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Conceptualizing and measuring educational poverty through family, school, and environmental opportunities

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1. Introduction

Educational opportunities (EO) refer to access and availability of resources that enable individuals to develop skills, knowledge, and abilities necessary for personal and professional development. EO are especially crucial for youth and children, as a deficiency in these opportunities can affect their cognitive and social-emotional development (Heckman et al., 2013). Early unequal EO lead to long-term impacts, including reduced employability, lower salaries, and increased social exclusion (Carneiro & Heckman, 2003).

The literature has identified several factors contributing to EO inequalities among young people, including socio-economic background (Boonk et al., 2018), parental education level (Brunello & Checchi, 2005), quality of schools (Jennings et al., 2015), and living environment conditions (Nieuwenhuis & Hooimeijer, 2016).

Inequalities in EO are closely related to educational poverty (EP), a concept that emerged in the late 1990s within the social sciences. This concept arose from a new understanding of poverty based on its recognition as a multidimensional phenomenon, leading to a new phase of research (Sen & Anand, 1997). This evolution emphasized the importance of considering both economic and educational factors in poverty discourse and shifted the conceptualization of EP to an essential component of human poverty. Consequently, these changes have prompted increased institutional and political attention to EP at both European and national levels, highlighting its significance as a societal issue.

Like other complex phenomena, EP involves multiple dimensions that are not readily observable, making it difficult to define and measure comprehensively. How we define and measure EP affects its recognition, extent, and severity, influencing policy decisions and strategies to reduce vulnerability. Therefore, efforts to define and measure EP must be closely aligned with policy interventions to address issues with significant social impact. From unidimensional approaches focusing on educational qualifications and competencies to multidimensional frameworks considering socio-economic and context-related factors (Battilocchi, 2020), there is still a lack of consensus on how to define and measure EP effectively. A significant step toward a comprehensive definition of EP was made by Save the Children in their report *La lampada di Aladino* (2014). EP is defined as 'the deprivation of children and adolescents from the opportunity to learn, experience, develop, and freely cultivate their capabilities, talents, and aspirations' (p. 4). Drawing on Sen's capabilities theory and Nussbaum's development framework (2011), Save the Children's definition (2015) includes four dimensions of educational deprivation: 1) *learning to understand*, which is related to cognitive and problem-solving skills; 2) *learning to be*, which involves psychological and emotional development; 3) *learning to live together*, which entails the ability to promote social and inter-personal relationships; 4) *learning to lead an autonomous and active life* involving aspects like health, physical integrity, and food security, which are regarded as functional conditions for education and other learning opportunities.

Within this framework, EP is viewed as a deprivation of EO that hinders personal development. This deprivation impacts cultural resources, cognitive abilities, emotional and relational aspects,

and life planning, all of which shape the developmental trajectory of minors (Battilocchi, 2020).

Building on these considerations, our work aims to contribute to the ongoing debate by introducing a novel measure of EP at the individual level. Specifically, we propose a measurement strategy employing a set of indicators to assess the EO available to students across multiple critical domains in which they are embedded. This approach helps define the structure of opportunity constraints concerning educational resources. Further, it allows the evaluation of the impact of different contexts on learning opportunities and defines a multidimensional measure of EP.

The conceptual proposal described in Section 2 is based on a convenience sample (Section 3) of 191 Naples's high school students aged between 16 and 19. This case study serves as a crucial validation of the proposed measure of EP, enabling an optimal configuration of dimensions and indicators useful for measuring EP through a combination of exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Due to the lack of space, in this paper (Section 4), we will only present the CFA results that verify the significance of the dimensional structure discovered by EFA and confirm the dimensions and indicators defined in the conceptual section.

2. Conceptual framework

This study is part of the "Measuring and Mapping Poverty Education" project, a research initiative supported by the University Research Funding Program (FRA) of the University of Naples Federico II for 2022−2025. Drawing on the Save the Children framework, which views EP as a lack of opportunities for children and adolescents, we developed a conceptual framework that defines EP as a latent and multidimensional construct measured across three dimensions: family, school, and environment, each with its associated set of items.

Based on the existing literature, we also defined a comprehensive model (Figure 1)[1] with two primary hypotheses to enhance the understanding of EP and its effects on individuals.

