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Studies

Maria Skłodowska-Curie: A Product of Her Era, Family Upbringing, and Education.

A Biographical Research Analysis Exploring How Contemporary Youth Publications Shape Students' Scientific Identity, Self-Development, and Attitudes Toward Gender Equality in STEM

ADAM KRZYK

Abstract: This biographical research analysis examines how contemporary children's and young adult publications portray Maria Skłodowska-Curie as a scientific figure shaped by her historical context, family upbringing, and education, and how these portrayals contribute to students' scientific identity formation, self-development, and attitudes toward gender equality in STEM. The study analyses a corpus of modern youth-oriented biographies to identify dominant narrative frameworks, thematic emphases, and adaptive strategies used to translate Curie's life and achievements for different educational levels. Particular attention is given to representations of perseverance, intellectual autonomy, and commitment to science, and the negotiation of gender-based barriers. Through qualitative textual and discourse analysis, the research explores how Skłodowska-Curie's biography is reframed to align with contemporary pedagogical goals, including motivation for scientific inquiry, resilience in learning, and critical reflection on social inequality. The findings suggest that youth biographies do not merely transmit historical knowledge but actively construct role models that shape learners' perceptions of who can participate in science and under what conditions. By situating Curie simultaneously as a product of her era and an agent of change, these narratives foster historical consciousness while promoting inclusive values in STEM education. The study highlights the didactic potential of biographical narratives as tools for cultivating scientific curiosity, personal development, and gender-sensitive attitudes among young readers.

Keywords: Maria Skłodowska-Curie; youth biographies; scientific identity; STEM education; gender equality

The biography of an outstanding individual can play a significant role both in the didactic process and in school-based education more broadly. The life stories of people who achieved major scientific breakthroughs, transcended the limitations of their time, or developed exceptional moral character constitute particularly valuable material for educational analysis. One such figure is Maria Skłodowska-Curie, whose life has long fascinated researchers and inspired successive generations. Not only did this eminent scholar make groundbreaking scientific discoveries, but she also left behind a testimony to extraordinary strength of character, patriotism, social responsibility, and perseverance in the face of adversity.

As biographers consistently note, her attitudes were inseparable from her family background, her formative experiences, and the socio-political conditions in which she grew up. Authors emphasize that “many biographers of Maria Skłodowska-Curie highlight her exceptional patriotism and her constant engagement – alongside her scientific work – in the affairs of Poland, even during the period of its partition and political nonexistence. Her biography thus constitutes not only an example of personal heroism but also compelling evidence of the impact of family environment and education on the development of personality. In this sense, it can serve as an effective tool for educators and teachers.

The aim of this article is to examine the influence of the familial, educational, and socio-political environment on the development of Maria Skłodowska-Curie’s attitudes, and to demonstrate how elements of her biography can be used in school education as a means of shaping students’ values and dispositions. The discussion will incorporate both significant events from the scientist’s life and theoretical reflections on biography as a source of knowledge and inspiration.

Additionally, the article examines the ways in which contemporary children’s and young adult biographies of Marie Skłodowska-Curie articulate and negotiate her scientific identity, and investigates how these narrative constructions shape young readers’ dispositions toward science, persistence in the face of challenge, and conceptions of gender equity within STEM domains. By analysing the adaptive narrative strategies through which Curie’s life and work are reinterpreted for varied educational contexts, the research aims to clarify the pedagogical functions

of biographical storytelling in fostering scientific engagement, historical awareness, and broader personal development. The corpus comprises four publications that exemplify distinct generic conventions and instructional orientations.

Biography as a Source of Knowledge and a Tool for Education

Many biographers of Maria Skłodowska-Curie emphasize her exceptional patriotic stance and her persistent engagement – beyond her scientific work – in matters concerning Poland, even during the period of its partitioned nonexistence. It is therefore worthwhile to examine to what extent this attitude arose from her own experiences, and to what extent it was the result of her embeddedness in the mental atmosphere of her family. It is significant that biographers of the future Nobel laureate also discern a kind of inheritance of convictions, even a quasi-genetic grounding of beliefs derived, among other things, from “the bonds of blood,” referred to as the so-called “heritage of blood.” Ultimately, Maria’s patriotic posture drew upon both the experiences of her family and those of the entire nation.

Across the centuries, the existence of characteristic traits ascribed to various communities –including nations – has been explained in different ways. Artur Sandauer views such explanations in terms of the so-called “heritage of blood,” a notion already present in the Old Testament, where it was believed that the nature of tribes, peoples, and nations derived directly from the biblical progenitors Shem, Ham, and Japheth (Sandauer: 1977, LXIV). A Polish counterpart to this tradition can be found in the legend of Lech, Czech, and Rus, a narrative that accounts for the shared past of Slavic tribes. For a nation to exist, it constructs its own mythology in such a way as to justify its origin and, above all, its continued endurance (Wierzbicki: 2010, 21). Interestingly, Joachim Lelewel states that these narratives were “absurdly fabricated” (Lelewel: 1859, 2).

Geographic determinism was also invoked in attempts to answer key questions concerning human mentality and the dispositions of the human mind. This concept attracted the interest of many thinkers – Hippocrates, Polybius, Strabo, Lucius Maternus, and Firmicus – and had already achieved popularity in ancient Greece. It posited that who we are is determined by the environment in which we live, that is, by factors such as the configuration of the land, climate, fauna, and flora. In her biography of Marie

Skłodowska-Curie, Ève Curie identifies the influence of the environment in which Maria was raised as a significant factor shaping her childhood and her lifelong attitudes:

“Terrible are the moral consequences of oppression. Terrible are the distortions it produces even in souls so pure, so sincerely good by nature. Somewhere deep in the hearts of these girls, feelings are stirred that will never arise in the hearts of free beings. Their ethics are shaped according to special laws – the laws of slaves. Hatred becomes a virtue for them, obedience – a disgrace. (...) This constant vigilance, this nearly soldier-like stance toward their surroundings cannot help but exhaust and drain these very young girls. How difficult it is to forbid oneself to like a truly pleasant companion – solely because she is Russian (...).” – translation from Polish (Curie: 1983, 44–45)

Andrzej Wierzbicki notes that some views regarding “geographical determinism” had undergone modification, and that definitions and their significance were increasingly understood in broader contexts, which also took cultural factors into account. Thus, human traits and the characteristics we possess are also influenced by the socio-cultural environment. Wierzbicki added that the most popular conception of the environment’s impact on humans was formulated by Montesquieu, who, in addition to the aforementioned “geographical determinism,” considered religion, law, principles of governance, customs, and historical examples as factors shaping the ultimate form and character of human personality – its spirit.

Herder regarded Montesquieu’s assumptions as incomplete because they did not explain the diversity of human types, and he emphasized a more significant factor for him: heredity. He states,

“The mother of all formations on Earth is the genetic force, while climate’s role is limited to either hostile or friendly interaction (...). The genetic factor (internal force), although demonstrating considerable persistence and stability, was not entirely immutable and completely independent of climate. Prolonged exposure to external conditions, albeit resistantly, nonetheless influenced the genetic code sufficiently that acquired traits, developed under environmental influence, became hereditary traits.” – translation from Polish (Wierzbicki: 2010, 15-17)

Ève Curie recalls difficult moments from her mother's life to convey the reality in which Maria grew up:

"She remains silent. She cannot shake off her melancholy. From shame. From the disgust she always feels toward pretense and falsehood, toward the necessity of concealing her essential thoughts and feelings; (...) she reads extensively, increasingly so. Easy and difficult books – without choice – boring and interesting, textbooks, novels, poems, thick volumes of technical works from her father's library (...). In this way, she somehow wards off the specters of dark thoughts (...). For the moment she stops reading, everything immediately comes crashing back upon her." – translation from Polish (Curie: 1983, 29,36)

In summary, the theory of geographical determinism highlighted the character of nations, subject to evolutionary, gradual transformations, set against a background of climate changes imperceptible to individuals. However, cultural factors (e.g., education, wars) appear to have influenced societies much more rapidly, while the theory of heredity allowed a more flexible explanation of formative moments of character, which can help account for individual behavior. Georg Brandes describes the former capital of Poland during the Russian occupation as follows:

"Warsaw is a city with a population exceeding 400,000. It is located, as is well known, on the Vistula River. In its winter attire, covered with gray ice floes, the river made a deeply somber impression on me. The urban area is extensive, yet its fallen grandeur and the terrible memories hidden within its walls, which a passerby encounters at every turn, create a painful effect. In the previous century, it was, after Paris, the most splendid city in Europe; today, it is a provincial Russian city. What was once a historically significant and magnificent city has now become neglected and diminished. Each day it declines further, and the authorities take no action to promote its external development or prosperity. One's heart aches at the sight of the poorly paved streets or the dreadful sandstone statues decorating the Saxon Garden, especially when arriving from a historically rich city such as Vienna, or from a rapidly developing city like Berlin. Elsewhere, capital cities are subjects of distinctive, almost paternal, care by the ruling authorities; elsewhere, the cities themselves, out of civic pride, ensure their beauty and comfort to impress both residents and foreigners. In contrast, Warsaw is the capital of a country whose existence the government refuses to acknowledge—a city whose pride it seeks to suppress by every means. It should be noted

that Warsaw lacks local self-government, municipal councils, or anything comparable. The Kingdom of Poland is, in general, a country without electoral rights: there is no parliament, no Sejm, and no autonomous municipal institutions.” – translation from Polish. (Brandes: 1898, 10–11)

Ignacy Włodek, in 1780, wrote about three factors influencing the development of individuals – those “existing within us, with us, and apart from us” (Włodek: 1780). The first factor comprises the dispositions and abilities with which a person is endowed at birth. Włodek referred to the inherent “potential” present in each individual. Only the obstacles encountered in life cause part of this potential to remain unrealized (Wierzbicki: 2010, 24).

Interestingly, Włodek identifies the “factors with us” as environmental influences, namely the home, school, and centers of authority. In his view, the “factors apart from us” referred to climate, topography, soil type, fauna, and flora. Another scholar, Franciszek Siarczyński, contesting the value of genetic determinism, argues that human traits are the same everywhere and that every society contains both good and bad individuals. A similar view is expressed by Ève Curie:

“There seem to be, in the history of families, periods of exceptional flourishing. Owing to some mysterious causes, a single generation may suddenly rise far above those that preceded it and those that will follow, surpassing them in the richness of its talents, beauty, vitality, and success.” She then asked: “Why did no one recognize Maria’s exceptional abilities when she was still a young girl? Why was she allowed to waste so many years in the unproductive work of a governess, instead of being sent—at any cost and with the greatest determination—to study in Paris from the outset?” – translation from Polish (Curie: 1983, 39)

In this way, Ève Curie underscored the lost opportunities her mother faced during the many years she spent in the provinces.

Wierzbicki emphasizes that reflections on the idea of the nation resurfaced after the third partition of the Polish – Lithuanian Commonwealth and the subsequent establishment of the Duchy of Warsaw. These changes gave rise to independence-oriented aspirations on Polish lands. In Poland, the approach to nationality evolved so that, ultimately, the concepts of *nation* and *state* ceased to be synonymous. They came to be associated with mutually exclusive values: the nation meant the people, whereas the state signified the *others* – the partitioning powers.

Wierzbicki recalls the words of Hugo Kołłątaj, who saw the causes of Poland's backwardness in its socio-economic anachronisms, the serfdom of peasants, the marginalization of burghers, technological underdevelopment in comparison with other European countries, and, above all, weak political authority. Kołłątaj observes: "It is a laughable arrangement that, as soon as personal animosities arise among us, we immediately abandon the interests of the country – abandon even the homeland – exerting all our effort to bring the King to ever greater impotence, forgetting that the nation's impotence cannot be separated from his fate" – translation from Polish (Wierzbicki: 2010, 39).

In the same context, the author cited the words of Stanisław Staszic, who argues:

"The conflict between the despot (the sole ruler, the king) and the magnates was an expression of a general regularity in the historical process. In England, France, Sweden, and Hungary, it reached its culmination centuries earlier and was resolved unequivocally in favor of the monarchs. In Poland, however, the nobles managed to retain their influence through obscure maneuvers. Frequently resorting to treason against the state's interests and to bribery, they set an example of moral decay. The nobility, striving for temporal goods, valued the favor of powerful patrons over the interests of the state." – translation from Polish (Wierzbicki: 2010, 43)

The roots of Poland's downfall were seen in the conduct of the nobility, who – numbering roughly one million – ruled a population of eight to thirteen million. They blocked necessary reforms, perceiving every change as a threat to their liberties, and consistently employed the *liberum veto* to protect their privileges. Reformist ideas articulated at the end of the eighteenth century failed to protect the weakened state from the first partition, and the Constitution of 3 May 1791, despite being an innovative legislative act, likewise did not prevent Poland's collapse (Brandes 1898: 26-27).

Susan Quinn describes this part of Polish history in detail, identifying in these historical events important influences on the Skłodowski family and, of course, on the young Maria (Quinn: 1997, 17-54). Lucjan Biliński likewise focuses on the scholar's ancestors, recognizing in their legacy formative influences on the later Nobel laureate's personality development (Biliński: 2003, 13-29).

At the moment when Maria Salomea Skłodowska was born, on 7 November 1867, everything on Polish lands – as Susan Quinn notes – carried a symbolic, national-patriotic meaning (Quinn:1997, 17). Quinn also identifies symbolic motivations in the choice of name given by the future scientist's parents, Władysław and Bronisława Skłodowski, to their youngest child. In these post-partition times, the belief that Poland had been able to repel the Swedish invasion through the intercession of the Virgin Mary of Częstochowa held particular significance. Maria's second name – Salomea, often mistakenly assumed to be Jewish (Biliński 2003, 156) – was linked by Quinn both to the name of her paternal grandmother, in keeping with family naming traditions¹, and to a thirteenth-century princess, the founder of a Kraków convent who was beatified in the sixteenth century. Thus, the symbolic meaning of the names bestowed upon the future scholar reflected and united the mother's religiosity with the father's patriotism (Quinn: 1997, 18).

Quinn emphasizes that three years before Maria's birth, the January Uprising had been brutally suppressed, resulting in tens of thousands of Poles being deported to Siberia. In the subsequent years, tsarist officials launched a wide-ranging campaign of Russification aimed at eradicating all expressions of Polish identity, particularly in education, administration, and culture. Another important issue was censorship² and restricted access to foreign materials³, as highlighted by Georg Brandes in his account of travels

¹ The name Józef was borne by Władysław Skłodowski's father and thus by Maria Skłodowska's grandfather. Władysław's eldest son was likewise given this name. The popularity of the name Józef in nineteenth-century Poland stemmed from the widespread veneration of Prince Józef Poniatowski.

