5 Czechia

This note provides an overview of Czechia's digital education ecosystem, including the digital tools for system and institutional management and digital resources for teaching and learning that are publicly provided to schools and educational stakeholders. The note outlines how public responsibilities for the governance of digital education are divided and examines how Czechia supports the equitable and effective access to and use of digital technology and data in education. This includes through practices and policies on procurement, interoperability, data privacy and regulation, and digital competencies. Finally, the note discusses how Czechia engages in any initiatives, including with the EdTech sector, to drive innovation and research and development towards an effective digital ecosystem.

Key features

- Although the central government does not publicly provide much digital infrastructure for system
 and institutional management, the Czech School Inspectorate does own and provide access to
 several digital tools (*InspIS systems*) including a school information register and tools for selfevaluation, curriculum planning and assessment. The government and its agencies do publicly
 provide some digital resources to support teaching and learning.
- Schools have significant autonomy in Czechia to choose, acquire and use their own digital
 infrastructure solutions, both for institutional management and for supporting teaching and
 learning. Only a minority of tools for system management provided by the Czech School
 Inspectorate must be used by all public schools.
- Ensuring the equity of access to and use of digital infrastructure is a challenge. While the country
 has invested in hardware infrastructure in educational institutions, particularly since the COVID-19
 pandemic, there remain inequities across institutions and educational levels.
- The ministry has recently revised the curriculum for primary and lower secondary education to
 include new areas of informatics (to develop computational thinking) and digital competence. To
 support its implementation, the ministry created a dedicated website (<u>Revize.edu.cz</u>) as well as
 learning resources for educators on the new curriculum content. The ministry has also established
 a website (<u>edu.cz/Digitalizujeme</u>) and network of local experts to support the general digitalisation
 process of schools.
- Beyond the general provisions of the EU GDPR laws, there are no national rules or guidelines that govern the management, protection, use and access to student and education data. Access to educational microdata for third party research is also not provided for in any rules or guidelines.

General policy context

Division of responsibility

In Czechia, the governance of the education system is shared between government authorities at the central and lower levels. The central Ministry of Education, Youth and Sports (*Ministerstvo školství mládeže a tělovýchovy*) sets priorities, publishes national curriculum frameworks ("Framework Educational Programmes") and defines national reforms, while municipalities are usually responsible for organising pre-primary (ISCED 0) and basic education (ISCED 1 and 2). Regional authorities are usually responsible for organising secondary education (ISCED 3), including vocational education and training (VET) and tertiary professional schools (ISCED 6).

Decision-making is highly devolved within the Czech education system: schools have significant autonomy over how they allocate resources and how they implement the national curriculum and assessment (via each institution's "school educational programme"). Local municipalities or regions are primarily responsible for providing schools with equipment, investment and maintenance funds while the ministry provides funds to pay teachers and to purchase teaching resources for students. The ministry (together with other government ministries) is also responsible for setting the rules and conditions of funding programmes financed by the European Union (EU) and from which schools can additionally finance their digital infrastructure and equipment.

Public responsibilities for providing access to and use of digital technologies in education follow this partially decentralised and highly devolved context, with some of the digital infrastructure provided centrally but significant portions acquired locally or independently by schools. The public responsibility for providing hardware infrastructure is split between several ministries (Ministry of Education, Youth and Sports; Ministry for Regional Development; and Ministry for Trade and Industry).

Digital education strategy

The current national education strategy ("Strategie vzdělávací politiky České republiky do roku 2030+"; hereafter referred to as the Strategy 2030+), published in 2020, aims to modernise the entire education system and it references digital technologies both as a motivation for and means to achieve modernisation. The document explicitly addresses digital education: developing students' skills to use technologies responsibly, independently and appropriately, across all subject areas; ensuring adequate hardware, software and connectivity; strengthening teachers' digital skills; using technology to improve teaching and learning; and supporting the use of digital infrastructure to collect educational data for self-and system evaluation and improve communication between stakeholders.

The Strategy 2030+ integrates and replaces the previous digital education strategy, published in 2014.² In 2019, the country's Supreme Audit Office (*Nejvyšší kontrolní úřad*) reviewed the implementation of that strategy and concluded that the ministry had failed to create the conditions necessary for the long-term successful development of digitalisation in education and for improving digital literacy.³ A new review published by the Supreme Audit Office focusing on support for digital education in the period 2019-2021 found that schools were not well prepared for distance learning, but that the COVID-19 pandemic significantly contributed to developing digital education in the country including the provision of portable digital devices.⁴ Over CZK 8 billion (EUR 3.4 billion) was spent by the ministry during this period on supporting digital education.