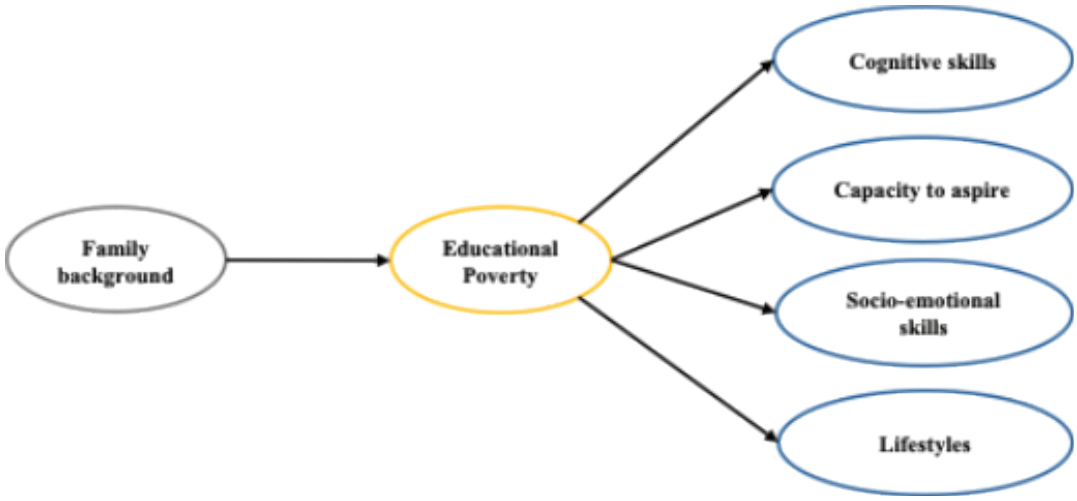

Figure 1 - A conceptual model illustrating the determinants and effects of EP

Firstly, we hypothesized that students' family backgrounds, including parental education levels and occupation, significantly influence the extent of educational deprivation they experience. This influence impacts family resources (Boonk et al., 2018), school choice (Jheng et al., 2022), and neighbourhood of residence (van Ham et al., 2012). Secondly, we posited that EP, characterized by limited access to EO in *family*, *school*, and *environmental contexts*, affects the development of students' cognitive abilities (e.g., school performance) and non-cognitive abilities (e.g., self-esteem,

[1] This model has been presented at the 4th international conference on "Data Science & Social Research" which was held in Naples (Italy) on 25th-27th March 2024. Title of the presentation: Defining a composite measure of Educational Poverty at the individual level: a multidimensional approach (Authors: De Falco, A., Davino, C., Fabbricatore, R., Pratschke, J., Romano R.)

motivation, social skills). By exploring these interconnections, our model aims to elucidate the multidimensional nature of EP and the relationship between the EO available to students and the skills they develop. However, in this work, we will focus solely on measuring EP. Therefore, providing a detailed description of the scheme falls beyond the scope of this paper.

Table 1 - Indicators of EP grouped by the Family, School, and Environment domains