² On the subject of censorship in the Polish lands, Brandes remarked: "I was invited to Warsaw to deliver three lectures in French in the great hall of the town hall. Even before my arrival, I had considerable difficulties with these lectures. I was required to send the manuscripts to Warsaw one month in advance. There, they were to undergo double censorship: the ordinary one and a special censorship applicable to public lectures. Since it was certain that a parcel containing the manuscripts would be detained indefinitely at the border if I sent it by post, I had to look for a more reliable route. Thanks to the courtesy of a certain embassy, I succeeded in sending the manuscript through St. Petersburg, and in this way, with only a slight delay, it reached Warsaw. Two copies were made there, and both were submitted to the dual censorship." (Brandes: 1898, 9-10)

³ The train stops at border. Here we are required to show our passports and submit our belongings for inspection. A gendarme appears in the carriage—a typical Russian blond in his ceremonial uniform, a long grey overcoat, a round cap without a visor, and a sabre at his side. He asks the passengers for their passports and leaves with them. (...) The first items found in my travel bag were two issues of the *Nouvelle Revue*, which I had taken for the journey. They contain various materials; each issue includes ten articles. It was therefore impossible to summarize in a few words what the journal contained. 'In

through Polish territories. In his report from the Vistula region, Brandes – an external observer – was able to characterize the Russian partition with a degree of objectivity and detachment:

“Russian authority, unlike the Prussian, is neither prudent nor consistent. It is capricious, absurd, and often rests in highly incompetent hands. The oppression to which the part of Poland under Russian rule is subjected would be impossible to endure even for a single month if numerous decrees were not mindless and unplanned, others too detailed to be enforced, and still others circumvented through bribery. One must remember that the execution of some regulations is entrusted to people of such limited intellect that they are easy to deal with, while at other times one encounters officials so intelligent and educated that the regulations remain a dead letter.” – translation from Polish (Brandes: 1898, 8-9)

As Quinn observes, many members of the Skłodowski family engaged in political activity. She described, among others, Władysław Skłodowski’s brother, Zdzisław, who was twice wounded in the struggle for independence and later fled to France for fear of reprisals. Likewise, Maria’s maternal uncle, Henryk, who also took part in the uprising, was exiled to Siberia for four years (Quinn: 1997, 20). Similarly, Józef – the father of Władysław and Maria’s great-grandfather – served as an artilleryman and participated in the November Uprising and in the battle near Chmielnik, for which he was taken prisoner by the Cossacks (Quinn: 1997, 23). Ireneusz Sadurski emphasizes that Józef Skłodowski, in his capacity as school director, paid close attention to the patriotic attitudes of teachers and refused to hire unqualified individuals. Sadurski notes: “Director Skłodowski, as far as he was able, circumvented the regulations and directives imposed by the superior authorities. On various occasions, he personally taught Polish history to his pupils and transmitted to them the national tradition” (Sadurski: 2011, 14). Quinn argues that it was precisely these family experiences and

that case, we shall take them and send them to the censor in Warsaw. Is this periodical forbidden?’ ‘Everything that I do not know is forbidden, and I do not know this particular book.’ The sight reminded me of an old lithograph depicting a large monkey rummaging through a traveller’s knapsack and inspecting his books. (...) Then the proper inspection began. Every pamphlet and every book was removed and set aside; every newspaper was taken out—even those in which I had wrapped my shoes—carefully smoothed out and placed into a separate bundle. Since my explanations proved insufficient, all printed materials were confiscated.” (Brandes: 1898, 5-6)

modes of upbringing that shaped the mentality of the young Skłodowski generation:

“The children of Józef and Salomea espoused even more liberal views than their parents. Some lived in Warsaw, others in the countryside, but all already belonged to the intelligentsia – a social group that, in the nineteenth and twentieth centuries, was in Eastern Europe strongly connected with the national cause. In Poland, the national question was inseparable from liberation from foreign domination. Józef’s children, however, like the contemporary intelligentsia, differed in their views on the paths leading to independence. Two positions prevailed within the family. These ideas contested for primacy in Poland throughout the nineteenth century. At that time, Stanisław Staszic, a leading reformer of the Enlightenment, repeatedly reminded Poles that handicraft, learning, commerce, and military force were essential, otherwise the nation would perish.” (Quinn: 1997, 24)

Thus, the memory of lost independence remained vivid within the Skłodowski family. Resistance to the occupier, as practiced by the father, could be realized only in the limited ways available at the time, which led him to undertake clandestine teaching – he refused to allow his children to be subjected to Russification. The home education provided by Władysław for his children functioned as a form of compensation and was partly motivated by his own sense of guilt, as he had invested the family’s life savings in a mill and lost the entire estate intended for his children’s education (Pasachoff: 1996, 12-13). As a consequence, he was compelled to send them to a state gymnasium, the only universally recognized school whose certificates enabled further study (Curie: 1983, 43). Ève Curie recounts an episode from her mother’s life:

“—And the monument! Let us go back; we forgot about the monument!’ And both girls immediately turn back, even at the risk of being late for school. For the matter was this: In the middle of the square stood an obelisk surrounded by eight lions, with the shameful inscription on its base: *To the Poles faithful to their monarch*. It had been erected by the tsar for the traitors of the November Uprising. Polish youngsters passing by customarily stopped and spat. If someone forgot to do so out of distraction, she would return to correct her mistake (...).” – translation from Polish – translation from Polish (Curie: 1983, 47)

As Brandes describes, two such monuments symbolizing tsarist authority existed in the city at that time: the monument to Paskiewicz – erected for the general who captured Warsaw and delivered it into Russian hands – and the obelisk bearing the names of Poles who had betrayed their homeland by collaborating with the Russians⁴.

Maria's patriotism can be interpreted through the lens of her family's experiences, as documented in numerous biographies (Curie, Quinn, Goldsmith, Pasachoff, Biliński, Emling, among others). The exemplary cases recalled here – the fates of various members of the Skłodowski family engaged in the struggle for independence and the consequences they endured – undoubtedly influenced Maria's personality from her earliest years. It is therefore understandable that her historically conscious attitude and profound patriotism – transmitted, in a sense, across generations – should not be surprising. Given the family's history, and the involvement of so many of its members in the fight for national freedom, it was almost inevitable that certain convictions would take shape within Maria. Growing up in the post-uprising era shaped the convictions she held as an adult and constituted the defining socio-political atmosphere of her formative years.

Lucjan Biliński observes: "The history of Maria Skłodowska's family may serve as an excellent contribution to research on the inheritance of intelligence and abilities" (Biliński: 2003, 13). For the purposes of his research, Ireneusz Sadurski outlines the profile of the scholar's grandfather, Józef Skłodowski—the eldest son of Urban Skłodowski, a landowner, and Małgorzata née Rykaczewska (Sadaj: 1982, 131–135) – who was born on 19 March 1804 and, at the age of eight, began his education at the elementary school in Zaręby Kościelne. The author points to the difficulties that marked Józef's educational trajectory, attributing their cause to the Russian occupation of the Duchy of Warsaw. For this reason, Maria's grandfather

⁴ "There are only two well-maintained monuments in Warsaw: the first is the colossal monument to Paskiewicz on Krakowskie Przedmieście, the city's main thoroughfare, erected by a grateful tsar to the man who was loyal, active, and as efficient as a knout in the hands of an executioner (Mickiewicz), and who in September 1831—when the last heroic defenders of the uprising blew themselves up—captured the ramparts of Warsaw and took the city. The second is a great iron obelisk bearing, for eternal remembrance, the names of the Poles who in 1831 betrayed their homeland and were, for that reason, hanged or shot by their compatriots. Four metal lions rest upon its splendid granite base. Around the foot of the obelisk gleam repulsive heraldic double-headed eagles of monstrous size. The inscription above the names, written in Russian and Polish, reads: *To the Poles who fell in loyalty to their monarch*. The erection of this obelisk in Warsaw failed in its purpose." (Brandes: 1898, 15-16)

interrupted his schooling, resuming it two years later at the District School in Łomża, where he obtained his secondary-school leaving certificate in 1823. Sadurski emphasizes the ambitions of the scholar's grandfather, who, immediately after passing his final examinations, enrolled at the University of Warsaw in the Faculty of Law and Administration with the intention of becoming a state official. Throughout his studies, he also received a government scholarship. Ultimately, however, due to his failure to sit for the final examinations, he devoted himself to a pedagogical career (Sadurski: 2011, 8). Sadurski underlines Józef Skłodowski's strong substantive preparation for teaching and noted that he taught history, geography, and German.

Józef Skłodowski's patriotic inclinations manifested themselves when, after the outbreak of the November Uprising, he joined the 5th Infantry Rifle Regiment (he took part in the Battle of Grochów). Thanks to the intervention of a senior official, Adam Sagatyński, Józef was able to return to the teaching profession – concealing his insurgent past (Sadaj: 1982, 139). Biographers identify the roots of the Skłodowski family's patriotism (and that of subsequent generations) primarily in the example set by Maria's grandfather, who, as a school director, promoted certain values among his staff and – certainly – among his own children (Sadurski: 2011, 30). These very experiences of Maria's forebears shaped her later political sensitivity and social consciousness, which ultimately translated into her patriotic commitment and her political involvement in the League of Nations (Pyćior: 1996, 449–467).

Maria Skłodowska-Curie's home

Maria Skłodowska-Curie's origins were repeatedly invoked by the press, particularly in connection with the scandal surrounding her alleged affair with Paul Langevin, and again after her death, when she was once more ascribed Jewish ancestry. It was precisely at this moment that Polish newspapers – more often than foreign ones – responded to such allegations by reminding readers of her Polish roots and by emphasizing aspects of her childhood and youth that were unknown abroad (Brandes: 1898, 27). The Polish press highlighted that stage of the scholar's life which unfolded on Polish lands, though not yet in a Polish state, since the latter did not exist at the time. *Gazeta Domowa* reports that

“Tradition, upbringing, and many other conditions have combined to make a woman occupying a distinguished position among scholars in the exact sciences something exceptional—especially in the field of physics or

chemistry, where scientific inquiry must rely upon a distinctly experimental method. Such an exception among exceptions is the Polish woman and Warsaw native, Mrs. Maria Skłodowska-Curie, recently recognized in the scientific world, who—thanks to her work in chemistry—has joined the select group of the most eminent individuals worldwide honored this year with the Nobel Prize. (...) The participation of a Polish woman in such significant achievements of pure science, which shed new light on the nature of the universe, pleasantly flatters our national pride (...).” – translation from Polish (Gazeta Domowa: 1902, 4-5)

Stressing Skłodowska-Curie’s Polish heritage served to reinforce patriotic sentiment in the nation; such rhetoric was viewed as necessary for enduring the difficult years of partition and for nurturing future aspirations for independence. For this reason, Skłodowska-Curie’s youth was frequently invoked – particularly by Polish biographers – to anchor her identity firmly in Poland (Kaczorowska: 2011). Biographies dedicated to the scientist emphasize her exceptional qualities: her mode of thinking, her perception of reality, her determination in pursuing chosen goals – all presented in the context of her patriotism. Maria Skłodowska writes:

“I lived constantly with the thought – although I had little faith in its fulfillment – of witnessing the rectification of the injustice done to my homeland: the wrong that had divided its lands and peoples among its enemies and had kept it in bondage for over a century. I dreamed of the deserved revival of the Polish nation, which had never forgotten its proud past despite prolonged, nearly hopeless oppression. A dream so difficult to realize, yet so dear to me, came to fruition as a result of the upheaval that swept across Europe. Under these changed circumstances, I went to Warsaw to see my family after a long separation and to visit the free capital of Poland.” – translation from Polish (Kaczorowska: 2011, 141)

Contemporary scholars of child development likewise underscore the formative importance of her childhood for her later personality. Oliwia Brzeźniak points out that

“the earliest years of a person’s life shape their entire existence. The significance of the home environment, the cultivation of a positive attitude toward acquiring both humanistic and scientific knowledge, and the encouragement of continual self-development conveyed by parents and family cannot be overstated in the formation of any young person’s personality. Maria

Skłodowska was exceptionally fortunate; her family home, the conditions of her schooling, and her perseverance in self-education (for example, her ambition to broaden her scientific horizons as well as her translation of poetry)—that is, the overall atmosphere of her childhood and youth—created the solid foundation upon which she was able to develop her scientific passions and talent.” (Brzeźniak: 2013, 229)

Wierzbicki recalls Stanisław Staszic’s views as representative of the period, noting his advocacy of home education as an antidote to the occupying powers’ attempts to impose intellectual subjugation upon Polish youth. In this respect, an analysis of the scholar’s early years and their influence on her worldview appears fully justified “...in domestic upbringing, he saw (...) an antidote to all the deficiencies of public education during the period of foreign domination; he perceived it as a means to counteract efforts aimed at poisoning the minds of youth with hatred toward their fathers and contempt for their homeland” (Wierzbicki: 2010, 47). Information about this period of her life appears for the first time in her autobiography, originally intended as a tribute to her husband. Already in the opening pages, the author allows the reader to become acquainted equally with Pierre and with herself. Maria referred to her origins, invoking her Polish descent, while also highlighting the petty-noble lineage of her family: “In my country this social class consists of many small and medium landowners, often related to one another. Until recently, it was principally from this source that the Polish intelligentsia was recruited. My paternal grandfather was the first to leave the land and to devote himself to the teaching profession, which he practised mostly in the provinces, and finally as the director of a gymnasium in Lublin” (Curie: 2009, 11-12). Her sister, Helena Skłodowska-Szalay, clarified the family’s origins even further: “In the Łomża region there is the village of Skłody. It was the seat of the Skłodowski family. The petty, settlement-based nobility occupied it entirely. They worked in their farmsteads and cultivated small plots of land. Some practised crafts” (Skłodowska-Szalay: 1958, 8). Numerous publications on Skłodowska-Curie have subjected this period of her life to close analysis, regarding it as crucial to the later trajectory of the scholar’s development. The earliest account of this stage was provided by Zygmunt Lasocki, who conducted genealogical research and examined the origins of the Skłodowski family. He began by distinguishing between two families of Skłodowskis – the Podlasie branch bearing the Jastrzębiec coat of arms, and the Nursk branch bearing the Dołęga coat of arms, to

which the scientist's family belonged. Drawing on his research, Lasocki described the heraldic lineage of Maria's ancestors and demonstrated their noble origins, which were formally recognized in 1843 thanks to the efforts of Maria's grandfather. He concluded that members of the Skłodowski family, unable to sustain themselves on the small landed estates they possessed in Skłoty in the Łęczyca region, dispersed across Polish territories, with some settling in Mazovia, where they founded the locality of Skłody (Lasocki: 1936, 49). According to Lucjan Biliński, these are significant elements of the family's formation – elements that scholars analyze in an effort to identify those moments in Maria's life that were meaningful for the development of her identity. As Biliński writes: "Among the various factors influencing the emergence of exceptional talent, we must also consider the genealogy of abilities and interests within the Skłodowski family and, on the maternal side, the Boguski family. It therefore appears justified to present these two families more broadly against the backdrop of the very difficult era in which they lived" (Biliński: 2003, 13). In her autobiography, Maria herself emphasizes her intelligentsia background, and the reader may thus gain the impression that it was her father who shaped her future interests – interests unusual for a young girl growing up in the late nineteenth century – while her mother deepened her knowledge and sensitivity during childhood. Maria writes:

"My father, Władysław, after completing his studies at the University of St. Petersburg (at that time the Russian partition lacked higher education institutions), worked in Warsaw as a teacher of physics and mathematics in both public and private secondary schools. He married Bronisława Boguska, a woman whose way of life suited him, as she was, despite her young age, exceptionally well-educated for the time and served as the headmistress of one of the best girls' schools in Warsaw. Our mother, severely affected by the loss of a daughter and weakened by a long illness of the lungs, died at the age of forty-two, leaving her husband and children in profound grief. I was only nine years old at the time, and my older brother was merely thirteen. This loss was the first serious sorrow in my life and plunged me into deep despair. My mother was an extraordinary person. Alongside remarkable intelligence, she possessed a great heart and an unwavering sense of duty. Despite her boundless understanding and kindness, she commanded high moral authority within the family. She was deeply religious (both parents were Catholics), yet she remained tolerant of all, including those who did not share her beliefs. She exerted a profound influence on me, as in addition

to my natural love for her, I felt deep admiration for her.” – translation from Polish (Curie: 2009, 12-13)

