

A Complex Network Approach to Structural Inequality of Educational Deprivation

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Abstract : Equity and education are major focus of government policies around the world due to its relevance for addressing the sustainable development goals launched by Unesco. In this research, we developed a primary analysis of a data set of more than one hundred educational and non-educational factors associated with learning, coming from a census-based large-scale assessment carried on in Ecuador for 1.038.328 students, their families, teachers, and school directors, throughout 2014-2018. Each participating student was assessed by a standardized computer-based test. Learning outcomes were calibrated through item response theory with two-parameters logistic model for getting raw scores that were re-scaled and synthesized by a learning index (LI). Our objective was to develop a network for modelling educational deprivation and analyze the structure of inequality gaps, as well as their relationship with socioeconomic status, school financing, and student's ethnicity. Results from the model show that 348 270 students did not develop the minimum skills (prevalence rate=0.215) and that Afro-Ecuadorian, Montuvios and Indigenous students exhibited the highest prevalence with 0.312, 0.278 and 0.226, respectively. Regarding the socioeconomic status of students (SES), modularity class shows clearly that the system is out of equilibrium: the first decile (the poorest) exhibits a prevalence rate of 0.386 while rate for decile ten (the richest) is 0.080, showing an intense negative relationship between learning and SES given by $R = -0.58$ ($p < 0.001$). Another interesting and unexpected result is the average-weighted degree (426.9) for both private and public schools attending Afro-Ecuadorian students, groups that got the highest PageRank (0.426) and pointing out that they suffer the highest educational deprivation due to discrimination, even belonging to the richest decile. The model also found the factors which explain deprivation through the highest PageRank and the greatest degree of connectivity for the first decile, they are: financial bonus for attending school, computer access, internet access, number of children, living with at least one parent, books access, read books, phone access, time for homework, teachers arriving late, paid work, positive expectations about schooling, and mother education. These results provide very accurate and clear knowledge about the variables affecting poorest students and the inequalities that it produces, from which it might be defined needs profiles, as well as actions on the factors in which it is possible to influence. Finally, these results confirm that network analysis is fundamental for educational policy, especially linking reliable microdata with social macro-parameters because it allows us to infer how gaps in educational achievements are driven by students' context at the time of assigning resources.

Keywords : complex network, educational deprivation, evidence-based policy, large-scale assessments, policy informatics

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