A significant proportion of the country's projects on digitalisation in education are funded by the European Union in addition to the funding provided by municipalities and/or regions. These include projects focused on developing digital skills and computational thinking, supported via European Structural and Investment Funds (ESIF), as well as the "National Recovery Plan" (*Národní plán obnovy*), supported via the EU Recovery and Resilience Facility (2021-2026). One of the aims of the National Recovery Plan is to support the revision and implementation of the new digital curriculum and the meaningful integration of digital technologies in teaching, as well as to increase the digital capacity of schools and tackle the digital divide.

Beyond education specifically, the government created a national Digital and Information Agency in 2023 as part of a project to transform the co-ordination and management of digitalisation in the country.⁶

The public digital education infrastructure

In Czechia, both the ministry and the regions/municipalities provide components of the digital education infrastructure. Given the significant autonomy of schools, institutions are primarily responsible for acquiring their own digital ecosystem and choosing which digital tools to use. This section reviews two aspects of the public digital infrastructure in Czechia: digital tools for system and school management, and digital learning resources for teaching and learning.

Digital ecosystem for system and school management

Student information system

The ministry does not currently use or provide a centralised student information system (SIS). Schools do have to share certain student data with the ministry for administrative and statistical purposes, but they usually collect and transfer data using commercially procured solutions for institutional management (e.g. *Bakaláři* or *Škola online*). The country plans to create an "Education Registers System" to simplify the acquisition and transfer of data amongst relevant stakeholders (e.g. the ministry and education agencies, schools, research organisations, etc.). The system aims to reduce the administrative burden on schools by defining a clear framework of required data and optimising the data sharing and collection process, as well as increasing the compatibility of existing institutional management systems. Similarly, the ministry

does not provide or use any kind of student admission management system but has recently established a task force to digitise this process for students in upper secondary education.

While the ministry does not have a centralised student information system, the Czech School Inspectorate (CSI; Česká školní inspekce) – an independent national authority for evaluating the quality and effectiveness of education – does have a publicly accessible national school register called the *InspIS Portál.* The register provides basic information about schools at all education levels collected by CSI, but also allows schools to enter additional information related to their school characteristics or facilities (e.g. specially equipped classrooms, ICT equipment, assessment methods, etc.) and to attach relevant school documents. The register also contains reports on each school produced by the CSI following their inspections.

Ministry officials estimate that the majority of schools in the country do use some kind of learning management system (often including tools for knowledge management or customer relationship management) to manage students at the institutional level, but these digital tools are not publicly provided by the ministry. Some digital tools for administrative functions may also be used or provided by local municipalities, but there are significant differences across the country in terms of how schools are managed and what tools municipalities provide to schools.

Self-evaluation tools for institutional management

The importance of school self-evaluation in Czechia was recognised in a 2001 White Paper by the ministry and was subsequently enshrined in law via the Education Act in 2004. It is further developed in the current Strategy 2030+. The CSI provides modules of its online *InspIS* system (Inspection Information System) to schools to support their self-evaluation activities. Aligning the tools used for self-evaluation with those used for external evaluation by CSI helps to ensure coherence between the two activities.

The *InspIS DATA* module is the main information system used by the CSI to monitor and record findings during school inspections. All schools must fulfil part of their legal obligations towards the CSI (e.g. implementing inspection surveys, transfer of records) by registering in the *InspIS DATA* system, and school management staff can access their external inspection reports via this system. Via the platform, staff can also access online self-evaluation tools that are aligned with those used for external evaluation. Although schools cannot modify these tools for their own school context, it does allow schools to generate a summary report that links directly to their last CSI external evaluation. The CSI cannot access any school data generated by self-evaluation in the *InspIS DATA* platform.

The *InspIS ŠVP* module facilitates the creation and administration of school educational programmes (ŠVP; *školních vzdělávacích programů*). It guides school leaders to formalise and systematically link their schools' educational offer with the national Framework Educational Programmes. The *InspIS ŠVP* system also serves school self-evaluation by automating the creation of targeted self-evaluation plans. Unlike the self-evaluation tools provided via the *InspIS DATA* module, the *InspIS ŠVP* module allows schools to select the criteria on which they want to focus a self-evaluation exercise and it pre-populates the plan with suggested objectives and goals that schools can modify or add.