Without exception, all studies devoted to the scholar’s childhood emphasize the significant role of her parents, and particularly her father, in the upbringing and education of the children. This was especially important for girls attending schools for young women, whose curricula were not designed to educate in the modern sense, but rather to prepare them for motherhood and the raising of future generations. Therefore, the father’s involvement in the education of all his children deserves special attention. Maria’s brother, Władysław, writes of their father:

“In his care for the children, he knew no bounds. He attended to our health and physical development, guided our education, and provided for our recreation. We managed our schoolwork independently, yet in every difficulty or doubt, he was always ready to help, despite his heavy workload, never excusing himself for lack of time. He additionally taught us physics and chemistry, read aloud to us in prose and verse, and during summer vacations, we began learning English with him, which later facilitated a more thorough mastery of the language. And even as we grew older, he never ceased to take an interest in our work. With my sister Maria, who before leaving for Paris had been a governess in a rural household, he conducted lessons in higher mathematics through correspondence. With me, once I had become a physician, he often assisted in translations from foreign languages.” – translation from Polish (Biliński: 2003, 36)

Whereas, Alicja Dorabalska highlights another aspect of Maria’s upbringing, linking the atmosphere of the Skłodowski household with the era in which the scholar grew up:

„She was raised in an environment of the Polish intelligentsia, in a household of profound culture, actively engaged in the scientific, intellectual, and also social life of its time. (...) Maria, the youngest of five siblings, developed rapidly in an atmosphere exceptionally conducive to the early appreciation of the essential values that intellectual life and scientific work can provide. Unlike the relatively frequent cases in which genius emerges against a spiritually alien background, Maria Skłodowska grew up among people, many of whom made lasting contributions to Polish intellectual life. It should not be forgotten that Professor Józef Jerzy Boguski, an eminent scientist and educator who devoted over fifty years to the development of chemistry

and physics in Poland, was her first cousin. The family also included the well-known novelist Helena Pajzderska, née Boguska, who wrote under the pseudonym Hajoty. Maria's older siblings were by no means unfamiliar with the world of scientific work: they pursued higher education, bringing into the family environment an active interest in science and its achievements." – translation from Polish (Dorabialska: 1935, 2-3)

Ève Curie writes extensively about the atmosphere in the Skłodowski household, providing the reader with an understanding of its unique character.

„It is five o'clock in the afternoon. The large dining table has already been cleared after afternoon tea, the lamp has been lit, carefully checked to ensure it does not "filuate," God forbid. The young Skłodowskis begin their lessons. A peculiar murmur slowly, gradually fills the entire house. Almost every room – particularly those occupied by the students boarding with Mr. Skłodowski – resonates with this sound. A strange murmur, a curious melody of murmurs and fragmented words, repeated – sometimes meaningfully, sometimes apparently or even truly nonsensically... Dates, numbers, names, and verses, words and individual syllables intertwine, forming intricate multilingual arabesques: Polish contending with Latin, French with German – but together, they cannot overcome one language: Russian. The atmosphere of diligent effort pervades the entire apartment. The space is transformed into a vast workshop of painstaking intellectual labor." – translation from Polish (Curie: 1983, 33-34)

Sister Helena, in describing Maria's exceptional qualities – already evident in her earliest childhood – recalls the following episode:

"She was once present during a reading lesson given to seven-year-old Brońcia and, watching with curiosity from the side, glanced into the book. Brońcia was reading a long sentence slowly and with difficulty. This irritated Mania, who suddenly read the sentence aloud, clearly and fluently. When she later saw the astonishment – indeed, the almost stupefied expressions – on her parents' faces, as well as the faint shadow clouding the brow of the embarrassed Brońcia, she burst into loud, sorrowful tears, apologizing and saying: "I didn't know I wasn't allowed to; that I was doing something wrong – but it was all so terribly easy." And so it was always: everything seemed to her so easy, so engaging, and so delightful. One could hardly tear her away from books; everything around her absorbed

her attention, and natural phenomena captivated her.” (Skłodowska-Szalay: 1958, 9-10)

Summarizing her reflections on her mother’s childhood in the biography, Ève Curie writes:

“The gymnasium – the boarding school – study – pupils: this is the leitmotif of Maria Skłodowska’s youth. Both she herself and everything around her are directly connected with learning and with school. Even her family home, because of the lodgers it hosted, is in a sense also a kind of school. Truly, the whole world must have seemed to Mania to be one great school, and people, in her view, were divided into only two categories: pupils and teachers, whose shared purpose in life is – exclusively and solely – study.” (Curie: 1983, 41)

In this way Ève Curie identifies in her mother’s early experiences the sources of her exceptional abilities and later scientific achievements, referring to them as the “high values of the environment” in which Maria grew up. She emphasizes that even at that time these abilities manifested themselves outwardly and were readily observable. The portrait of the scholar that she offered is multifaceted. The reader is allowed to see Skłodowska-Curie from various perspectives: as a child, an adolescent, a university student, a wife, a researcher, and ultimately a Nobel Prize-winning scientist of great renown. This effect arises from the narrative structure, whose task is to bring the figure of the scientist closer to us along with the components of her exceptional character. In biographical accounts, Maria appears from her earliest years as an intelligent child marked by a deep interest in reading. Brzeźniak observes that, in the case of Maria Skłodowska-Curie,

“The books she read in childhood and youth merit closer attention, although the surviving source materials say little about them. Biographers readily try to identify in her life story – primarily in the earliest years – signs of her later scientific success. They have mostly focused on issues related to the origins and development of her interest in physics and chemistry, while overlooking or only briefly noting her other fascinations.” (Brzeźniak:2013, 228)

The fascination with books displayed by the four-year-old girl was so intense that her educated parents feared premature maturity – premature, in their view:

"The parents tried, by various diplomatic means, to avoid giving her books. As experienced and wise educators, they were concerned about such early development, and whenever little Mania's hand reached toward one of the many children's books in the house, a suggestion was immediately heard: perhaps you would like to play with blocks? You know what—sing something to me! Where is your doll? – see, she needs to be dressed! Or, as today: 'I would prefer if you went to the garden...'" (Curie: 1983, 17)

This occurred because little Mania, from her earliest years, lost herself completely in books. These efforts, of course, did not diminish the future scientist's interest in reading; under the influence of her father and the student lodgings he managed, reading became an integral part of her youth. Especially during her childhood and adolescence, Maria filled every free moment with reading, which – as Ève Curie explains – served as an escape into a world without the worries and difficulties of daily life. In a letter to her friend Kazia, Maria Skłodowska-Curie wrote:

"I am currently reading: (1) Daniell's Physics, of which I have finished the first notebook, translated by Józef Boguski; (2) Spencer's Sociology in French; (3) Paul Bert's Lessons in Anatomy and Physiology, a wonderful book, which I have in Russian. I read several things at once, because concentrating on a single subject for too long would weary my already often exhausted mind. When I am absolutely incapable of productive reading, I work through algebraic or trigonometric problems, for these allow no compromise in attention and help to clear my mind." – translation from Polish (Curie: 1983, 86-87)

Interestingly, Barbara Goldsmith notes that even as an adult, Maria Skłodowska-Curie – just as in her childhood – had the habit of losing herself completely in reading.

"Months passed before she stopped hiding in corners to cry – something she did in secret, away from her family and schoolmates. At school she did not display even a trace of sadness, remaining the best pupil in her class. Immediately after her mother's death, Mania immersed herself almost completely in books, sometimes for hours and sometimes for entire days. She spoke very little. For her, the only way to endure was to reject the outside world and focus with unwavering determination on a single subject, thereby keeping the sense of emptiness at a distance. Many years later her daughter Ève recalled how, returning home at three in the morning, she noticed the light still on in her mother's room. She entered, but her mother did not

even register her presence, absorbed as she was in scientific materials. Clearly, the depression and inner withdrawal of childhood left their mark not only on young Mania but also on the adult Curie.” – translation from Polish (Goldsmith: 2007, 21)

In her mother’s intense reading and self-education, Eve perceives individual attributes that later contributed to the scientist’s greatness. She emphasizes that, because the children were raised in an intellectual environment where knowledge was valued above all else, the family initially failed to recognize Maria’s exceptional abilities:

“In an environment of average minds, her astonishing individuality and intellect would have immediately stood out, sharply distinguished from the rest. But within her own family circle these qualities did not yet appear extraordinary. Her brother and sisters, all three, were themselves highly gifted, full of energy; they excelled in their studies as well, winning medal after medal. As a result, no one in the family imagined that she surpassed the others by far, that she was made of altogether different clay.” (Curie: 1983, 75-76)

The experiences of her childhood were not without significance for Maria; they left a lasting imprint on her personality and on the values she embraced as a young person – they helped shape her. Maria’s sister observed that the achievements of the Skłodowski siblings demonstrated the enormous influence their father Władysław had on their upbringing: on his son Józef – later a medical doctor and head physician at the Dzieciątka Jezus Hospital in Warsaw; on his daughter Bronisława – who became a medical doctor and long-time director of a tuberculosis sanatorium in Zakopane and the principal founder of the Radium Institute in Warsaw, whose establishment had been initiated by Maria; on his daughter Helena – a teacher and school inspector in Warsaw, later Szalay by marriage; and on the youngest child, Maria Skłodowska-Curie (Skłodowska-Szalay: 1958, 8). Lucjan Biliński comments: “I believe that if, during the lifetime and scientific career of Maria Skłodowska, Mensa – the association of people with high IQ – had existed, not only she but most of her immediate family would have been members. They were exceptional individuals, distinguished not only within their local environment, but far beyond” (Biliński: 2003 13). Maria herself repeatedly acknowledges the influence of her parents on her intellectual formation, writing in her autobiography: “I remember both my parents perfectly, bound to each other by love, respect, and collaboration. Two main

goals guided them in life: service to the homeland through the education and instruction of the youth entrusted to them, and the upbringing of their five children to be worthy people and good citizens” (Sklódowska-Szalay: 1958, 8-9). Several factors motivated her father’s extraordinary commitment to his children’s education. Aware of the ongoing process of Russification⁵, he sought – both as a pedagogue and as a father – to mitigate the detrimental impact of contemporary schooling on young minds, especially those of his own children. Not insignificant were the pangs of conscience that plagued him for years after losing his life savings, knowing he would be unable to finance his daughters’ education. He understood that such education would only be possible abroad (Curie: 1983, 62). Due to Russian restrictions, he himself had been unable to pursue his chosen field, and thus – one may presume – he transferred his own unfulfilled aspirations in the sciences onto his children, as Barbara Goldsmith observes (Goldsmith: 2007, 13). It was precisely these aspirations that fueled his determination to provide them with the best education available at the time. Thanks to their father’s instruction, he could look with hope toward the future educational opportunities of his children. “For many years Władysław reproached himself for having lost all his savings in this way and for depriving his children of the funds he had intended for their education. He found peace only in his later years, when he saw that somehow we were all managing. Perhaps at that point he realized that his own example and his constant pedagogical efforts had contributed to their success” – translation from Polish (Quinn: 1997, 28).

Marie Skłodowska-Curie articulates the nature of scientific work in the following terms: “A great discovery is not the ready-made product of a scientist’s mind (...) it is the fruit of accumulated preparatory work (...). The greatest achievements require something more than scientific training; they require that a person be made for a particular task.” Goldsmith adds: “Marie Curie, whose character had been shaped by discrimination, pressure,

⁵ “In Warsaw, everything that reveals a love for the native language is, as a rule, forbidden. One is not allowed, for example—strange as it may seem—to enlighten and educate the common people, for instruction may be given only in Russian, a language unknown to the simple folk. Ignorance is widespread: barely one-fifth of the population can read and write. This must strike any foreigner who has spent even a few weeks in Warsaw. Here one will never see, for instance, a cabman reading a newspaper, as is common in other cities; indeed, most coachmen do not even know their numbers. They are told the name of the street, instructed to turn right or left, and given a signal when the carriage is to stop.” (Brandes: 1898, 20)

parental ambition, patriotism, and emotional reserve, was precisely such a person" (Goldsmith: 2007,12). Ève Curie likewise emphasizes the role played by Maria's father – her own grandfather – in the scientist's education during childhood:

"Mania is not at all offended by these, admittedly minor, signs of her father's pedantry. She loves him with all her heart and is inclined to believe there is nothing he cannot do, does not know, or is unable to understand. And it must be admitted that she is not far from the truth, for her father's erudition is indeed exceptionally broad. One is struck with amazement at how, under his material circumstances, burdened by professional duties and the upbringing of four children, he managed to keep pace with scientific progress, to obtain the latest books and journals—without limiting himself to his own fields (mathematics, physics, and chemistry)—and to deepen his knowledge of modern languages (in addition to Russian, he knew French, German, and English excellently) as well as Latin and Greek." – translation from Polish (Curie: 1983, 60-61)

Marie's brother Józef, in analyzing his sister's exceptional qualities – which he believed were shared by all members of the family – points to seriousness, responsibility, and conscientiousness:

"I often wonder which spiritual qualities most closely link Marie Curie to her family home. If we set aside the scientific institution, which was, of course, her own unique and personal achievement, certain shared characteristics inherited from our parents appear identifiable and worthy of emphasis in all of us, despite our considerable individual differences. These are: a serious attitude toward life – manifested not only in form but in substance – a strong sense of responsibility, and conscientiousness in carrying out one's obligations (...)." – translation from Polish (Biliński: 2003, 44)

Władysław inspired both respect and admiration in his children. As Józef recalled, their father knew French, Russian, German, and English. Maria mastered all these languages as well, which indicates the influence of her father on her linguistic abilities. His support did not cease in her early childhood but continued later, as he advised and assisted her with mathematical problems, while helping Józef with languages when the latter studied medicine (Quinn: 1997, 28-29). Ève Curie emphasizes that her mother was fully aware that she owed her knowledge to her father and to the intellectual atmosphere of the family home, which for years inspired her intellectual

development (Curie:1983, 61). Maria stresses the powerful influence of her father on her formation, writing in her autobiography:

“It is with constant gratitude that I recall my father, who, asking nothing for himself, yet through work often beyond his strength, secured for us everything that could support our physical and intellectual development. He was not satisfied with the level of the schools we attended, so he educated us privately at home. We took regular lessons in foreign languages – French, German, and English – and he supplemented our natural science instruction in the afternoons or evenings, making use of gymnasium textbooks. On Saturdays he always gathered us from seven to nine and introduced us to Polish literature. In this way we came to know the works of our foremost writers and poets.” (Sklódowska-Szalay: 1958, 13-14)

It should be emphasized that thanks to her father, Maria received a solid and wide-ranging education in both the humanities and the sciences. One could speculate about the possible influence of her mother on young Maria, or whether – had her mother not died prematurely – the future scientist would still have pursued a scientific career, with her father playing a somewhat lesser role in her upbringing. Maria Skłodowska-Curie writes:

“School-level mathematics and physics came easily to me. I received help in this field from my father, who enjoyed these subjects and taught them himself. He took every opportunity to explain some natural phenomenon to us. But unfortunately, he had no laboratory and could not carry out experiments.” Reflecting on her father later in life, as a renowned scientist and professor at the Sorbonne, she wrote: “We had a good father, and we owed him much. He fostered in us early independence and a love of work; he instilled in us a deep love of our homeland and an equally deep hatred of the partitioning powers, especially the Tsarist government, with which we had the most direct contact.” (Sklódowska-Szalay: 1958, 12-14)

