

Model-based educational policy development in Latvia

Andra Blumberga, Ritvars Freimanis, Pal I. Davidsen, Anita Vēciņa, Antra Kalnbalkite

Education is considered one of the main drivers of welfare in society. The OECD stresses the importance of understanding the factors determining teacher demand and supply, such as the age structure of teachers, enrollment rates, starting and ending age of compulsory education, average class size, the teaching load of teachers, teacher education, employment and working conditions, and job opportunities outside education [1]. These factors have potentially strong implications for the quality and equity of education.

Education systems are complex adaptive systems affected by laws, culture, and ethos [2 - 3]. Educational policies cannot be simply copied from one system to another because actors in a different system may react to the same policy differently [4 - 5]. However, educational policymakers often pass legislation based on linear cause-effect models [3], [6 - 8]. Literature review [9-19] shows that, no system dynamics (SD) model exists to study the dynamics of teacher supply and demand at the national, municipal, and school levels and forecast the impact of various policy tools.

The task addressed in this study, contracted by and carried out in collaboration with the Ministry of Education and Science in Latvia, has been to create an SD simulation model that facilitates the analysis of the demand for and the supply of teachers in Latvian schools under a variety of educational policies. The education system of Latvia and demographics are described in [20-23].

To meet the demand for educational policy assessment, a model for policy scenario simulations was developed to create future scenarios of the demand and supply of educators in Latvia and identify policies leading up to them. The main structure of the model is presented in Figure 1.

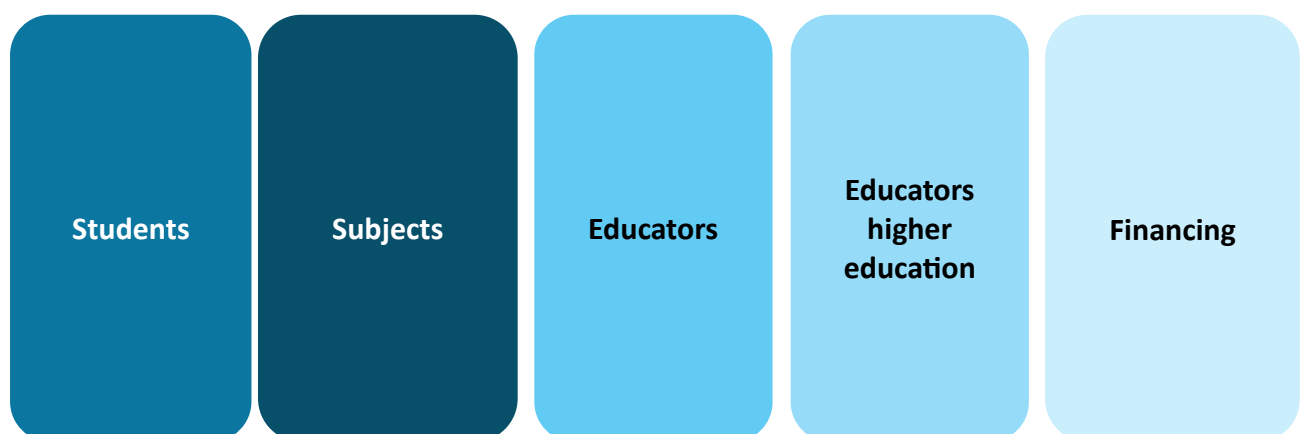


Figure 1: Structure of a policy testing tool for the demand and supply of educators.

The structure of the model revolves around two aging chains that consist of:

- cohorts of the pupils characterized by the subject that they (choose to) study and the school they attend, that, altogether, constitute the educational demand.

- cohorts of educators, characterized by their competencies (originating from their original and lifelong training as well as their school affiliation(s), that, altogether constitute the educational supply.