Family	School	Environment	Additional variables
1.1 [BOOKS] Do you have the necessary books for your school activities? 1.2 [MAT_SCOL] Do you have all the school supplies (notebooks, drawing paper, calculators, dictionaries, etc.) you need to do homework and classroom activities? 1.3 [TIME_STUD] Do you usually manage to dedicate the necessary time to study when you are at home?	2.1 [DIGIT] Do you use digital devices (tablet, PC, etc.) for educational activities at school? 2.2 [LIBRARY] Are there libraries at school that you can use?	3.1 [SOCIAL] Are there enough places or spaces in your neighbourhood where kids your age can socialize? 3.2 [GREEN_AREAS] In the area where you live, are there parks, gardens, or other public green spaces accessible within a 15-minute walk?	4.1 [GEND] Gender 4.2 [SCHOOL_ATT] Type of school attended 4.3 [IT_GRAD] Grade in Italian 4.4 [MAT_GRAD] Grade in Mathematics 4.5 Having incurred school debts [SCH_DEBTS] 4.6 [HELD_BACK] Having been held back a grade
When you are at home: 1.4 [SPACE_STUD] Do you have a quiet space to study? 1.5 [DESK_STUD] Do you have your own desk to study? 1.6 [PC_TAB] Do you have access to a computer and/or tablet for studying? 1.7 [SUPP_PEOPLE] Do you receive support and/or help with homework? 1.8 [BOOK_HOME] Excluding textbooks, how many books are there in the house?	Does your school offer you the opportunity to: 2.3 [CORS] Attend recovery or reinforcement courses? 2.4 [LAB] Participate in extra-curricular laboratory activities (e.g., programming courses, foreign languages, etc.)? 2.5 [CULT_TRIPS] Take part in cultural trips or organized outings? 2.6 [PRESCHOOL] Did you attend kindergarten (preschool)?	Can you easily reach from the area where you live 3.3 [LIBR_ACC] Libraries 3.4 [THEAT_ACC] Theatres 3.5 [CINE_ACC] Cinemas 3.6 [MUS_ACC] Museums 3.7 [SPORTC_ACC] Sports centers (gyms, pools, etc.)	4.7 [OCCUP_FAT] Father's occupation 4.8 [EDUCAT_FAT] Father's educational attainment 4.9 [OCCUP_MOT] Mother's occupation 4.10 [EDUCAT_MOT] Mother's educational attainment
During the year, do you have the opportunity to: 1.9 [TRAV_FAM] Travel with family 1.10 [TRAV_AMI] Travel with friends 1.11 [MUSEUMS_EXHIB] Visit museums, exhibitions 1.12 [ARCH_SITES] Visit archaeological sites, monuments 1.13 [CINE] Go to the cinema 1.14 [THEATER] Go to the theatre 1.15 [CONCERT] Attend music concerts 1.16 [HOBBY] Pursue hobbies in your free time (e.g., photography) 1.17 [SPORT] Engage in sports			

Regarding the sets of variables used to define the EP construct, the family dimension includes indicators that evaluate access to books and educational materials, time available for study, dedicated study space (equipped with a desk, internet, and a device), and support for academic tasks. Additional indicators assess students' ability to participate in extra-curricular and leisure activities, such as traveling, visiting cultural sites (e.g., museums, exhibitions, theatres, cinemas, concerts), and engaging in hobbies and sports. In the school dimension, indicators assess the availability of educational resources within the school. This includes the use of digital tools (e.g., tablets and computers) for learning, access to the library for study, availability of remedial and advanced courses, and participation in after-school workshops (e.g., language or programming classes). Moreover, indicators evaluate involvement in educational trips and museum visits and whether students attended kindergarten, which provides early opportunities for social, relational, and physical development. Lastly, the environment dimension includes indicators that measure the availability of resources such as public green spaces, libraries, theatres, cinemas, museums, and sports facilities accessible to students in their area of residence.

For the identification of these indicators, we relied on two primary sources: the Save the Children report (2014) and the 2023 ISTAT survey 'Bambini e ragazzi: comportamenti, atteggiamenti e progetti futuri'[2]. Additional indicators were developed ad hoc to capture specific

[2] https://www.istat.it/informazioni-sulla-rilevazione/indagine-su-bambini-e-ragazzi-comportamenti-atteggiamenti-e-progetti-futuri/

aspects of EP not addressed by these sources. All the developed indicators refer to educational resources that, as highlighted in the literature, play a crucial role in the cognitive and social-emotional development of young people. Table 1 details the indicators/questions for each proposed dimension of EP (in brackets labels used in graphs and tables) and additional respondent characteristics.

3. Data and methods

Starting from the conceptual framework outlined in the previous section, we developed a questionnaire to investigate EP individually.

From January to March 2024, we surveyed a convenience sample of high school students in Naples, encompassing those in their third to fifth years. The students were recruited from schools that participated in open day events at one of the University of Naples Federico II departments, as well as during laboratory activities conducted in several Neapolitan schools by the researchers involved in the study. Following a rigorous selection process, 100 students who did not pass an attention check were excluded from further analysis, resulting in a final sample of 191 students: 111 identified as female, 77 as male, and 3 as non-binary. This meticulous approach ensures the accuracy and representativeness of our analysis, providing a robust foundation for our findings. The questionnaire has been structured into sections dedicated to collecting information on the three dimensions of EO (family, school, environment) and individual characteristics such as family background and educational outcomes.