All the Skłodowski children were thoroughly educated, completed university studies, and pursued the professions of their choice. The scientist recalls:

“We all had an aptitude for intellectual work. My brother, Józef Skłodowski, after completing his medical studies, later became head physician of one of Warsaw’s major hospitals. My sisters and I intended, following the example of our parents, to devote ourselves to teaching. However, the eldest,

Bronisława, later changed her mind and chose medicine. After receiving her medical diploma from the University of Paris, she married a Polish physician, Kazimierz Dłuski. A few years later, they jointly established a large sanatorium in the beautiful mountain town of Zakopane, then under Austrian rule. My other sister, Helena, later Szalay, worked for many years with great success in private schools in Warsaw. After the war, she was appointed to one of the state secondary schools in independent Poland.” (Sklódowska-Curie: 2009, 15)

The profound impact of her father on Maria is evident in the fact that numerous biographers never omit her childhood – in fact, they consistently return to it. Examples of such references in the literature are abundant. Quinn, for instance, observed that Maria, “raised on the poetry of Mickiewicz and in the spirit of patriotic ideals, tended to view life as a heroic struggle against great difficulties. The battle against adversity is one of the central themes of nearly all her non-scientific writings. And because her biography of Pierre and her Autobiography became foundational sources for later scholars, the overcoming of successive obstacles remained forever the central thread in the Curie story” (Quinn: 1997, 250). Barbara Goldsmith similarly stresses:

“Her painful experiences manifested themselves in what she called deep depression, the seed of a syndrome that would recur later in her life. In later years, as Madame Curie, under the gaze of the entire world, she expressed herself less openly, describing these episodes as fatigue, exhaustion, or nervous trouble. (...) She spoke little. The only way for her to survive was to shut out the world and focus with a manic determination on a single topic, thereby keeping the feeling of emptiness at bay.” (Kaczorowska: 2011, 21)

Biographical narratives

Biographical narratives constitute a valuable pedagogical tool, as they provide learners with empirically grounded accounts of human experience that promote socio-emotional, cognitive, and cultural development. By examining the lived trajectories of influential historical and contemporary figures, students gain structured opportunities to cultivate empathy, as these narratives illuminate diverse experiences of adversity, resilience, and achievement. Such accounts also serve as case studies that strengthen analytical and critical thinking skills, enabling learners to evaluate motivations,

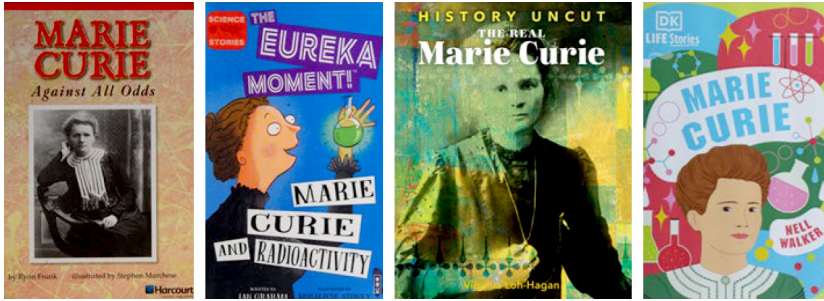
contextualize decisions, and draw connections between past and present phenomena. Furthermore, biographies broaden cultural and historical awareness by exposing students to heterogeneous cultural backgrounds and temporal contexts, thereby fostering global perspectives and intercultural competence. Collectively, the integration of biographies into educational settings supports the formation of reflective, informed, and socially attuned individuals.

Biographies function as powerful educational instruments by providing empirically grounded narratives that illuminate the complexities of human development, resilience, and social influence. Through detailed accounts of individuals' lived experiences, biographies facilitate cognitive and emotional engagement, fostering empathy, enhancing perspective-taking, and supporting the development of a growth mindset. These narratives allow readers to examine adaptive responses to adversity, derive lessons from documented successes and failures, and contextualize personal trajectories within broader historical, cultural, and sociopolitical frameworks. Moreover, biographies amplify diverse and often marginalized voices, thereby promoting inclusivity, challenging preconceived assumptions, and encouraging socially responsible behaviour. As accessible repositories of lived evidence, biographies not only enrich readers' understanding of human behaviour but also motivate positive action, leadership, and lifelong learning.

The research

This study investigates how contemporary children's and young adult biographies of Marie Skłodowska-Curie construct her scientific identity and how these representations influence learners' attitudes toward science, perseverance, and gender equality in STEM fields. By analysing the adaptive strategies through which Curie's life story is reframed for diverse educational audiences, the research seeks to elucidate the didactic potential of biographical narratives in cultivating scientific curiosity, historical consciousness, and personal development among young readers.

The corpus consists of four publications representing distinct genres and pedagogical approaches:



- Frank, R. (2008). *Marie Curie: Against all odds*. Harcourt School Publishers.
- Graham, I. (2018). *The Eureka Moment! Marie Curie and radioactivity*. Salariya Book Company.
- Loh-Hagan, V. (2019). *The real Marie Curie (History Uncut)*. 45th Parallel Press.
- Walker, N. (2022). *Marie Curie (DK Life Stories)*. Penguin Random House.

Together, these works span narrative nonfiction, illustrated biographies, graphic storytelling, and hybrid activity-based resources. Their variations in length, visual composition, scientific depth, and narrative complexity provide a fertile foundation for comparative analysis.

Methods

This research adopts a qualitative, interpretive design grounded in comparative content analysis. The dataset comprises textual, visual, and paratextual elements (timelines, glossaries, reflective prompts). Analytical dimensions include:

- thematic framing;
- narrative strategy;
- visual/iconographic representation;
- scientific and historical conceptualization;
- implicit pedagogical messaging.

This methodological framework enables a systematic examination of recurring motifs and distinctive pedagogical features across genres.

Historical Context: Curie as a Product of Her Era

All four biographies foreground the political and educational oppression of partitioned Poland: Russian imperial censorship, systemic gender discrimination, and the exclusion of women from university education.

- **Frank (2008)**, aimed at younger readers (grade 5), simplifies geopolitical dynamics but highlights inequality as a formative force.

- **Graham (2018)** employs graphic storytelling to dramatize clandestine education, portraying the Flying University as an exciting act of intellectual resistance.
- **Loh-Hagan (2019)**, for grades 7–8, presents a balanced account combining accessible prose with critical reflection prompts that contextualize Russian oppression and institutional barriers.
- **Walker (2022)**, written for middle-grade readers (ages 9–12), offers substantial detail about Russification, the Flying University, and the prohibition of the Polish language instruction. The book’s expansive format allows for nuanced contextualization.

Across the corpus, Curie’s early environment is consistently interpreted as a crucible of resilience, intellectual defiance, and moral courage.

Family Background: Intellectual Formation and Emotional Hardship

The books convergently depict Curie’s family as intellectually vibrant yet financially constrained.

- **Walker** underscores her father’s scientific instruments as catalysts of early curiosity and portrays maternal loss as a defining emotional trauma;
- **Frank** highlights her father’s pedagogical influence and simplifies emotional content for younger audiences;
- **Graham** dramatizes family tragedies through comic-style panels for heightened immediacy;
- **Loh-Hagan** situates Curie’s family within a transgenerational scientific legacy, noting five Nobel Prizes in the Curie lineage.

Texts for younger readers emphasise curiosity and diligence, while more advanced publications articulate the psychological impact of bereavement and economic hardship.

Educational Trajectory: From Clandestine Learning to the Sorbonne

A central narrative across the corpus is Curie’s uncompromising commitment to education.

- **Walker** provides detailed accounts of governess employment, her pact with Bronya, and her impoverished living conditions in Paris;
- **Frank** condenses these elements, focusing on the sisterly arrangement and eventual academic success;

- **Graham** renders the Flying University and Sorbonne episodes dramatically through dialogue and visual sequencing;
- **Loh-Hagan** emphasises systemic exclusion, including Curie's prohibition from speaking at the Royal Institution.

Collectively, these narratives portray education as both the foundation and engine of Curie's scientific identity.

Scientific Contributions and Ethical Identity

Curie's key scientific achievements – radioactivity, the discovery of radium and polonium, and the development of mobile radiography during WWI – appear across all texts in age-appropriate forms.

- **Walker** highlights perseverance, ethical choices (e.g., refusal to patent radium), and collaboration with Pierre;
- **Frank** simplifies scientific detail, emphasising discoveries and honours;
- **Graham** introduces technical vocabulary through accessible visual explanations;
- **Loh-Hagan** incorporates dimensions of controversy and exclusion, presenting Curie as both a scientific trailblazer and a social reformer.

Across the corpus, Curie emerges not only as a scientist but also as a moral agent and cultural symbol.

Conclusion

The four publications exhibit a coherent didactic orientation, consistently promoting core educational values such as perseverance and grit, intellectual autonomy, scientific curiosity, ethical responsibility, and gender inclusivity in STEM. Each genre accomplishes this pedagogical work through genre-specific instructional strategies: the graphic biography (Graham) enhances emotional immediacy and affective accessibility; narrative nonfiction (Walker; Loh-Hagan) emphasises historical accuracy, contextual depth, and conceptual sophistication; the simplified instructional biography (Frank) scaffolds foundational scientific ideas for emerging readers through clarity and linguistic economy; and the critical biography (Loh-Hagan) cultivates socio-ethical awareness, and critical engagement with scientific culture. Taken together, these generic approaches demonstrate how biographical storytelling can be strategically adapted to accommodate diverse developmental, linguistic, and cognitive profiles, thereby maximising its pedagogical impact across age groups and learning contexts.

This analysis reveals that modern youth biographies of Marie Skłodowska-Curie collectively construct her as an individual shaped by socio-political constraints, familial intellectualism, and rigorous academic pursuit. Although the publications differ in narrative density, scientific complexity, and visual design, each contributes to shaping young readers' conceptions of scientific identity, historical continuity, and personal perseverance.

These works exemplify biography's dual role as narrative and pedagogy. When thoughtfully crafted, such texts not only introduce scientific concepts and historical conditions but also cultivate motivation, moral imagination, and an inclusive vision of scientific careers – particularly for girls and under-represented groups in STEM.

Despite their formal heterogeneity, the four examined publications exhibit a coherent didactic orientation, consistently promoting perseverance, intellectual autonomy, scientific curiosity, ethical responsibility, and gender inclusivity in STEM. Each genre mobilizes distinctive instructional strategies: the graphic biography (Graham) leverages visual dramatization and emotional immediacy; narrative nonfiction (Walker; Loh-Hagan) foregrounds historical accuracy and conceptual sophistication; the simplified instructional biography (Frank) scaffolds foundational scientific concepts for younger readers; and the critical biography (Loh-Hagan) encourages metacognitive reflection and socio-ethical awareness. These generic differences align with the study's hypotheses: the biographies overwhelmingly frame Curie's life as a narrative of resilience shaped by political oppression, gender inequality, and poverty; they foreground family influence – particularly parental pedagogical values and Bronya's cooperative role – as central to Curie's intellectual formation; and they consistently represent education as the primary engine of her scientific development. Furthermore, all publications incorporate motivational and ethical dimensions, positioning Curie as a moral exemplar whose life embodies perseverance, altruism, and intellectual independence. As anticipated, genre significantly modulates emphasis, with graphic texts privileging affective engagement, narrative nonfiction deepening historical and scientific contextualization, and activity-based materials emphasizing experiential learning and value transmission.

The analysis also underscores several structural limitations. The corpus is necessarily selective and cannot represent the full spectrum of Curie-related literature; the wide age range of target audiences necessitates careful contextualization in comparative interpretation; and genre-dependent

constraints – such as textual compression in graphic and activity formats – complicate direct comparison with more expansive narrative nonfiction. Moreover, the interpretive nature of qualitative content analysis introduces an element of subjectivity, while the absence of empirical classroom testing means that pedagogical impact must be inferred rather than validated. Nonetheless, the findings yield important implications for science education. Biographies emerge as powerful tools for fostering scientific motivation when they combine emotional engagement, narrative coherence, and conceptual accuracy. Curie's life story, in particular, offers a compelling case for illustrating the socio-cultural embeddedness of scientific practice, demonstrating how political conditions, gender norms, and family's support shape scientific opportunity. Graphic and illustrated formats show special potential for engaging reluctant or visually oriented learners, while activity-based resources can strengthen scientific reasoning through hands-on inquiry. Crucially, representations of women in science across these texts support gender inclusivity and provide aspirational models for girls. For educators, these insights highlight the need to select biographical materials strategically – depending on whether the instructional aim is to promote historical understanding, scientific process skills, ethical reasoning, or identity-building within STEM.

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Abstrakt: Tato biografická výzkumná analýza zkoumá, jak současné publikace pro děti a mladé dospělé zobrazují Marii Skłodowskou-Curie jako vědeckou osobnost formovanou historickým kontextem, rodinnou výchovou a vzděláním, a jak tyto obrazy přispívají k formování vědecké identity studentů, jejich osobnímu rozvoji a postojům k rovnosti pohlaví v oborech STEM. Studie analyzuje korpus moderních biografií zaměřených na mládež s cílem identifikovat dominantní narativní rámce, tematické důrazy a adaptační strategie používané k překladu Curieho života a úspěchů pro různé úrovně vzdělávání. Zvláštní pozornost je věnována zobrazení vytrvalosti, intelektuální autonomie, etického závazku vůči vědě a překonávání genderových bariér. Prostřednictvím kvalitativní textové a diskurzivní analýzy výzkum zkoumá, jak je biografie Skłodowské-Curieové přetvářena tak, aby odpovídala současným pedagogickým cílům, včetně motivace k vědeckému bádání, odolnosti v učení a kritické reflexe sociální nerovnosti. Výsledky naznačují, že biografie mladých lidí nepřenášejí pouze historické znalosti, ale aktivně vytvářejí vzory, které formují vnímání žáků o tom, kdo se může podílet na vědě a za jakých podmínek. Tím, že Curieovou představují

současně jako produkt své doby i jako iniciátorku změn, tyto příběhy podporují historické povědomí a zároveň propagují inkluzivní hodnoty ve vzdělávání v oblasti STEM. Studie zdůrazňuje didaktický potenciál biografií. Výsledky naznačují, že biografie mladých lidí nejen předávají historické znalosti, ale aktivně vytvářejí vzory, které formují vnímání studentů o tom, kdo se může podílet na vědě a za jakých podmínek. Tím, že Curie je současně představována jako produkt své doby i jako iniciátorka změn, tyto příběhy podporují historické povědomí a zároveň propagují inkluzivní hodnoty ve vzdělávání v oborech STEM. Studie zdůrazňuje didaktický potenciál biografických příběhů jako nástrojů pro rozvíjení vědecké zvědavosti, osobního rozvoje a genderově citlivého přístupu u mladých čtenářů.