In addition to providing the *InspIS DATA* and *ŠVP* modules for schools at all education levels (including VET), the CSI website makes available a range of resources for school management staff linked to monitoring and improving the quality of education in schools. These include research reports, concrete recommendations for particular issues and information about best practices for linking self-evaluation and external evaluation.

Finally, the National Pedagogical Institute (NPI; *Národní pedagogický institut*), an education agency managed by the ministry, provides a self-evaluation tool for schools focused specifically on digital education. Schools can use the *Profil Škola21* tool to create their own school ICT profile, evaluate their progress towards ICT integration and compare their school with others on the platform based on the European Digital Competence Framework for Educational Organisations (DigCompOrg).¹¹ The EU

SELFIE for Schools tool functions similarly.

Examinations, career guidance and professional development

While high-stakes, end-of-year examinations are paper-based, the CSI conducts annual low-stakes online assessments through its *InspIS SET* module for a representative sample of students in primary and secondary education. ¹² These assessments contribute to the CSI's evaluation and verification of learning outcomes in the Czech education system. Schools can also directly use the *InspIS SET* module to carry out their own online assessments using a public bank of test items (as well as add their own items). The CSI is working to supplement the bank of items with released items from international surveys.

To help students navigate their school trajectory and find their future career, the National Pedagogical Institute (NPI) offers a career guidance platform that provides a range of information, tools and resources for students in primary, secondary and tertiary education (e.g. on choosing subjects or orienting career decisions post-secondary education).¹³ The platform also provides some resources for educators and employers, for example on labour market statistics or information on graduate employability.

In terms of career support and professional development for teachers, the CSI provides the *InspIS E-LEARNING* module that school leaders and teachers can use for online learning and to access professional resources. They can also test their skills and obtain electronic certificates via the platform.

Digital ecosystem for teaching and learning

Digital teaching resources in formal education

The NPI provides teachers with the *Metodický portal RVP*, a platform with static teaching resources created and shared by other educators and targeted at pre-primary, primary and lower secondary educational levels. ¹⁴ Resources cover a wide range of subjects and are classified on the platform according to the relevant level of education, subject domain and topic. The platform connects to the *Katalog EMA*, which is a centralised catalogue of open-licensed digital educational resources otherwise stored on several different portals and websites. ¹⁵ The catalogue ranks resources according to their popularity and quality to help teachers find useful resources. However, a recent review by the Supreme Audit Office found that 64% of the materials on the portal had never been viewed by any user. ⁴ The NPI is therefore currently working on improving the coverage, accessibility and functioning of the platform.

During the COVID-19 pandemic, virtual classroom environments were used significantly by schools across the country as the primary mode of teaching to ensure distance learning; however, it is unclear to what extent such tools continue to be used in schools. The ministry has started a pilot programme on hybrid teaching and learning (where schooling is in-person Monday-Thursday, and online on Friday) with 70 schools (including primary and secondary education). Other resource providers, including education publishers, philanthropic organisations and EdTech companies (e.g. Microsoft), also provided digital resources for teaching and learning to educators for free during the pandemic.

Open educational resources

As part of the EU-funded project on developing computational thinking managed by the ministry, the University of South Bohemia developed the *iMyšlení* platform which provides a range of open educational resources (e.g. Massive Online Open Courses, free applications, videos and texts) for online learning for students, teachers, parents and the wider general public.¹⁷ It also aims to popularise topics related to computational thinking, like programming and robotics, for different audiences. The ministry, together with the Ministry of Labour and Social Affairs (MLSA; *Ministerstvo práce a sociálních věcí*) and with funding from European Social Funds, also manage the *PortalDigi* open portfolio of resources focused on developing citizens' digital competencies.¹⁸ The platform links to other portals (e.g. *DigiVýuka*, *DigiKatalog*,

Evaldo) that provide resources for developing digital skills and for identifying potential issues when working with digital technology, both in general and for specific roles in the workplace.