The model has been initialized with data from 2022 thus the aging chains have been supplied with information dating back to the start of the millennium. The model builds on the assumption that the educational system from then on will evolve following the educational laws and regulations. Admittedly, there are a variety of legacy issues that will cause the system only to adapt to that law and those regulations over a transition period, - issues that are not captured in full detail by the model. Consequently, the validity of the model results will improve as time passes towards 2050.

The model hosts 2282 variables (64 stocks) expanded to 9 393 669 variables across 73 main and sub-dimensions. DT = 1 year.

Model validation was conducted in two ways. First, it was confirmed that the model produces results that align with the historic development (2000 – 2022) and effectively allows to balance the future demand for education with the supply of educational capacity, - and that the model is appropriately sensitive to the policies assessed. The implication is that, while a balance may be attained, the recruitment policies influence the working conditions (say, part-time with significant overhead vs. full-time with less overhead) and therefore, expectedly, the educational quality on offer. Secondly, representatives from the Ministry of Education and Science, educational administrators at the municipal and local levels, as well as representatives of the educators (union members) expressed satisfaction when confronted with the model interface and the results produced by the model. The results were interpretable and triggered important discussions regarding the policies currently proposed by the Ministry.

The necessity of having such a model-based planning tool becomes evident as it highlights the intricate balance between supply and demand policies. Implementing changes on either side - whether by increasing teacher recruitment or adjusting workload policies - requires concurrent adjustments on the other side to avoid mismatches. Without such a tool, the risk of either a surplus or a shortage in teacher supply, relative to demand, increases. Such a mismatch would cause inefficiencies and potential disruptions in the education system. Therefore, a robust model not only aids in foreseeing potential challenges, but also provides actionable insights that are useful when we try to align teacher supply with evolving educational demands under current educational policies. Such an alignment is essential in order to maintain a balanced and efficient education system capable of adapting to both current and future challenges.

Analysis shows that, while various scenarios offer insights into how we may address educator deficits and surpluses, as well as workload imbalances, challenges persist in achieving an optimal balance between the demand for and the supply of teachers. Further refinement of recruitment strategies and ongoing monitoring are crucial remedies to ensure a sustainable education system. This research provides valuable insights and a vehicle by which policymakers and stakeholders may facilitate a more effective higher education institutions education of teachers and their workload allocation in the school system to improve educational outcomes in Latvia.

REFERENCES

1. OECD. (2023). Education GPS. Retrieved June 27, 2024, from <http://gpseducation.oecd.org>.
2. Burns, A., & Knox, J. (2011). Classrooms as complex adaptive systems: A relational model. *TESL-EJ*, 15(1), 1-25.
3. Groff, J. S. (2013). Dynamic systems modeling in educational system design & policy. *New Approach in Educational Research*, 2(2), 72-81.
4. Keshavarz, N., Nutbeam, D., Rowling, L., & Khavarpour, F. (2010). Schools as social complex adaptive systems: A new way to understand the challenges of introducing the health promoting schools concept. *Social Science & Medicine*, 70(10), 1467-1474.
5. Lemke, J. L., & Sabelli, N. H. (2008). Complex systems and educational change: Towards a new research agenda. In M. Mason (Ed.), *Complexity theory and the philosophy of education* (pp. 112-123). Oxford, UK: Wiley-Blackwell.
6. Haggis, T. (2008). Knowledge must be contextual: Some possible implications of complexity and dynamic systems theories for educational research. In M. Mason (Ed.), *Complexity theory and the philosophy of education* (pp. 150-168). Oxford, UK: Wiley-Blackwell. doi: 10.1111/j.1469-5812.2007.00403.x
7. Radford, M. (2008). Complexity and truth in educational research. In M. Mason(Ed.), *Complexity theory and the philosophy of education* (pp. 137-149). Oxford, UK: Wiley-Blackwell.
8. Maroulis, S., Bakshy, E., Gomez, L., & Wilensky, U. (2014). Modeling the transition to public school choice. *Journal of Artificial Societies and Social Simulation*, 17(2), 3.
9. Lopez, L., Guevara, P., Zuniga-Saenz, R. (2005). Forecasting Primary Education Efficiency. *Proceedings of The 23rd International Conference of the System Dynamics Society*.
10. Guevara, P., Zúñiga, R., López, L. (2011). Coordination Failures in Complex Environments: A Model for Primary Education Systems in Developing Countries. *Proceedings of the 24th International Conference of System Dynamics Society, Washington (DC)*.
11. Bianchi, C., & Salazar Rúa, R. (2022). A feedback view of behavioral distortions from perceived public service gaps at 'street-level' policy implementation: The case of unintended outcomes in public schools. *Systems Research and Behavioral Science*, 39, 63-84.
12. Moore, R. A. (2012). Policy impact on improving the K-12 education system in the USA. *Journal of Education*, 192, 13-27.
13. Gaynor, A. (2015). Development toward school readiness: A holistic model. *Journal of Education*, 195(3), 1-14.
14. Clauset, A. (2012). Different students: How typical schools are built to fail and need to change: A structural analysis. *Journal of Education*, 192, 13-27.
15. Venter, L., & Vosloo, M. (2018). A systems perspective on school improvement approaches. *International Journal of Applied Systemic Studies*, 8(2), 151-180.