Klíčová slova: Maria Skłodowska-Curie; biografie mladých lidí; vědecká identita; vzdělávání v oboru STEM; rovnost pohlaví

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Research survey

Educational Implications of Lexicographic Misalignment: AI-Generated Definitions of English Loanwords in L2 Context

JAKOV PROROKOVIĆ

Abstract: By replicating the experimental design of Balenović and Proroković (2025), on the same lexical dataset, the present research investigates whether the GPT-5 model yields more accurate, contextually appropriate, and linguistically differentiated lexicographic output when it comes to senses and usages of English loanwords in Croatian. Additionally, the aim is to determine how GPT-5's definitions, contextual examples, and sense partitioning compare qualitatively and quantitatively to those produced by GPT-4o. Despite improvements, the findings indicate that the GPT-5 model continues to display systematic vulnerabilities in L2 contexts, particularly for low-frequency loanwords. Though not exclusively, as in GPT-4o, less attested items elicit a higher rate of L1-to-L2 overgeneralization, leading to unverified or semantically implausible uses presented with high confidence. The study concludes that, although GPT-5 represents a significant step forward in the lexicographic endeavor, its performance remains inconsistent for L2 loanword interpretation. In other words, there still seems to exist the continued need for critical human oversight and the educational importance of AI literacy. Model's misinterpretation of prompt design and intent entails that recognizing and correcting such errors requires not only user awareness but language competence as well.

Keywords: *large language models (LLMs), GPT-5, cross-linguistic lexicography, loanword sense definitions, overgeneralization and AI overconfidence*

1 Introduction

Lexicography has long been regarded as a clearly delineated and methodologically stable branch of linguistics. At its core, the lexicographic endeavor involves synthesizing attested linguistic evidence across diverse

registers and contexts of use, identifying recurrent semantic and formal regularities, and systematizing these into structured entries that represent a term's meanings and realizations in relation to its defining traits (Bergenholtz & Tarp, 2003; Atkins & Rundell, 2008). In other words, lexicography mediates between raw linguistic data and organized lexical knowledge. However, this apparent methodological straightforwardness becomes more complex when applied within the domain of contact linguistics, where linguistic systems interact, borrow, and influence one another dynamically. In such contexts, the stability of lexical meaning, often presupposed in traditional lexicographic frameworks, is challenged by processes of borrowing, semantic shift, and hybridization. The present study therefore investigates how lexicographic principles can be adapted or reconceptualized for contact linguistic settings, and how artificial intelligence (AI)—particularly large language models (LLMs)—can assist or transform such analysis. More precisely, it explores whether the most recent AI models can avoid the unnecessary (either unattested or plain wrong) overgeneralization that was observed in earlier models when defining loanwords in their non-native contexts (see Balenović & Proroković, 2025).

1.1 Lexicography and AI

Research on large language models (LLMs) for linguistic and lexicographic purposes has expanded rapidly in recent years (cf. de Schryver, 2023; Lew, 2024; Chen et al., 2024; Klosa-Kückelhaus & Tiberius, 2025 etc.). Even the early models started to integrate contextualized representations that capture more finer-grained semantic nuances (cf. Ethayarajh, 2019; Yarbrow & Olney, 2021; Liu et al., 2021), finally resulting in systems that demonstrated considerable potential for assisting in the generation of candidate definitions and sense inventories, thereby accelerating the discovery and initial drafting phases of lexicographic work (Balenović & Proroković, 2025; Lew, 2024). AI systems no longer merely replicate traditional dictionary-defining practices but increasingly engage in context-sensitive definitional reasoning, allowing for new forms of semi-automated lexical analysis, thus inviting a reconsideration of the epistemological and methodological foundations of lexicography in the age of intelligent computational models. Nevertheless, despite notable improvements in language-specific competencies and context sensitivity, the greatest danger lurks in unreservedly taking the AI's output without having in mind that the models tend to generate probability-based sequences of linguistic structures they extrapolated from

the training data, but without necessarily being referenced or grounded in meaning (where meaning implies extra-linguistic awareness), thus becoming a form of “stochastic parrots” (Bender et al., 2021).

What models tend to excel at is using distributional patterns and memorizing encyclopedic facts to produce definitions (fast, fluent), and with the more recent advancements capturing richer, distributional and contextual information than single-token embeddings alone. At the moment, it seems rather inevitable that the use of LLMs will reshape the field of lexicography, especially in the cross-linguistic and cross-cultural context and in relation to learners’ interaction with the emerging technology. In fact, this is already happening in the sense that many learners seem to be gradually shifting from relying on traditional print or electronic dictionaries toward querying LLMs (especially ChatGPT) as a first stop for meaning, usage, and collocations (see Ptasznik & Lew, 2025; Liu et al., 2025). In other words, it is now perfectly clear that we can (if not ought to) use them for unearthing candidate definitions and sense inventories, for they significantly accelerate discovery and initial drafting. This does not entirely eliminate dictionary use, but rather reorders it: learners often turn to dictionaries only when the LLM fails, or to verify or expand on LLM outputs. In fact, learners sometimes detect errors or hallucinations in LLM output and revert to dictionaries as a sanity check, so the relationship is not simple replacement but dynamic interplay (Liu et al., 2025). In other words, LLMs are reshaping dictionary use patterns among language learners by inserting themselves as an intermediate interpretive tool, with learners treating LLMs as “first-instance interpreters,” and dictionaries becoming secondary resources (*ibid.*).

Though lexicographic in nature, this study also carries broader implications for the development of users’ critical awareness when interacting with AI systems. In particular, it highlights the necessity for users to reflect consciously on what they seek to find out and how they formulate their queries; an issue repeatedly identified in recent educational research as a persistent challenge for learners and educators alike (Woo et al., 2024; Milakis et al., 2025; Kang et al., 2025; Kim et al., 2025). A substantial part of employing AI in dictionary compilation lies in the careful design of prompts. As the results of this study (or at least its implications) will illustrate, effective prompting is neither trivial nor mechanical for it requires a high degree of linguistic awareness, disciplinary literacy, and attention to contextual and semantic detail. Moreover, as de Schryver (2023) cautions, while replacing a series of semi-automated lexicographic tasks (such as corpus building,

annotation, or headword list generation) with a single well-crafted prompt represents a remarkable technical advance, it does not remove the human element required for the framing of the prompt that directly conditions the quality and interpretability of the AI output. Large language models produce non-deterministic responses and even identical prompts may yield divergent results, thus underscoring the need for human oversight and reflective engagement to ensure that AI-generated material aligns with lexicographic standards and communicative intent (see de Schryver, 2023; Beliga & Filipović Petrović, 2024; Balenović & Proroković, 2025; Klosa-Kückelhaus & Tiberius, 2025 etc.).

1.2 On the Shoulders of the Previous Study

This study builds directly on the pioneering work of Balenović and Proroković (2025), *“The lexicographic potential of artificial intelligence: a case study of English loanwords in the Croatian language,”* in which the authors explored how generative AI models can distinguish senses and usages of English loanwords in Croatian. Their study showed that, while ChatGPT is quite capable of generating dictionary-style definitions for English loanwords used in Croatian (especially those that are frequent and well documented), its reliability diminishes for less frequent terms. In such cases the model tends to overgeneralize from English, importing senses that are not actually used in Croatian, and sometimes producing incorrect or unattested examples. Comparisons between early-2024 and early-2025 data revealed modest improvements, with the newer version of ChatGPT demonstrating greater nuance in dealing with ambiguous usages and somewhat better alignment with expected senses. Nevertheless, inconsistencies remained, particularly in how word frequency correlated with sense number, indicating that high frequency did not always yield more distinct senses, contrary to what one might expect.

Said findings set a foundation for the present study, which preserves the same sample of loanwords but uses an upgraded model (GPT-5), in order to test whether those improvements continue, and whether the limitations noted can be addressed. By adopting the same set of English loanwords as in Balenović & Proroković’s (2025) for a representative sample, this paper ensures continuity with the same empirical footing, but pushes the inquiry further by testing a more advanced underlying architecture: the GPT-5 model. In this way, the work can be seen as a natural extension of the previous paper: it not only replicates their experimental design (on the

same lexical material), but also investigates how advancements in model capacity and contextual reasoning might improve, refine, or challenge their original findings. This continuity in sample selection enables valid comparison across model developmental periods, while the shift to GPT-5 allows us to test whether more powerful models can overcome the limitations documented in the earlier work. Finally, the goal of this paper can be summarized as an attempt to answer the question of the ways in which GPT-5's definitions, contextual examples, and sense delineations differ qualitatively and quantitatively from those generated by GPT-4o for the same set of items?

2 Study Design

2.1 Research Questions

Building on Balenović and Proroković's (2025) findings, and employing the same corpus of English loanwords attested in Croatian, this study seeks to examine how the newer GPT-5 model performs in comparison to GPT-4o. The focus is on assessing whether the model's enhanced contextual reasoning and linguistic depth translate into more accurate and context-sensitive lexicographic performance. Accordingly, the research is guided by the following questions:

1. How effectively does the model capture language-specific contextual differences in meaning and register behavior of English loanwords used in Croatian?
2. To what extent does GPT-5, compared to GPT-4o, distinguish between the semantic and pragmatic nuances of the same lexical item when used in English (L1) versus Croatian (L2)?
3. Are higher-frequency loanwords handled more consistently and precisely than low-frequency or emerging ones, and if so, how does this pattern compare to that observed in GPT-4o?

2.2 Method

The methodological framework of this study closely follows that established by Balenović and Proroković (2025), ensuring consistency and comparability between the two research stages. As in the previous study, prompts were used to elicit the model's definitions, categorizations, and contextual interpretations of English loanwords attested in Croatian. However, for the present investigation, only four prompts were employed, as opposed to the six used previously. Specifically, the model was queried using the following:

Senses of “X” in Croatian, Word class of “X” in Croatian, Senses of “X” in English, and Word class of “X” in English.

Table 1. Prompts designed to elicit information on the target English loanword where »X« designates the targeted loanword

Feedback goal	Prompt designed to address it
Senses of »X« in Cro	Ako postoje, koja su moguća značenja/načini uporabe riječi »X« u hrvatskom jeziku?
Word class of »X« in Cro	Kao koja vrsta riječi se riječ »X« može koristiti u hrvatskom jeziku?
Senses of »X« in Eng	What are the possible senses of the word »X« in English?
Word class of »X« in Eng	Which word classes can the word »X« represent when used in English?

This slight methodological reduction was introduced in order to focus on the model’s ability to distinguish cross-linguistic semantic and grammatical differences between the same lexical item used in Croatian (L2) and English (L1), while maintaining a reproducible dataset. Each prompt was issued individually (with the new session being started each time) in identical conditions to ensure consistency, and responses were recorded and analyzed for accuracy, contextual adequacy, and internal consistency. This approach enables a direct comparison of GPT-5’s output with that obtained from GPT-4o, providing insight into the model’s development in lexicographic competence.

2.3 Sample and Data Collection

The lexical sample used in this study corresponds to that analyzed by Balenović and Proroković (2025), ensuring full comparability between the two datasets. For the exact list of English loanwords tested on the GPT-5 model, see Balenović and Proroković (2025). As in the previous research, the selection of items is grounded in the work of Bogunović and Kučić (2022) and Bogunović (2023), who compiled the ENGRI corpus—a corpus of English-origin words attested in Croatian. The sample focuses on loanwords that have largely retained their original orthographic and phonetic forms and that are verifiably integrated into contemporary Croatian usage, thus ensuring relevance and representativeness across frequency levels. For the purposes of the present analysis, all GPT-5 data were obtained through systematically designed prompts during late September and early

October 2025, whereas the comparative dataset based on GPT-4o, as stated in Balenović and Proroković (2025), was collected between February and March 2025.

3 Results

3.1 Qualitative Overview of the Lexicographic Data on loanwords in L2 context

When examining the GPT-5 responses to the prompt requesting the senses of English loanwords in Croatian, several notable inconsistencies and interpretive issues emerge (Table 2). For instance, in the case of the loanword *cross*, the model displays considerable inter-response stochasticity—alternating between orthographically adapted and non-adapted forms, offering English examples accompanied by Croatian translations, and at times generating seemingly unattested or fabricated Croatian examples that appear to be semantic overgeneralizations from English (e.g., *Nemoj **biti** **cross***; a supposedly Croatian counterpart of “Don’t be cross”). A similar phenomenon is observed with the loanword *touch*, where the derived verbal representations such as *Nemoj to **touchati*** or ***Touchaj** ikonu da se otvori* cannot be verified through standard web or corpus searches. The lack of attestation suggests that these are not naturalized Croatian usages but rather AI-generated projections extrapolated from English input.

Table 2. Variation across responses and L1 interference in GPT-5 responses to the prompt asking for the senses of the English loanwords *round*, *dog*, *cross* and *touch*, in the Croatian language¹

GPT-5 feedback	Comment
Riječ „round“ (izgovor: raund) ušla je u hrvatski jezik kao posuđenica iz engleskog, iako nije jako česta u općem jeziku – ali se koristi u sportu, glazbi, piću i općim izrazima (posebno u žargonu). U nastavku su sva njezina značenja i načini uporabe u hrvatskom jeziku. (...) 2. „Round“ = runda pića (u žargonu) U svakodnevnom govoru, pogotovo među mladima ili u kontekstu ugostiteljstva, round može značiti i krug pića koji netko plaća društvu. Primjeri: „Ja plaćam ovaj round, ti sljedeći.“ „Daj još jedan round piva!“ (...) 3. „Round“ = glazbeni kanon / višeglasje (rjeđe) U glazbenom kontekstu, riječ round može značiti pjesmu u kojoj se više glasova pjeva istu melodiju s vremenskim pomakom, kao u engleskom izrazu singing in a round. Primjer: „Frère Jacques’ je tradicionalni round.“ (...) Riječ „dog“ (izgovor: dog) potječe iz engleskog jezika i znači „pas“, ali u hrvatskom jeziku ta riječ nije ušla kao standardna posuđenica – nije dio općeprihvaćenog standardnog jezika. (...) 2. U žargonu (neformalno, pod utjecajem engleskog). U svakodnevnom govoru, posebno među mladima koji koriste engleske izraze, dog se ponekad koristi kao nadimak ili metafora (najčešće u internetskom i urbanom slengu). Primjeri: „Ej, dog, kako si?“ (= prijateljski izraz, poput „brate“, „frende“) „On je pravi dog – odan i pouzdan.“ (= metaforički: vjeran, dobar) (...) 5. U prenesenom (simboličkom) značenju U nekim kontekstima (npr. umjetničkim, glazbenim ili metaforičkim), dog se koristi kao simbol: vjernosti i odanosti; grubosti, instinkta, muževnosti; (u negativnom smislu) nižeg statusa ili nečistoće; Primjeri: „U njemu se budi dog.“ (= životinjski instinkt, borbeni duh) (...)	Unattested L2 loanword usages (likely overgeneralisations from L1 contexts)

¹ The text listed in the tables represents a reduced version of the GPT-5 responses to the analyzed prompts; i.e., it has been edited to remove symbols and non-essential elements for the sake of brevity and clarity, retaining only information pertinent to this study. Additionally, the responses have been significantly shortened, retaining primarily those instances interesting for the purposes of this study.

Riječ „cross“ (izgovor: kros) potječe iz engleskog jezika (i starofrancuskog *crois*, lat. *crux*) i u osnovi znači „križ“, „preći“ ili „ukrižiti“, ovisno o kontekstu. (...) 1. „Cross“ = križ (simbol, znak) Najosnovnije i izvorno značenje riječi *cross* jest križ, simbol s dvije okomite crte. U tom smislu, *cross* se često javlja u nazivima ili kao likovni/religijski motiv. Primjeri: „Red Cross“ → Crveni križ; „**Cross necklace**“ → **ogrlica s križem** (...) 3. „Cross“ u sportu. U sportu, *cross* ima nekoliko ustaljenih značenja: U atletici i trčanju – *cross* (ili *kros*) znači utrka izvan staze, najčešće po neravnom terenu. „**Trčim kros svake godine.**“ „**Školski kros bio je jučer.**“ (...) 5. „Cross“ = ljut, uzrujan (iz engleskog pridjeva) U engleskom *cross* može značiti i nervozan, ljutit („He was very cross with me“), ali to značenje nije preneseno u hrvatski osim u duhovitim ili stilski imitacijskim kontekstima. Primjer: „**Nemoj biti cross.**“ (šaljivo: „Nemoj se ljutiti.“) (...)