Other openly accessible teaching and learning resources are available through public (social) media channels. For example, the NPI runs a YouTube channel with content targeted at educators. ¹⁹ Česká televize, a public television network, produces free educational programming and interactive games and learning resources for pre-primary, primary and secondary students on its *CT edu* channel. ²⁰ While students normally view and interact with content online on its website, some content was also directly broadcast on television during the COVID-19 pandemic.

Online assessment and self-evaluation tools for teaching and learning

In addition to resources for teaching and learning, the ministry and education agencies provide several self-evaluation tools for teachers, schools and students. The *Metodický portal RVP* provides access to instruments developed by other education professionals for evaluating various institutional and classroom issues (e.g. school climate) as well as student and parent attitudes.²¹ It also provides a self-assessment tool for teachers, *Profil Učitel21*.²² Teachers can use the tool to evaluate their own digital competencies, based on the European Digital Competence Framework for Educators (DigCompEdu).

Separate to the *Metodický portal RVP*, there is also a publicly available online assessment application called *Evaldo* aimed at the general public that forms part of the *PortalDigi* platform.²³ The application simulates common digital environments and asks users to complete tasks in order to evaluate their digital competencies. The application is based on the European Digital Competence Framework for students (DigComp II). Based on users' results, it recommends areas for further development and links to relevant educational resources elsewhere on the *PortalDigi* platform.

Access, use and governance of digital technologies and data in education

Providing a public digital education infrastructure does not necessarily imply that stakeholders will use it. Different rules and policies can therefore ensure access to digital technologies in education, as well as support and govern their use.

Ensuring access and supporting use

Equity of access

Czechia does not have specific laws on ensuring equitable access to and use of digital tools and resources in education. In practice, both the CSI and the NPI in particular publicly provide various digital tools (e.g. *InspIS* system and modules) and resources (e.g. *Metodický portal RVP, Profil Učitel21, Profil Škola21*), in principle enabling school staff and teachers to access components of the digital education ecosystem in a homogenous and equitable way across all education levels. However, the devolution of responsibilities to schools for ultimately using those resources (with the exception of the *InspIS DATA* system), their discretion to acquire additional components of their digital infrastructure, and the varying levels of ICT integration in schools and across educational levels leads to possible disparities and inequities across institutions.

In terms of funding, there is no specific equity component of the non-earmarked funding provided to primary and lower secondary schools by the ministry for their operational needs. Outside of this central operational budget, there is some earmarked funding for expenditure related to digital education specifically. The National Recovery Plan provides two such funds (via the municipalities) for public primary and secondary schools (including VET institutions). The first fund is targeted towards students and schools from low socioeconomic backgrounds with the aim of closing the digital gap in education. It is available in multiple years

for purchasing hardware equipment including mobile devices to loan for free to disadvantaged students; the formula to define the eligible allocation takes into account a school's socio-economic situation. The goal is to purchase 70 000 devices nationally to support pupils in need, and for at least 80% of schools to implement the loan initiative. The second fund is designed as a one-time subsidy to purchase digital teaching aids (e.g. robotics kits, virtual reality devices, specialised software); the budgets for this purpose are calculated using a fixed amount per student (therefore no equity component to the funding formula). While the two funds are differentiated in this way, schools maintain autonomy over how to spend them (i.e. which hardware or software solutions to purchase). Private and religious schools can also apply for this funding. While these earmarked funds are accessible to all schools and could thus mitigate some disparities across schools, uneven access to (digital) hardware and resources will likely remain issues given the high degree of school autonomy and that only one of the two funds includes an equity dimension in its funding formula.

Finally, although the development of digital competences now forms part of the mandatory educational objectives defined by the ministry, schools and teachers can meet this objective with some pedagogical discretion – therefore possibly leading to different educational offers across schools in this area.

Supporting the use of digital tools and resources

In addition to providing earmarked funding for digital infrastructure through the National Recovery Plan, the ministry has developed dedicated online support and guidance materials on digitalisation through its *Digitalizujeme* ("We digitise the school") website, including examples of good practice, a handbook on IT administration for school directors, and standards on school connectivity and security. A network of so-called "IT gurus" – expert consultants paid by the ministry and located regionally – has also been created to support schools in their digitalisation process. Furthermore, schools can have a dedicated "ICT methodologist" in their school whose task it is to help colleagues integrate digital technologies in their teaching and to help create their school's Digital Strategy. This role has state-recognised concessions in teaching duties and individuals must complete specific trainings.

