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# Opening Telecommunication Data for Inclusive Education

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**Abstract**—In this paper, we present the main stages of our research in the context of the NetMob 2023 Data Challenge. Following our global research work in cloud continuum infrastructures for inclusive education, we aim to evaluate the impact of telecommunication infrastructures on digital access from an open data perspective in education. We will analyze the French National Education use case crossing the 4G dataset provided by the French telecommunications operator Orange with open datasets for inclusive education in order to propose the first definition of a new Inclusiveness Education KVI (Key Value Indicator) compatible with the Hexa-X 6G KVI definition.

**Index Terms**—telecommunications data, open data, digital inclusiveness, digital divide, inclusive education, 6G, KVI

## I. INTRODUCTION

Technology represents an excellent opportunity to improve digital equality, but during COVID-19, the digital divide has grown. Besides, disruptive technologies like 5G generate an important societal controversy. To address this issue, Hexa-X presents the 6G technology as a technology centered on societal values that moves the gravity center from traditional hard indicators, the Key Performance Indicators (KPIs), to the soft indicators, the Key Value Indicators (KVI).

Our research work concerns the impact of telecommunications infrastructures on inclusive education. From a global point of view, we propose a new open infrastructure of telecommunications for education based on the cloud continuum concepts and beyond with explicit consideration of inclusiveness workload and indicators by design, introducing an Inclusiveness Education Key Value Indicator (KVI) definition compatible with the 6G Key Value Indicator concept of Hexa-X<sup>1</sup>.

Regarding communications infrastructures for education challenges revealed during the COVID-19 pandemic, we could focus our research, especially on applications with similar characteristics to those used in existing central cloud infrastructures for distance and hybrid learning or future classrooms.

<sup>2</sup>

<sup>1</sup>Hexa-X H2020 5G-PPP project. Deliverable D1.2, Expanded 6G vision, use cases, and societal values, April 2021.

<sup>2</sup>Equivalent in terms of data consumption, latency of other parameters

Crossing datasets with a multi-disciplinary approach contributes to reducing the digital divide and digital illiteracy. From this inclusion perspective of designing open infrastructures for education centered on societal values, we would cross some open datasets of the education and telecommunications domains with the provided Orange dataset [1] to define our first version of the proposed Inclusiveness Education KVI.

The remainder of this abstract paper is organized as follows. Section 2 describes our use case, French National Education. Section 3 presents some analyses concerning open education data. Finally, we present the future directions in Section 4.

## II. THE FRENCH NATIONAL EDUCATION USE CASE

The French National Education use case [2] presents some learning, space-temporal, and inclusion characteristics that are interesting for our research.

Concerning learning stages organization<sup>3</sup>, the K12 French system is divided into four major stages from 3-5 years named "maternelle" (preschool<sup>4</sup>), 6-10 years named "école" (primary school), 11-14 years named "college" (middle school), and 15-17 years named "lycée" (high school). Regarding spatial structure, Education in Metropolitan France<sup>5</sup> is divided into three geographical areas: A area, B area, and C area. Every educational area regroups some administrative educational units named "Academia" (meaning Academy), which concentrate on managing all K-12 education establishments across one city or more. For example, the Paris metropolitan area in the provided 4G Orange dataset includes three academies (Paris, Versailles, and Créteil). Normally, academic holidays<sup>6</sup> take place every six weeks for a period of 16 natural days for an academic area, with a total period of 30 days across all academic areas. A scholar holiday period is divided temporarily and spatially: a scholar holiday period starts on Saturday

<sup>3</sup>Organisation de l'école. Ministère de l'Éducation Nationale et de la Jeunesse. URL: <https://www.education.gouv.fr/organisation-de-l-ecole-12311>.

<sup>4</sup>Education is obligatory in France from 3 years old from September 2020.