Riječ „touch“ (izgovor: tač) potječe iz engleskog jezika i osnovno joj je značenje „dodir“. (...) Značenje i vrsta riječi ovise o kontekstu – u hrvatskom se najčešće javlja kao imenica ili glagol (u žargonu), ali i kao dio složenica. 1. „Touch“ = dodir (fizički kontakt) Najosnovnije značenje – dodir rukom ili drugim dijelom tijela. Primjeri: „**He felt the soft touch of her hand.**“ → **Osjetio je nježan dodir njezine ruke.** „**Touch screen**“ → **zaslon na dodir.** (...) 2. „Touch“ kao glagol („dirati“, „dodirivati“) Izvorno engleski glagol *to touch* znači dotaknuti, dodirnuti, imati kontakt. U hrvatskom govoru, osobito u žargonu i IT-u, ponekad se koristi u obliku „touchati“ / „tačati“, ali to nije standardno. Primjeri: „**Nemoj to touchati.**“ → (žargonski) Ne diraj to. „**Touchaj ikonu da se otvori.**“ (...)

A further example of this overextension can be seen with the loanwords *round* and *dog* (Table 2), or even *show*, one of the most frequently borrowed English words in Croatian. When prompted to identify its possible word classes, GPT-5 proposes several options, one of which includes a verb form allegedly used in everyday speech, illustrated by the sentence *Ne moraš mi to **showati**, već sam vidio* (eng. “You don’t have to show it to me; I’ve already seen it”). Although such morphological adaptation (*showati*) might appear plausible, corpus and web searches reveal no empirical evidence of its occurrence in authentic Croatian usage. This strongly suggests that the model is hallucinating plausible-sounding but non-existent lexical forms, extending legitimate English derivational or syntactic patterns into Croatian contexts where they do not exist.

An important aspect of prompt design is the introductory phrase “*Ako postoje*” (Eng. *If they exist*), which is used when requesting the possible senses of a particular word in its L2 context, i.e., in Croatian. It is therefore striking that ChatGPT consistently fails to make a clear distinction between English and Croatian when providing these senses. The introductory phrase itself should indicate that the senses in L2 are not necessarily existent, and as such, should relieve the pressure of confirmation bias or affirmatively forced output, which the LLMs are designed to do. The model

often continues to list meanings attested in English, rather than restricting its output to the L2 context. This occurs despite the prompt being carefully formulated both semantically and linguistically: the request explicitly asks for the senses of the loanword in Croatian, and the prompt itself is phrased in L2. Nevertheless, the AI frequently lists examples from the source language, provides uses that are inapplicable in Croatian, or offers translations in which the loanword loses its original orthographic or phonological form. In such cases, the output becomes redundant, as it does not provide the information that was explicitly requested. This highlights a persistent limitation of the model: even when the prompt is unambiguous and clearly targeted, GPT occasionally fails to constrain its responses to the intended linguistic context.

A particularly illustrative example of prompt misinterpretation and partial self-correction can be observed in the GPT-5 responses to the loanword *slow* (Table 3). When prompted with the question “*Ako postoje, koja su moguća značenja/načini uporabe riječi ‘slow’ u hrvatskom jeziku?*” (“If they exist, what are the possible senses of the word *slow* in the Croatian language?”), the model fails to address the intended inquiry regarding the English loanword’s usage in Croatian (L2). Instead, it provides examples of the Croatian equivalent *spor*, effectively reverting to source-language translation rather than analyzing the loanword itself. Furthermore, the model introduces irrelevant grammatical information—such as word class categorizations—despite these not being requested and despite the query being posed in a completely new session, suggesting that the model reverts to default definitional behavior when uncertain about the semantic scope of a prompt.

In the subsequent clarification prompt (“*Da, ali mene zanima korištenje engleske riječi ‘slow’ u njegovom izvornom obliku u hrvatskom jeziku?*” – “Yes, but I am interested in the use of the English word *slow* in its original form in Croatian”), the model explicitly acknowledges its initial misunderstanding and adjusts its approach (Table 3). It now attempts to generate examples of the English loanword used in Croatian contexts. However, its performance remains inconsistent: while some examples correspond to genuinely attested usage, others are invented or unverified upon corpus or web examination (e.g. *živim slow* or *pustili su slow*). This pattern indicates that although GPT-5 is capable of recognizing its prior misalignment and modifying its interpretive frame, it still exhibits semantic overreach; i.e., producing plausible yet unattested examples in an effort to satisfy user intent. Such behavior underscores the model’s pragmatic adaptability, but

also its epistemic unreliability in low-frequency, cross-linguistic contexts, where the boundaries between legitimate borrowing and artificial generation remain blurred.

Table 3. Prompt–response misalignment and source-language transfer in GPT-5 lexical feedback

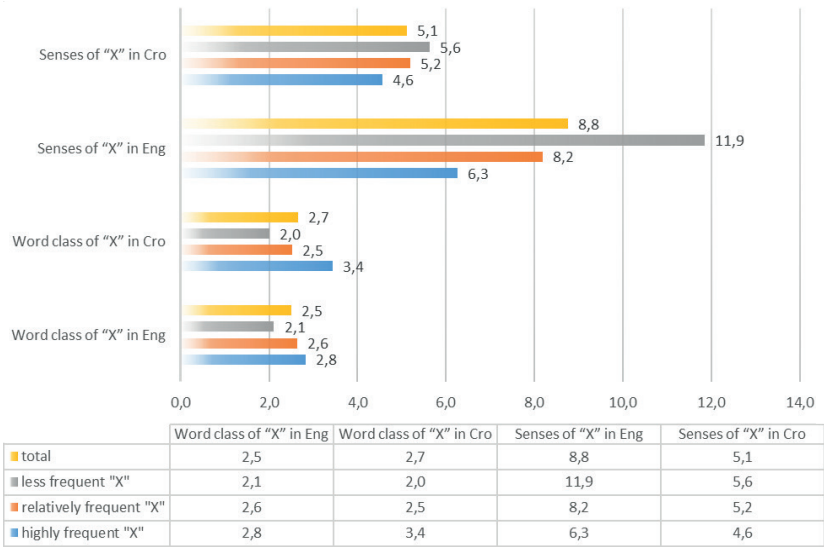
Prompt: Senses of “X” in Cro <i>Ako postoje, koja su moguća značenja/načini uporabe riječi “slow” u hrvatskom jeziku?</i>	Comment
GPT-5 feedback: <i>Odlično pitanje! Engleska riječ “slow” u hrvatskom jeziku nema izravan jednoznačni prijevod, ali se može prevoditi i koristiti na više načina, ovisno o kontekstu. Evo glavnih mogućih značenja i uporaba: 1. Kao pridjev – “spor” Najčešće značenje. Osoba, životinja, stvar ili radnja koja se odvija polako. He is a slow runner. → On je spor trkač. The Internet is slow. → Internet je spor. She’s slow at understanding jokes. → Spora je u shvaćanju šala. 2. Kao prilog – “polako”, “sporo” Kada opisuje način na koji se nešto događa. Drive slow! → Vozite polako! He speaks slow and clearly. → Govori sporo i jasno. (Napomena: u standardnom engleskom bi se reklo “slowly”, ali u kolokvijalnom govoru “slow” često zamjenjuje prilog.) 3. Kao glagol (rijetko) – “usporiti” (u izrazu “to slow (down)”) U hrvatskom jeziku nema samostalnog glagola slow, nego se uvijek prevodi opisno ili glagolom usporiti. Slow down! → Uspori! The car slowed at the corner. → Auto je usporio na zavoju. (...)</i>	Providing translated examples of the source language use of the targeted loanword “slow”. The model does not give examples for the loanword use in L2, but instead provides examples of how the L1 counterpart for said loanword can be used (<i>spor</i>). Additionally, it provides word classes as a response despite not being asked for it, and despite this being a completely new session when the question was posited.
Prompt: Additional clarification for the previous prompt <i>Da, ali mene zanima korištenje engleske riječi “slow” u njegovom izvornom obliku u hrvatskom jeziku?</i>	
GPT-5 feedback: <i>Aha – sad te razumijem točno. Dakle, pitaš ne za prijevode riječi slow, nego na koje se načine sama engleska riječ “slow” (u tom obliku) koristi u hrvatskom jeziku – dakle, kao posuđenica, stilski izraz, oznaka, naziv i sl. (...) Možemo razlikovati nekoliko tipičnih načina uporabe: 1. U nazivima pokreta, trendova i koncepata Najpoznatiji slučaj. Slow food – međunarodni pokret koji promiče lokalnu, tradicionalnu i sporiju pripremu hrane (suprotno “fast foodu”). → U hrvatskom se koristi neprevedeno: pokret slow food, slow food restoran, slow turizam, itd. Primjer: “U Istri raste interes za slow foodom i održivim ugostiteljstvom.” Slow travel, slow fashion, slow living, slow journalism itd. (...) 2. Kao dio brendova i naziva (...) 3. U izražavanju stila života i marketing Koristi se metaforički, često u engleskom obliku i kurzivom: “Trend slow life postaje sve popularniji među mladima.” “Živim slow, bez žurbe.” Tu se slow koristi kao modna riječ, svojevrsni slogan koji implicira filozofiju sporosti, svjesnosti i ravnoteže. 4. U glazbi i umjetnosti Slow jam, slow dance, slow tempo – koriste se u glazbenom žargonu. “Na kraju večeri pustili su slow.” (u značenju: ples uz sporu glazbu) Ovo je ustaljeno u govoru, osobito među DJ-ima i u plesnom kontekstu. (...)</i>	The model now acknowledges that it misinterpreted the initial prompt and now attempts to attune to the user’s reiterated request. It now demonstrates the understanding of the type of information the user wanted to retrieve, but still fails to provide examples of the loanword truly attested in L2; that is, some of them can be found in everyday use and are confirmed via search engine checks, while others sound odd and fail to withstand this level of scrutiny.

Overall, these examples illustrate GPT-5's continued tendency toward cross-linguistic overgeneralization; that is, its inclination to project L1 semantic and morphological structures onto L2 contexts without sufficient grounding in real language data. This behavior likely stems from the model's training bias toward English-dominant corpora and its design inclination to prioritize affirmative or content-complete responses over epistemic restraint (see Balenović & Proroković, 2025; Malmqvist, 2025). Consequently, while the model demonstrates growing fluency and syntactic adaptability, its semantic precision in bilingual or contact-language contexts remains inconsistent, particularly where corpus evidence is sparse or the prompt demands culturally embedded lexical distinctions.

3.2 Descriptive Statistics: Frequency Data and Trends

The overall results regarding the average number of meanings per prompt are perhaps more revealing in terms of intra-prompt than inter-prompt variation (Figure 1). In other words, it is particularly informative to observe how the number of distinct meanings provided by the model fluctuates in relation to the L2 frequency of a given loanword across different prompts. On one hand, it is unsurprising that the model tends to generate a greater number of senses for a loanword in its L1 context than in its L2 usage, reflecting its broader sense inventories in that language. On the other hand, a notable and somewhat unexpected pattern emerges within both the L1 and L2 "senses" prompts: loanwords that are less frequently attested in L2 usage tend to receive a higher number of meanings from GPT-5 than those that are more frequent. This inverse relationship between frequency and polysemy, as represented in the model's output, runs counter to linguistic expectations. One would expect polysemy to correlate positively with frequency, since more frequent lexical items ought to develop extended senses through broader contextual use. Yet, the model's responses suggest that when an English loanword becomes more frequent in Croatian, the AI attributes fewer potential senses to it. This may indicate that GPT-5 is not sensitive to corpus-based frequency effects in the same way humans are, but rather overgeneralizes from limited or ambiguous cross-linguistic data. Moreover, one might expect the opposite trend in the L1 context if polysemy were indeed a factor influencing borrowing—i.e., that the likelihood of a word being adopted into Croatian increases with its semantic versatility in English. However, this trend does not appear in the results either.

Figure 1. The average number of distinct meanings per prompt type in relation to loanword frequency



Additionally, the results regarding average numbers of word classes in total are also striking (Figure 1), but they seem to be partly influenced by technically incorrect examples. There is no clear rationale for why a prompt asking for the word classes of a loanword would yield an equal or greater number of categories in its non-native L2 context than in its L1 usage. For instance, consider the example of the word *rock*: although the prompt explicitly requests the word classes of *rock* in Croatian (*if they exist*), GPT produces five different categories (Table 4). Only the first is a legitimate word class (noun); the subsequent categories—such as metaphoric meaning or derived forms—do not correspond to conventional grammatical categories. To be clear, as evident in the example provided in continuation, the model does note in the extension of its (redundant) part of the feedback that it is still referring to specific grammatical category such as nouns, though now in relation to different context use, the question remains as to why it would then separate the number of categories that exist in its L2 use (in comparison to L1 use where the model provided two categories—noun and verb—at the time of the data retrieval, it listed 5 different points)?

Table 4. Feedback inconsistency in word classes of the loanword *rock* in L2 context

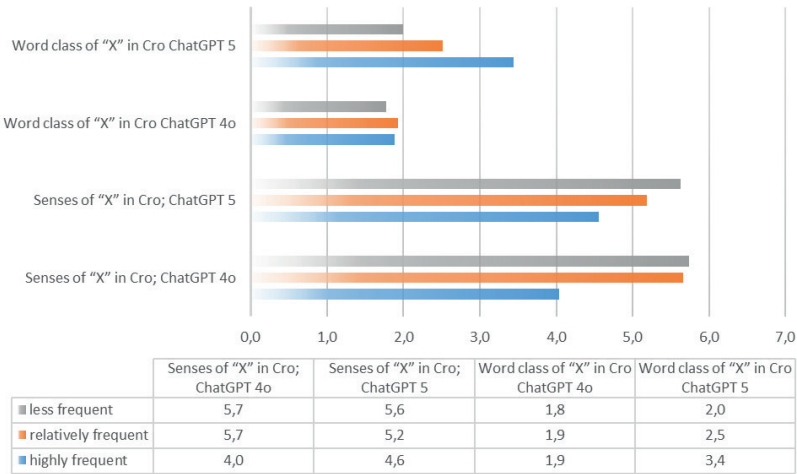
Prompt: Word class of "X" in Cro (Kao koja vrsta riječi se riječ »rock« može koristiti u hrvatskom jeziku?)
AI feedback: (...) 1. Imenica (najčešće i standardno značenje) Vrsta riječi: imenica muškog roda Značenje: glazbeni žanr koji se razvio iz rock'n'rolla; moderna glazba s izraženim ritmom i električnim instrumentima. Primjeri: „Volim slušati rock i blues.“ (...) 2. Atribut / opisni dodatak (u složenicama) (...) 3. Kao sastavni dio naziva ili Brenda Riječ rock često se koristi u nazivima festivala, klubova, pjesama, časopisa, brandova itd. U tim kontekstima zadržava svoj izvorni oblik i piše se velikim početnim slovom ako je dio imena. Primjeri: „INmusic Rock Festival“ „Planet Rock Radio“ (...) Ovdje je rock imenica, ali funkcionalno dio vlastitog imena. 4. Preneseno značenje (kolokvijalno) U neformalnom govoru rock se može koristiti prenesenim značenjem – za nešto što je „jako“, „žestoko“, „buntovno“, „kul“. Primjeri: „To je pravi rock!“ „Njegov govor bio je čisti rock'n'roll.“ I dalje je imenica, ali s metaforičkim značenjem. 5. Izvedenice (od engleskog korijenja). Od riječi rock razvile su se i domaće izvedenice, koje su u potpunosti prilagođene hrvatskom jeziku: Riječ Vrsta riječi Značenje rokerski pridjev koji se odnosi na rock (rokerska glazba, rokerski stil) roker imenica osoba koja sluša ili svira rock (...)