The NPI's *Metodický portal RVP* platform, in addition to providing pedagogical supports, also provides broader resources for educators on various aspects of teaching and learning including digital education, such as academic articles, webinars and blogs.

Cultivating the digital literacy of education stakeholders

In Czechia, there are guidelines providing a framework for teachers' digital competencies at all educational levels (*Rámec digitálních kompetencí učitele*), based on the EU's DigCompEdu.²⁵ As outlined in the Strategy 2030+, the ministry is also revising the national curriculum framework for basic education to include the new areas of informatics and digital competence. The revised framework was approved and published in 2021 for both basic schools and grammar schools. Basic schools at ISCED level 1 must integrate the revised curricula in their school educational programme from September 2023; basic schools at ISCED level 2 must do so from September 2024, and grammar schools from September 2025. A similar reform for upper secondary VET education is currently underway.

To support schools with this transition, the NPI has created the *Revize* website which contains comprehensive information resources on the curriculum reform, as well as guidance and best practices for its implementation. 26 At the request of schools, the ministry also developed and published a model school educational programme for informatics and digital competence which schools can access via the *InspIS* $\check{S}VP$ system. To support teachers with the transition, the NPI provides courses, teaching resources and methodological support on the new areas of the curriculum as a part of a project financed by the EU's Recovery and Resilience Fund. 27

In 2016 *DigiKoalice* was established as a joint platform of the ministry and the NPI. It is a unique platform connecting schools with stakeholders interested in digital education, with a particular focus on developing digital skills and on digital jobs.²⁸ It brings together more than 200 member organisations, from state institutions and agencies, to schools, ICT companies and non-profit organisations. Members can share resources and find courses or events focused on the development of digital skills (some of which are free).

In terms of broader engagement with stakeholders, a new Interdepartmental Group for Digital Education has been formalised within the Government Council for Information Society, following its role in the context of the Structured Dialogue on Digital Education and Skills initiative by the European Commission. The National Office for Cyber and Information Security (NUKIB; *Národní Úřad pro Kybernetickou a Informační Bezpečnost*) also provides online learning resources on cybersecurity issues targeted at different groups of the general population, including students, teachers and parents.²⁹ In collaboration with the ministry, the Office has created resources specifically for students and teachers on topics related to cybersecurity, fake news and Internet scams.

Governance of data and digital technologies in education

In Czechia, data protection and privacy are provided for under the European Union's General Data Protection Regulation (GDPR). The ministry also provides some guidelines related to digital security in schools via its *Digitalizujeme* website (although these focus on secure network connectivity rather than data protection and privacy). However, the government does not have any specific additional rules related to student data protection and privacy nor are there any rules or provisions related to accessing student microdata (anonymised microdata for research purposes are currently made available upon request). An exception to this is the selected aggregated data that the CSI makes publicly available from their national inspection activities and from international surveys (e.g. PISA).

There are some standards of interoperability among digital tools used by the ministry and national agencies, but no formal rules or guidelines governing the interoperability of the broader digital education infrastructure. In terms of guidelines for ensuring the quality of digital educational resources, in 2016 the NPI published quality educational criteria for digital resources developed with public funds.³¹

Supporting innovation, research and development (R-D) in digital education

Developing a national digital education ecosystem presents challenges both to develop appropriate local solutions and to incentivise relevant innovation by external stakeholders. Providing incentives, supporting research and development, and funding education technology start-ups are part of the typical innovation portfolio countries could consider.

Although no public research priorities have been formulated in the field of digital education nor is there a specific research programme funded by the ministry to support research on the topic, some national agencies do conduct their own research on aspects of digital education (particularly since the onset of the COVID-19 pandemic). For example, the CSI has conducted research on distance learning and on the use of and perceptions of ICT in education, and in 2023 the national technological agency (*Technologická agentura České republiky*) had one project focused on examining the state of digital infrastructure and its financing in education.³²

The Strategy 2030+ also signals an intention to strengthen educational research in general and improve communication between the ministry and the research community. The creation of the Education Registers System, in effect a centralised information register connecting various existing student datasets within the education system, will facilitate information sharing between education stakeholders including research organisations and will promote access to anonymised educational microdata (upon request) for research

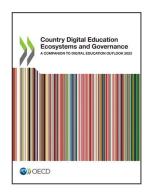
purposes. Currently there is no publicly available or documented educational microdata (beyond the basic information about schools gathered in the *InspIS Portál*).