<sup>5</sup>For Corsica, the overseas territories the calendar could be adapted by the educational authorities

<sup>6</sup>Vacances scolaires 2018-2019. Ministère de l'Éducation Nationale et de la Jeunesse. URL: <https://www.education.gouv.fr/bo/17/Hebdo26/MENE1719943A.htm>.

in the A area, and after a period of 7 days, on the next Saturday, the scholar holiday starts in the next academic area following the ordered sequence A area, B area, C area.<sup>7</sup> In terms of educational inclusion, the French National Education has a priority education policy that aims to correct the impact of social and economic inequalities on academic success (RES and RES+) and various units for inclusive education of students with disabilities (ULIS, EREA, and SEGPA).<sup>8</sup>

### III. OPEN DATA FOR INCLUSIVE EDUCATION

We are working with the open data repository of the French government dedicated to education [3]. This repository provides open datasets with general information about the schooled population and digital inclusion statistics like the Social Position Index of schools (named after the French acronym, IPS) in France. We were exploring the IPS of different academic stages (primary, middle, and high school) and the IPS of EREA units from the academic year 2018-2019. We were performing preliminary analyses of the primary school IPS dataset and after we extended these analyses to the other stages for all cities in the dataset. Preliminary analysis showed that the IPS index presents a normal distribution. Descriptive statistics of primary schools IPS dataset showed the city with the biggest IPS standard deviation is Marseille, and the city with the smallest IPS standard deviation is Rennes; this means IPS are more spread out for Marseille. There were our first two candidates to deeply analyze the digital education gap in France and its relationship with telecommunication data. We

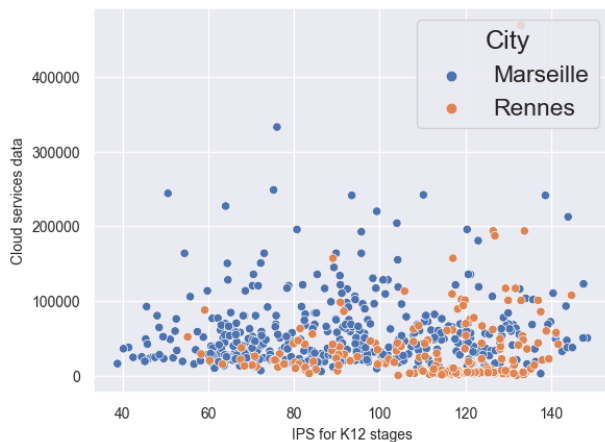


Fig. 1. Relation between the cloud services traffic and the IPS for the K12 stages

cross the Educational National open data with the traffic files of eight cloud services for these two cities for a laboral day. As represented in Fig. 1, there is no correlation between the IPS and the data consumption on the tiles associated with the set of primary, middle, high and EREA schools of Marseille and Rennes.

<sup>7</sup>The period of the provided dataset, from 16th March 2019 to 30th May 2019, includes three bank holidays and the Spring break of the 2018-2019 academic year, starting in A area on a Saturday, 13th April, and returning the school the Monday 6th May for the C area.

<sup>8</sup>*École inclusive*. éducol — Ministère de l'Éducation nationale et de la Jeunesse - Direction générale de l'enseignement scolaire. URL: <https://eduscol.education.fr/1137/ecole-inclusive>.

### IV. FUTURE WORK

As mentioned in the Introduction section, one of the main goals of our global research about cloud continuum infrastructures for inclusive education is to propose a new open infrastructure education based on 5G technology and to define a new Inclusiveness Education KVI. This KVI indicator would be composed of many soft indicators such as global network availability, mobile network usage, quality of service, or ownership of digital devices close to the Student's Digital Opportunity model proposed by Jim, Evans, and Grant for the United States [4]. We would extend this model to the mobile network and add other soft indicators emerging from intrinsic peculiarities of the French National Education use case, especially regarding inclusion scope.

The main goals of this study are the following :

1) Continue to evaluate the relationship between economic factors like the IPS of a given area and data usage for all applications and by categories of applications.

2) Continue to study the temporal and spatial traffic patterns across the academic areas and scholar or academic holiday periods described below as the first stage of our global research to characterize the mobile traffic for future mobile infrastructures for inclusive education.

3) Evaluate the relationship between 4G network availability and data usage for a set of applications equivalent to educational applications of a traditional central cloud infrastructure for distance or hybrid education for the 20 French cities.

4) Create a first version of our inclusiveness KVI relating the previous observations with the schools located in a given area in order to estimate the digital divide across different geographical levels. Improve the accuracy of this inclusiveness KVI taking into consideration other inclusion open data.

5) Predict the traffic demand for a mobile education infrastructure with Machine learning (ML) based forecasting models.

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