If the model were uncertain about the intended meaning of the term “vrsta riječi” in the prompt—despite it being a well-established term in Croatian language—it would have been preferable for it to seek clarification from the user before generating a response. Instead, the model opts to provide content at the risk of being incorrect or redundant. While this behavior is not inherently a mistake, it highlights a characteristic that is suboptimal for a responsible tutoring or lexicographic system: the generation of intra-prompt variability that exceeds the user’s informational needs. Specifically, the model acknowledges the original question but then continues to produce additional categories that are irrelevant or inconsistent, resulting in inadequate outputs. For example, if asked in English, it would be illogical to classify a word simultaneously as a noun, a verb, and a metaphoric or derived unit. This pattern again underscores both the stochastic nature of LLM outputs and the importance of human oversight: users must critically evaluate responses and, ideally, the model should be designed to seek clarification when prompts are ambiguous or when generating outputs that could be misleading.

The results obtained with the GPT-5 model reveal patterns similar to those observed in the earlier study by Balenović and Proroković (2025), which was based on the GPT-4o dataset used for comparison in Figure 2. In both cases, the same inverse relationship emerges between the frequency of a loanword in Croatian and the number of meanings that the model attributes to it: words occurring less frequently in the L2 context are typically associated with a greater number of senses. On the other hand, the number

of different word classes suggested by the AI models either rise with the frequency of the loanwords or remain stable.

Figure 2. Comparing GPT4o and GPT5 outputs in relation to loanword frequency and the number of meanings per prompt



As far as the number of reverse proportionality in the sense-frequency relationship, Balenović and Proroković argued that one plausible explanation for this trend was in the model's access to data. For more frequent items, the abundance of contextual evidence enables the model to delimit meanings more precisely, resulting in fewer but more accurate senses. Conversely, for low-frequency loanwords, the scarcity of L2 examples leads the model to overgeneralize, often transferring semantic distinctions from English into Croatian contexts where they are not attested. While the GPT-5 model demonstrates moderate improvement over its predecessor in managing these distinctions, the same tendency persists: the model continues to exhibit semantic inflation for less commonly used loanwords (cf. Table 1). This suggests that the problem is not merely one of model architecture, but of data distribution and representativeness. As the previous authors note, such outcomes may also be affected by the corpus compilation methodology (in this case, the ENGRI corpus) which, being domain-specific, could skew frequency counts and thereby influence interpretive results. Further comparative testing on non-domain-specific datasets could therefore help determine whether these trends are intrinsic to the model's processing or contingent upon corpus design.

3.3 Inferential Statistics: Frequency Effects on Polysemy and Word Class Variation

A one-way ANOVA was conducted to examine the effect of loanword frequency in the L2 (Croatian) on two dependent variables: (1) the number of word senses that the GPT-5 model generated for each item in Croatian, and (2) the number of distinct word classes assigned to those items. The analysis revealed a statistically significant effect of frequency category on the number of word senses, $F(2, 78) = 3.9565, p = .02309$. As shown in Figure 3, the mean number of senses increased as frequency decreased, suggesting that less frequent loanwords tended to exhibit a greater range of semantic interpretations in Croatian. In other words, with the decline in the frequency of a loanword in L2, there is a rise in the number of senses it exhibits in GPT-5's output. Conversely, the results for word classes indicated the opposite trend. The one-way ANOVA for word class variation yielded a significant main effect of frequency, $F(2, 78) = 15.791, p < .001$. As displayed in Figure 3, the number of distinct word classes generated by the model decreased with lower-frequency items. This inverse relationship suggests that while GPT-5 tends to overgeneralize semantically when examples are sparse, it remains more constrained grammatically under similar conditions.

This pattern aligns with the descriptive findings and further supports the interpretation that, for low-frequency loanwords, the scarcity of L2 evidence in the input data may lead the model to transfer semantic distinctions from English into Croatian contexts where such senses are not attested. On the other hand, the more stable and proportionally narrower distribution of word classes may indicate that the model, when not constrained by prompts demanding elaborate output (the implication being that the ask for the number of possible word classes is inherently one less demanding), achieves greater accuracy. This asymmetry highlights the complex relationship between input frequency, lexical representation, and model behaviour.

The correlation matrix presented in Table 5 examines the relationship between GPT-4o and GPT-5 outputs for the number of word senses and word classes generated for English loanwords in Croatian, alongside their frequency in the L2. The analysis reveals a significant positive correlation between GPT-4o and GPT-5 in the number of senses assigned to the same items ($r = .42, p < .01$), indicating a consistent trend across models in how they semantically interpret loanwords in Croatian. In other words, when GPT-4o generated a greater number of senses for a given word, GPT-5 tended to do

the same, suggesting a shared underlying representational bias or overlap in their training data and lexical mapping.

Figure 3. One-Way ANOVA analysis for frequency-polysemy relationship in GPT-5 model when it comes to both word senses and word classes

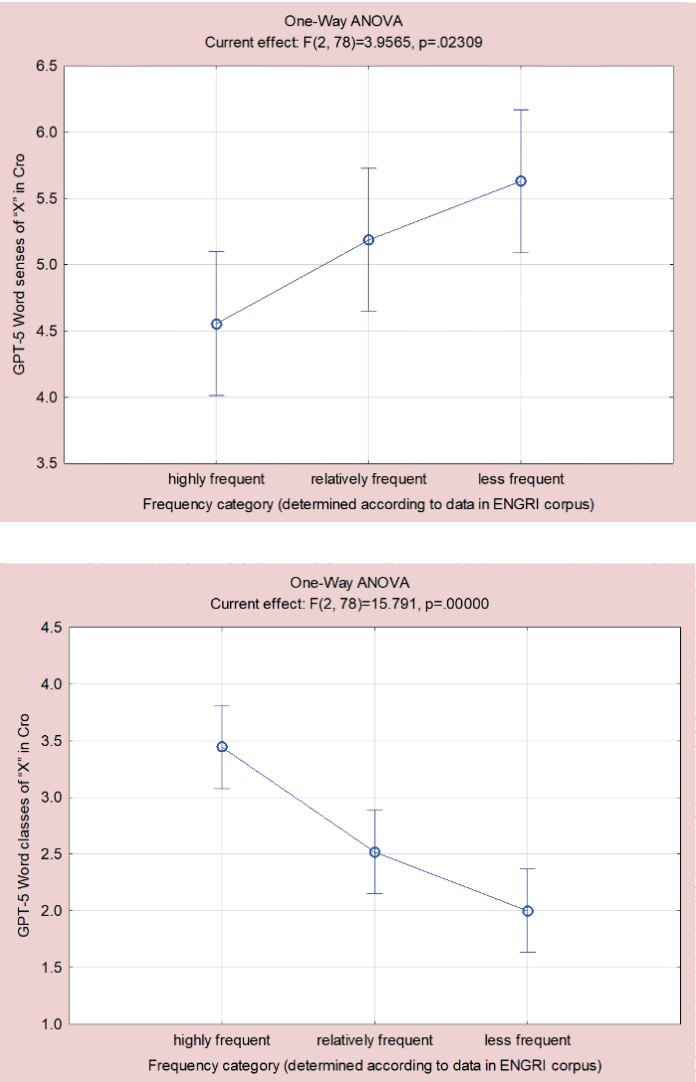


Table 5. Correlation matrix concerning output sense frequency trends across the two examined models (GPT-4o and GPT-5)

	GPT-4o Senses of "X" in Cro	GPT-4o Word class of "X" in Cro	GPT-5 Senses of "X" in Cro	GPT-5 Word class of "X" in Cro	Loanword frequency in Croatian
GPT-4o Senses of "X" in Cro	1.00	0.11	0.42**	-0.01	-0.25*
GPT-4o Word class of "X" in Cro		1.00	0.22	0.14	0.09
GPT-5 Senses of "X" in Cro			1.00	-0.00	-0.09
GPT-5 Word class of "X" in Cro				1.00	0.28*
Loanword frequency in Croatian					1.00

* $p < 0.05$; ** $p < 0.01$

In contrast, the correlation between word class variation and frequency was positive but modest ($r = .28$, $p < .05$ for GPT-5), indicating that more frequent loanwords are associated with a greater diversity of syntactic realizations, a result that complements the ANOVA findings. No significant cross-model correlation was observed for word classes, implying that GPT-5 and GPT-4o diverge more in grammatical than in semantic mapping when producing Croatian output. Taken together, these results suggest that both models exhibit a consistent pattern in their semantic behavior, but GPT-5's outputs remain more stable and contextually constrained in terms of grammatical categorization, thus potentially supporting the view that model evolution between GPT-4o and GPT-5 primarily refines morphological and syntactic inference, while maintaining a similar approach to lexical-semantic generalization though this inference remains beyond the aims and scope of this paper and analysis.

4 Discussion

Out of the issues recently compiled by the European Data Protection Board in *AI Privacy Risks & Mitigations—Large Language Models (LLMs)* (Barberá, 2025), including context-related knowledge limitations, lack of robustness,

and variability in training data quality, the challenge most relevant to this study concerns prompt design and input quality. As noted in the report, LLMs are highly sensitive to the phrasing of inputs, with minor variations in prompt formulation often leading to drastically different outputs (pp. 22–23). In the context of this research, it is useful to highlight a related phenomenon that is not explicitly underscored in Barberá (2025): even when identical prompts are submitted in separate, newly initiated sessions, the model frequently produces different outputs. In this study, the only variable affecting these inter-prompt differences is the specific loanword being analyzed. This observation reinforces the stochastic nature of LLM responses: output variability is not solely a function of prompt formulation but also of inherent model randomness. The model may offer diverse avenues for defining the same loanword in an L2 context, reflecting a degree of unpredictability that must be taken into account in lexicographic applications.

Furthermore, the educational implications of this lexicographic research are highly relevant in the context of integrating AI into language learning, and they seem to go far beyond the quality of the model's output; they concern the quality of the input—that is, what and how users ask. Even when an AI system is technically accurate and contextually fluent, its performance remains bounded by the specificity and appropriateness of the prompt it receives. A poorly designed prompt can easily yield an answer that is formally correct yet functionally misleading: it may fail to provide the information the user actually intended to retrieve. In this sense, the “failure” of the AI lies precisely in its success; it performs its task with perfect obedience to the input, yet lacks the inferential, social, and contextual awareness that a human interlocutor would naturally apply to interpret the learner's intent. These implications align well with recent findings indicating that users of AI models have to develop the metacognitive ability to evaluate whether the data retrieved truly satisfies the learning task at hand (Woo et al., 2024; Kang et al., 2025; Kim et al., 2025), suggesting that human–AI co-agency in language learning is one of the ways to mediate the negative effects (cf. Alm, 2025; Ciocan, 2025). Ultimately, as Liu, Chen, and Xu (2025) demonstrate, AI tools are not (yet) sufficient to simply replace traditional learning instruments, but instead are to reshape the learner's relationship when it comes to knowledge retrieval and evaluation, making reflective engagement and guided mediation more crucial than ever.

Unlike human teachers, who rely on pragmatic and paralinguistic cues to infer a learner's communicative goals, AI systems cannot read beyond the literal formulation of the query. They respond to “what is asked”, not

necessarily to “what is meant”. This asymmetry highlights a critical limit of learner autonomy in AI-mediated learning environments: effective interaction with AI presupposes a high level of prompt literacy: the ability to formulate questions precisely, interpret responses critically, and assess whether the output aligns with one’s learning objectives. Without such literacy, learners risk misinterpreting or over-trusting outputs that, while linguistically plausible, may not serve their intended purpose. Moreover, this issue may be even more relevant in the context of response accuracy; i.e., user’s lack of critical reflection is not only problematic in relation to ChatGPT’s responses failure to address the intended purpose of the prompt, but further amplifies with the possibility of said AI model to provide accurate or truthful answers. This is another issue identified by Barberá (2025), which she labels as inadequate calibration, resulting in model overconfidence. This study firmly corroborates that observation: the AI often provides unattested examples of loanwords in Croatian with high confidence. Correcting such errors requires an interlocutor who not only recognizes the mistake but is also capable of critically evaluating the AI’s output. Consequently, effective interaction with LLMs demands that human users possess both sufficient linguistic competence and a healthy degree of skepticism, enabling them to challenge and refine the model’s responses (cf. Spatola, 2024).

Additionally, the results also clearly outlined the inverse relationship between frequency and polysemy which, as represented in the model’s output, runs counter to linguistic expectations. Typically, corpus-based studies demonstrate that polysemy correlates positively with frequency, since more frequent lexical items tend to develop extended senses through broader contextual use (see Zipf, 1949; Ferrer-i-Cancho, 2014; Casas et al., 2019; Ferrer-i-Cancho & Vitevitch, 2018 and others). Yet, the model’s responses suggest that when an English loanword becomes more frequent in Croatian, the AI attributes fewer potential senses to it. Moreover, one might expect the opposite trend in the L1 context if polysemy were indeed a factor influencing borrowing; i.e., that the likelihood of a word being adopted into Croatian increases with its semantic versatility in English (cf. Chesley & Baayen, 2010; Ingham, 2024). However, this correlation does not appear in the results either (cf. Calude et al., 2020). Together, these findings suggest that while GPT-5 demonstrates considerable lexical sensitivity, it does not model frequency-based semantic extensions in a human-like manner, and thus fails to replicate expected relationships between loanword frequency, semantic range, and contextual adaptability.

5 Conclusion

This study underscores the growing importance of cross-linguistic lexicographic research that integrates artificial intelligence tools. This type of research can help us, not only advance our understanding of how large language models process meaning and context across languages, but also understand broader pedagogical implications for how AI is to be used in educational settings. In this sense, the findings presented here highlight two major observations:

- (1) In the educational and lexicographic context, the most important implication of this research lies in highlighting the user's responsibility to approach AI-generated linguistic data critically. While large language models such as GPT-5 can provide comprehensive and often insightful lexical analyses, they also display a non-negligible degree of inaccuracy and contextual misalignment. Consequently, users who are insufficiently aware of these limitations (or lack the requisite competence to assess them), risk accepting flawed or misleading interpretations as accurate. This underlines the need to develop not only linguistic and lexicographic literacy but also AI literacy: the ability to design precise prompts, to recognize the boundaries of model reliability, and to maintain a healthy degree of skepticism when interpreting outputs.
- (2) The results further confirm the observations made by Balenović and Proroković (2025), indicating that GPT-based models, despite notable advances, still exhibit inconsistency in distinguishing between the senses of English loanwords used in Croatian (L2) contexts. The findings suggest that the less frequent a loanword is in everyday Croatian use, the higher the likelihood of the model overgeneralizing from its English (L1) counterpart; i.e., often extending senses that are not attested in the recipient language. Moreover, the comparative analysis between GPT-5 and GPT-4o reveals similar tendencies, with counterintuitive results showing a greater number of proposed senses for high-frequency items. This pattern appears to reflect ChatGPT's inclination to prioritize response generation over precision, where overgeneralization and L1-to-L2 semantic transfer contribute to inflated sense counts in less frequent or semantically ambiguous categories.