16. Achelia, E., Asmara, I. J., Akbar, M., Tasrif, M. (2017). The Impact of Education on National HRST Performance. *International Journal of Social Science and Humanity*, 7(7), 546-553.
17. Mital, P. (2015). A modeling framework for analyzing the education system as a complex system. PhD Thesis, Georgia Institute of Technology.
18. Reed, E. (2023). A framework for quantifying the sensitivity of throughput rates in the South African education sector. MSc thesis, Faculty of Engineering, Stellenbosch University.
19. Galindo, O. L. L. (2022). Enrollment dynamics for primary, middle, and secondary: Education in Colombian municipalities, PhD thesis, Universidad De Bogotá Jorge Tadeo Lozano, Facultad De Ciencias Naturales E Ingeniería, Bogotá D.C.
20. Central Statistical Bureau of Latvia. (2024). IRS010. Population at the beginning of year, population change and key vital statistics 1920 - 2024. Central Statistical Bureau of Latvia. https://data.stat.gov.lv/pxweb/en/OSP_PUB/START_POP_IR_IRS/IRS010/
21. Ministry of Education and Science. (2024). National Education Information System (Valsts izglītības informācijas sistēma, VIIS). Ministry of Education and Science, Republic of Latvia. <https://www.viis.gov.lv/dati>
22. Organisation for Economic Co-operation and Development. (2013). PISA 2012 results: What makes schools successful (Volume IV): Resources, policies and practices. OECD Publishing. <https://doi.org/10.1787/9789264201156-en>
23. Elacqua, G., & Marotta, L. (2019). Do multiple school jobs affect teacher performance? Evidence from Brazil (IDB Working Paper Series No. IDB-WP-01051). Inter-American Development Bank. <http://dx.doi.org/10.18235/0001889>
24. Cabinet of Ministers. (2019, September 3). Cabinet Regulation No. 416 of 3 September 2019 "Regulations on the National Standard for General Secondary Education and Samples of General Secondary Education Programs". *Latvijas Vēstnesis*, 197, 27.09.2019. <https://likumi.lv/ta/id/309597>
25. Cabinet of Ministers. (2018, November 27). Cabinet Regulation No. 747 of 27 November 2018 "Regulations on the National Basic Education Standard and Samples of Basic Education Programs". Retrieved from <https://likumi.lv/ta/id/303768>
26. Cabinet of Ministers. (2020, June 2). Cabinet Regulation No. 332 of 2 June 2020 "Regulations on the National Vocational Education Standard and State Professional Education Standard". Retrieved from <https://likumi.lv/ta/id/315146>