresses digital governance in education comparatively and offers a classification that makes the differences between countries visible. A further limitation concerns the centralisation dimension (D1). Because it rewards central decision-making, D1 may place federal and devolved systems at a structural disadvantage, even though the delegation of authority to local public bodies in these systems is itself a form of public ownership rather than a loss of sovereignty. The case of Belgium, where the two communities are treated separately, makes this tension visible. Future studies could address this by defining public ownership to include local public authorities in federal systems, or by treating federal states as single jurisdictions, so that the score reflects public control rather than administrative centralisation.

CONCLUSION

This study examined the geography of digital sovereignty in education by developing a comparative typology of 29 educational jurisdictions based on four dimensions: the level of decision-making authority, public ownership of educational data, public provision of digital infrastructure, and the strength of regulatory protection. By bringing these dimensions together, the study moves beyond single-country analyses and provides a comparative framework for understanding how different education systems organise digital governance.

The findings demonstrate that digital governance in education is shaped not simply by technological capacity or economic development, but by different models of public governance and institutional traditions. While some education systems maintain strong public control over educational data and digital infrastructure, others rely more heavily on commercial platforms and market-based provision. The analysis also shows that digital sovereignty is not a binary condition. Rather, education systems occupy different positions along a continuum of public control and platform dependence, reflecting different combinations of data ownership, infrastructure provision, and regulatory oversight.

The study contributes to the literature by linking the concepts of digital sovereignty, data colonialism, and platformization to the field of educational governance. It demonstrates that debates

about digital technologies in education should not be understood solely as questions of technological innovation or efficiency, but also as questions of governance, authority, and public accountability. In this respect, the proposed typology offers a conceptual tool that enables researchers and policymakers to compare educational jurisdictions using a common analytical framework while recognising the diversity of governance arrangements.

Although the study provides a comparative overview of digital governance across educational jurisdictions, it should be interpreted in light of its methodological limitations. The proposed typology represents one analytical perspective rather than a definitive classification of education systems, and digital governance continues to evolve rapidly as new technologies, particularly artificial intelligence, reshape educational infrastructures and data ecosystems. Future research could extend this framework by incorporating longitudinal analyses, additional governance dimensions, and measures of democratic data governance to examine how digital sovereignty develops over time under changing technological and policy conditions.

AI Usage and Assistance

During the preparation of this manuscript, the author utilised AI tools (Google Gemini / ChatGPT) to rephrase portions of the text and enhance the fluency of the English. Following this AI assistance, the entire manuscript was thoroughly reviewed and approved by a human language editor to ensure accuracy and an appropriate academic tone. The author takes full responsibility for the final content and integrity of the publication.

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