The ministry and associated agencies do not develop any EdTech solutions directly, nor are there institutionalised partnerships between independent EdTech companies and the ministry. While there are no formal financial mechanisms (e.g. investment, subsidy) to incentivise private sector innovation and development in this field, the ministry does support and foster some collaboration with EdTech indirectly or through non-monetary means (e.g. the *DigiKoalice* platform). The ministry and the NPI also organise an annual *DigiSeč* conference dedicated to digital technologies in teaching that brings together teachers in primary and lower secondary schools with other professionals, researchers, and EdTech companies.³³

Notes

- ¹ https://www.edu.cz/wp-content/uploads/2021/09/brozura S2030 en fin online.pdf
- ² https://www.edu.cz/strategie-msmt/strategie-digitalniho-vzdelavani-do-roku-2020/
- ³ https://www.nku.cz/assets/kon-zavery/K18018 en.pdf
- 4 https://www.msmt.cz/file/55382/
- ⁵ For more on ESIF projects see: https://www.edu.cz/podpora-skol/projekty-esif/ (overview), https://www.imysleni.cz/o-projektu (project on developing computational thinking); For more on the National Recovery Plan, see: https://www.edu.cz/npo/.
- ⁶ https://digitalnicesko.gov.cz/dia/
- ⁷ Bakaláři: https://www.bakalari.cz/; Škola online: https://www.skolaonline.cz/
- ⁸ https://portal.csicr.cz/
- ⁹ White paper (2001): https://www.msmt.cz/reforma-terciarniho-vzdelavani/bila-kniha/narodni-program-rozvoje-vzdelavani-v-ceske-republice-bila-kniha-2001; Education Act (2004): https://www.msmt.cz/dokumenty/skolsky-zakon-ve-zneni-ucinnem-ode-dne-1-2-2022
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- ¹⁷ https://imysleni.cz/
- ¹⁸ https://www.evaldo.cz/projektove-weby
- ¹⁹ NPI YouTube channel: https://www.youtube.com/channel/UCzx0HUrvq48ZPtKvqIrKJAg/featured
- ²⁰ https://edu.ceskatelevize.cz/? ga=2.186807914.395114136.1668783469-1279886337.1668783463
- ²¹ http://evaluacninastroje.rvp.cz/nuovckk portal/Default.aspx?tabid=72&language=cs-CZ
- ²² https://ucitel21.rvp.cz/
- 23 https://www.evaldo.cz/
- Resources portal for schools and digitalisation: https://www.edu.cz/digitalizujeme; Standards on connectivity: https://www.edu.cz/digitalizujeme/standard-konektivity-skol/; Headmaster's guide to IT administration and management: https://www.edu.cz/digitalizujeme/it-guru/ IT gurus: https://www.edu.cz/digitalizujeme/it-guru/
- ²⁵ https://ucitel21.rvp.cz
- ²⁶ https://revize.edu.cz/
- ²⁷ https://www.nidv.cz/
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- ²⁹ https://osveta.nukib.cz/
- 30 https://www.edu.cz/digitalizujeme/standard-konektivity-skol/
- https://clanky.rvp.cz/clanek/c/Z/21071/kriteria-kvality-digitalnich-vzdelavacich-zdroju-podporenych-z-vereinvch-rozpoctu.html
- ³² CSI research on 1) distance learning during the Covid-19 pandemic https://www.csicr.cz/html/2021/TZ_Distancni_vzdelavani_v_ZS_a_SS/html5/index.html?&locale=CSY&p_n=1">https://www.csicr.cz/html/2021/TZ_Distancni_vzdelavani_v_ZS_a_SS/html5/index.html?&locale=CSY&p_n=1">https://www.csicr.cz/html/2021/TZ_Distancni_vzdelavani_v_ZS_a_SS/html5/index.html?&locale=CSY&p_n=1">https://www.csicr.cz/html/2021/TZ_Distancni_vzdelavani_v_ZS_a_SS/html5/index.html?&locale=CSY&p_n=1">https://www.csicr.cz/csicr/media/Prilohy/2021_přílohy/Dokumenty/Sekundarni-analyza-PISA-2018.pdf; National Technology Agency digital education project: https://starfos.tacr.cz/cs/project/TIRDMSMT015MT05#project-main
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