The analysis strategy unfolded in multiple phases. Initially, a univariate statistical examination was conducted on all binary indicators to identify those with sufficient variability. Exploratory Factor Analysis (EFA) was used to assess the tetrachoric correlation matrix, allowing for selecting a cohesive set of indicators for computing scores across the three EO dimensions. Subsequently, Confirmatory Factor Analysis (CFA) was then employed to validate the dimensional structure identified by EFA.

4. Results

Factor loadings obtained through the CFA are shown in Table 2, and they confirm the three-dimensional structure proposed to operationalize EP.

Table 2 – Factor loadings estimate from CFA

Dimension	Indicator	Estimate	SE	t-values	p-values	ci.lower	ci.upper
Family							
	BOOKS	0.530	0.104	5.106	0.000	0.327	0.733
	MAT_SCOL	0.622	0.126	4.936	0.000	0.375	0.870
	PC_TAB	0.658	0.125	5.251	0.000	0.413	0.904
	BOOK_HOME	0.507	0.093	5.475	0.000	0.326	0.689
	TRAV_FAM	0.490	0.099	4.955	0.000	0.296	0.684
	TRAV_AMI	0.587	0.099	5.934	0.000	0.393	0.781
	MUSEUMS_EXHIB	0.625	0.103	6.097	0.000	0.424	0.826
	ARCH_SITES	0.649	0.089	7.287	0.000	0.475	0.824
	THEATER	0.811	0.077	10.591	0.000	0.661	0.961
	CONCERT	0.748	0.083	9.030	0.000	0.585	0.910
	HOBBY	0.617	0.101	6.123	0.000	0.419	0.814
	SPORT	0.503	0.100	5.016	0.000	0.306	0.699
School							
	LIBRARY	0.610	0.127	4.819	0.000	0.362	0.858
	CORS	0.591	0.131	4.496	0.000	0.333	0.848
	LAB	0.942	0.181	5.213	0.000	0.588	1.296

Environment							
	SOCIAL	0.502	0.087	5.764	0.000	0.331	0.672
	GREEN_AREAS	0.450	0.105	4.283	0.000	0.244	0.656
	LIBR_ACC	0.545	0.082	6.617	0.000	0.383	0.706
	THEAT_ACC	0.914	0.039	23.426	0.000	0.837	0.990
	CINE_ACC	0.905	0.045	20.195	0.000	0.817	0.992
	MUS_ACC	0.872	0.046	18.851	0.000	0.781	0.962
	SPORTC_ACC	0.508	0.117	4.345	0.000	0.279	0.738

Model parameters for the paths of domains to items are all significant ("P(>|t|)" = 0). The fit of the model can be considered satisfactory: the Comparative Fit Index is 0.95; the Tucker- Lewis Index is 0.95; and the Root Mean Square Error of Approximation is 0.04, with a confidence interval of 0.03 to 0.05. Further developments of the analysis could consider the computation of a global EP index through the scores identified for each of the three dimensions. Moreover, it is also interesting to identify a possible heterogeneity in the EP distribution by grouping individuals according to similar patterns across the three dimensions.

5. Conclusions

This study proposed a method to measure educational poverty among adolescents aged 15-19, focusing on the accessibility and utilization of educational opportunities. It identified three main domains of opportunities: those provided by the family context, the school, and the social environment. A conceptual model was introduced, suggesting that educational poverty, defined in terms of opportunities, is influenced by the family context in which the adolescent lives and grows. It impacts both cognitive and non-cognitive skills.

The study's results concentrated on the construct of opportunities, measured by 30 indicators. Of these, only 22 demonstrated strong discriminatory and measurement capabilities across the domains considered. Factorial analyses confirmed a three-dimensional structure, underscoring the multidimensional nature of educational poverty and the complexity of the issue. However, some potential limitations of the factor analysis should be acknowledged, particularly regarding the impact of the sample size and its convenience nature on the robustness and generalizability of the results. A larger and more representative sample in future studies could enhance the stability of the factor structure and the external validity of the findings.

Future research will also focus on estimating the entire conceptual model to better understand the network of relationships between educational poverty and other related constructs. This information will be crucial for stakeholders and authorities to devise interventions to reduce educational poverty disparities.

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