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Abstrakt: Tento výzkum replikuje experimentální design Balenoviće a Prorokoviće (2025) na stejném lexikálním datovém souboru a zkoumá, zda model GPT-5 poskytuje přesnější, kontextově vhodnější a jazykově diferencovanější lexikografický výstup, pokud jde o významy a použití anglických přejatých slov v chorvatštině. Cílem je dále zjistit, jak se definice, kontextové příklady a rozdělení významů modelu GPT-5 kvalitativně a kvantitativně liší od těch, které produkuje model GPT-4o. Navzdory zlepšením výsledky ukazují, že model GPT-5 nadále vykazuje systematické slabiny v kontextu L2, zejména u málo frekventovaných přejatých slov. Ačkoli ne výlučně, stejně jako v GPT-4o, méně doložené položky vyvolávají vyšší míru nadměrné generalizace z L1 do L2, což vede k neověřeným nebo sémanticky nepravděpodobným použitím prezentovaným s vysokou mírou jistoty. Studie dospěla k závěru, že ačkoli GPT-5 představuje významný pokrok v lexikografické oblasti, jeho výkonnost zůstává při interpretaci přejatých slov v L2 nejednotná. Jinými slovy, stále se zdá, že existuje potřeba kritického lidského dohledu a vzdělávacího významu gramotnosti v oblasti AI. Nesprávná interpretace návrhu a záměru modelu ze strany modelu znamená, že rozpoznání a oprava takových chyb vyžaduje nejen povědomí uživatele, ale také jazykovou kompetenci.

Klíčová slova: velké jazykové modely (LLM), GPT-5, mezijazykové lexikografie, definice významu přejatých slov, nadměrná generalizace a přehnaná sebejistota umělé inteligence

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From Theory to Practice: Implementing Maria Montessori's Pedagogy in Various Types of Educational Institutions

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Abstract: Maria Montessori was an Italian physician and educator who developed an innovative teaching method known as the Montessori method. Her interest in education began when she worked with children with disabilities. She developed teaching methods that were adapted to the individual needs of students, focusing on their natural curiosity and ability to learn independently. The Montessori method emphasizes independence, freedom of choice, experiential learning and self-paced learning. The child is an active participant in the learning process, where self-discovery, independence, responsibility are encouraged, and the holistic approach focuses on the child's emotional, social and physical development.

Montessori pedagogy has positive opinions from principals and teachers who have worked and are working with this method. However, the attitudes of parents are more diverse.

Keywords: Maria Montessori method, children, independence, development, own pace of learning, curiosity about the world.

Introduction

In the face of dynamic changes taking place in the education system, which are becoming more and more common, and do not always fully meet social expectations. Parents and students themselves are constantly looking for alternative solutions that could meet their educational needs. In the context of searching for effective teaching methods, alternative pedagogy is gaining importance. In particular, the use of methods developed by pedagogues such as Célestin Freinet, as well as educational concepts of Waldorf schools and the educational system of Maria Montessori. They are one of the potential ways to find effective solutions in the field of education.

Research objective: The aim of this study is to analyze the functioning of Maria Montessori pedagogy in the local context, taking into account the specification and implementation of its assumptions in educational practice.

Research method: The study was conducted using qualitative methods, including interviews and observations, which allowed for collecting opinions and reflections of participants in the educational process, such as directors of institutions, coordinators of pedagogical innovation, educators, teachers and pedagogical staff. The collected data aims to identify both positive aspects and challenges related to the implementation of Montessori pedagogy in a given educational environment.

Maria Montessori (1870-1952) was one of the first women in Italy to graduate from medical school. She specialized in psychiatry, and in her early career she worked with children with intellectual disabilities. She experimented by offering children educational materials that allowed them to explore their surroundings with their senses – this brought extremely positive results. In 1907, she decided to use her knowledge and experience by opening Casa dei Bambini for children from one of the poorest districts of Rome – San Lorenzo. Here, children acquired respect for their surroundings, self-trust, independence and responsibility. At the same time, Montessori observed that young children were very early fascinated by letters and numbers. They also showed deep concentration. Maria Montessori continued to observe children, perfected her educational materials and shaped the method of education that soon also included older children. Maria Montessori spread her approach to child development by traveling all over the world: from Italy to Argentina, from Spain to England, from Holland to India. She defended children's rights. She was nominated for the Nobel Peace Prize three times. To this day, children of all ages and all over the world are educated using the Montessori method to grow into efficient, creative and sensitive adults¹.

The Montessori method emphasizes independence, freedom of choice and learning through experience. The key assumptions of this method are:

- The child is an active participant in the learning process, they are encouraged to discover and learn on their own, this supports their natural curiosity.
- The prepared environment, M. Montessori's studio is carefully designed to support children's independent exploration.

¹ M. Montessori, *The Secret of Childhood*, published by PWN SA, Warsaw 2018, p. 5.

- An individual approach, teachers observe students and adapt materials and activities to their individual needs or interests.

In natural conditions, the child's independent learning is combined with the teacher's actions and the use of acquired competences in new situations. Therefore, five stages can be distinguished in the child's activity cycle (J. S. Turner 1992).

1. Observation, on various occasions, of an activity demonstrated by a model (teacher, parents, friends) that the child is interested in and wants to master.
2. Joining the activity. The child interacts with the model, begins to cooperate at the level of their competence.
3. First independent activities. The child performs the activity many times. Learns through trial and error. Takes responsibility for the effects, becoming increasingly skilled in performing the activity.
4. Moment of revelation. The child realizes that they can do it, they already know how to act to achieve the intended goal.
5. Using acquired skills in the context of a social goal. The child feels the need to demonstrate newly acquired skills to other people and improve them. They perform the activities they have mastered with great pleasure when the opportunity arises, expresses their readiness to teach others how to perform the activities, cooperates willingly, and provides assistance.

We observe this natural learning process in almost every family and in those kindergartens and schools that work according to the Montessori principles².

Main assumptions and methods of M. Montessori's work

Preparing the environment and preparing the teacher is the practical foundation of our upbringing. The teacher's attitude must always be based on love. The child deserves the first place, and the teacher follows them and supports them (Maria Montessori)³.

² S. Guz, *The Montessori Method in Preschool and School*. Children's Education and Achievements, Maria Curie-Skłodowska University Publishing House, Lublin 2006, p. 22.

³ R. Czekalska, A. Gaj, B. Lauba, J. Matczak, A. Piecusiak, J. Sosnowska, *Odkryjmy Montessori jeszcze raz...* Program wychowania przedszkolnego, wyd. Oficyna Wydawnicza „Impuls”, Kraków 2009, s. 7.

The child in the center of attention: The Montessori method focuses on the child as an active participant in the learning process. Children are encouraged to discover and learn at their own pace.

- Montessori material, special teaching aids that are interesting and manipulative, they allow children to discover concepts and skills in a practical way. The materials are often self-correcting, which allows children to check their progress on their own.
- Prepared environment, Montessori class is precisely planned to support the child's independent learning. Teaching materials are available at your fingertips and adapted to the needs of the student, their age and skills.
- Multi-age classes, in M. Montessori classes students of different ages learn together, this promotes cooperation, mutual support and development of social skills.
- Holistic approach, M. Montessori education focuses not only on academic aspects, but also on the emotional, social and physical development of the child.
- Responsibility, independence, children are encouraged to make decisions about learning, this develops their sense of responsibility and the ability to think independently.
- Own pace of learning, children in the M. Montessori system learn at their own pace, which allows them to better acquire knowledge or skills.
- Role of the teacher, the educator in the Montessori method acts as a guide, observing children and supporting them in their individual needs and interests, instead of traditionally conducting classes.

Effects of work and methods used in Montessori pedagogy

The main goals (...) referring directly to the assumptions of M. Montessori pedagogy, are as follows:

- providing the child with a sense of security and full acceptance;
- building a positive self-image;
- developing the child's independence and eye-hand coordination;
- learning about the world based on multi-sensory experience and experimentation;
- acquiring the ability to communicate verbally and non-verbally;
- improving the ability to organize, classify and count;
- arousing interest in the natural, socio-cultural and technical reality;

- learning about universal values, such as: goodness, beauty, truth, love;
- expressing a creative attitude in various forms of children's expression;
- implementing socially acceptable behaviors;
- involving the child's family in the process of their upbringing.

They are also in correlation with the goals specified in the core curriculum of preschool education for preschools, preschool departments in primary schools and in other forms of preschool education⁴.

The main effects of the methods used in Montessori pedagogy are primarily: independence, creativity, social skills, interest in learning, internal discipline.

The main ideas of Montessori pedagogy: learning by doing, self-education, concentration, feeling silence, order, observation, presenting material, individual course of study, free choice of work⁵.

The Montessori method aims to support the natural development of children and unleash their potential by creating appropriate conditions for learning and discovering the world.

- Individual approach - Children work at their own pace, which allows them to adapt learning to their individual needs and interests.
- Working in mixed-age groups - Children of different ages learn together, which promotes the exchange of experiences and mutual help as well as the development of leadership skills.
- Learning by doing - Children learn through practical experiences, which makes knowledge more accessible, understandable and lasting.
- Open environment - Montessori classrooms are designed to be friendly, stimulating, with easy access to various teaching materials.
- Sensory materials - Using special teaching materials and toys that engage children's senses, e.g. different shapes, colors, textures, to help them learn through experience.

Global Influence - The Montessori Method has gained popularity around the world and there are now many Montessori educational institutions that apply its principles. The method is used in a variety of contexts, from pre-school to high school.

⁴ Ibid., p. 5.

⁵ G. Badura-Strzelczyk, Help me do it myself. How to use Maria Montessori's ideas in modern times, published by Oficyna Wydawnicza "Impuls", Kraków 1998, p. 140.

- Education of the Whole Child - Montessori believed that education should encompass all aspects of a child's development: intellectual, social, emotional and physical. As such, her method places great emphasis on developing emotional and, consequently, social skills.
- Long-lasting Legacy - Maria Montessori died in 1952, but her educational philosophy still has a huge influence on modern teaching and education. Her methods are used in different cultures and contexts, which is evidence of their universality.

The Montessori method is valued for its flexibility and adaptation to the individual needs of children, as well as for promoting their independence and self-reliance⁶.

In the 2017/2018 school year at the Sports Championships General Education School Complex (ZSOMS) in Racibórz, the idea of introducing Maria Montessori pedagogy was born, states the school's management.

The concept concerned early school education classes. For this purpose, both the staff and the base had to be prepared. Most elementary education teachers expressed their willingness to take additional qualifications to deepen their knowledge, skills and competences in the area of M. Montessori pedagogy methods and techniques. The teachers working in the after-school club, the catechist and the boarding school manager also decided to expand and supplement their qualifications. This is a large team that motivated, inspired and very effectively complemented each other. Only in a group, which also had its own separate building, could the planned undertakings be achieved. Then came the time to create the appropriate base. It was necessary to allocate an appropriate room, with the right floor, carpet, new furniture, a place to rest, without desks, supplemented with toys and didactic aids preferred in M. Montessori's pedagogy.

The undertaking was not easy in the context of the fact that the school always lacked financial resources for teaching aids or furniture and replacing floors. Another difficulty was to find a free, large room, i.e. a new classroom. After several arduous months, the classroom was prepared. The new room was called the "Room of Silence". Classes were held there for students of grades I-III, for children staying in the common room and even for those who wanted to stay in the boarding school. These classes often had the

⁶ <https://www.montessori.info.pl> › dr-maria-montessori, <https://www.montessori-centrum.pl/>

character of a reward. The children knew that we were quiet there, that they could choose toys or teaching aids and work on them at will in a place they chose themselves (a table, a desk, a sofa, etc.), but later they would return them to the place they had taken them from and in the same condition as they were, i.e. not damaged. We do not take toys or teaching aids, we do not compete, everyone works at their own pace and in accordance with their interests. Students do what gives them pleasure, what they like and what they can do best. They willingly reach for what is new, different and interesting. In this way, they develop their creativity, stimulate their interests and consolidate the competences and skills they already have. And all under the watchful eye of a guide, a teacher.

The parents of the students were happy to accept these novelties, even supported them. They had previously been introduced to the principles of M. Montessori's pedagogy and accepted this idea. In the local environment, this pedagogical innovation gained great approval.

The Pedagogical Council of the Complex of General Education Schools of Sports Championship in Racibórz accepted this concept in the form of an original program and accepted it for implementation.

The new recruitment to the first grades, where it was possible to create another new 25-person class for the first grade, showed that there is a need for such pedagogical innovations and that parents focus on the development of their children, individualization, building creativity, independence and responsibility⁷.

Reflections and opinions of the director of ZSOMS in Racibórz

- The M. Montessori method allows for adapting learning to the individual needs and pace of development of each child.
- Children taught in the Montessori system become more independent and responsible. They are given space to make decisions, and this develops their critical thinking skills.
- The M. Montessori pedagogy enables exceptional social development, working in groups teaches children cooperation, empathy and conflict resolution.

⁷ Interview with the director of the Sports Championship General Education School Complex (ZSOMS) in Racibórz, 20/22/2024. Material at the author's disposal.

- The Montessori method does not focus only on academic and theoretical aspects but also on the emotional, social and physical development of the child - a holistic approach
- Unleashing curiosity about the world and engaging in various activities is one of the advantages of the M. Montessori pedagogy
- This method enables positive educational experiences, develops independence, creativity and the ability to make decisions. Students often feel more motivated to learn because they have more freedom in choosing topics and ways of working
- The M. Montessori pedagogy strengthens and promotes social skills. Children often work in groups, which allows them to develop communication and interpersonal skills.
- Preparation for life by teaching children organization, time management and responsibility for their own actions, which is important in adult life, including sensitivity to diversity, where diversity and inclusiveness are often emphasized.

Here are some opinions and observations of people working with children based on this method - opinion of the coordinator of Montessori pedagogy at ZSOMS in Racibórz:

- Students like Montessori classes because they are different.
- They willingly participate in classes using new methods and techniques because it is something interesting and new.
- In Montessori pedagogy, there are other toys and teaching aids, so they are not associated with a classic lesson.
- Students work at their own pace.
- Children use the toys and teaching aids that interest them the most.
- Students can work in silence and in a place of their choice, not at a desk.
- Children who work with the Montessori method develop faster, are more creative and curious about the world.
- In higher grades, they achieve better teaching results than their peers⁸.

Another educational institution that has implemented Maria Montessori's methods and techniques is the non-public Kindergarten in Kornica.

⁸ Interview with the director and teachers of ZSOMS in Racibórz, 20/11/2024. Material at the author's disposal.

Reflections of the person acting as the director of this non-public kindergarten:

- Every kindergarten wants novelties, interesting visions and missions in its institution, this builds its image in the local and educational environment.
- Pedagogical innovations are eagerly introduced, which are based on the interests of teachers and parents (some of them).
- Two groups of children were created in the kindergarten - standard and conducted which used the Montessori pedagogy method.
- Opinion of the group's educator and the teacher's assistant in the group.
- Small groups in which classes are conducted.
- Significant cognitive development in children.
- Great interest of children in new didactic toys⁹.

On March 18, 2024, at the scientific conference - XVII Racibórz Pedagogical Seminar "Psychosocial and cultural functioning of the young generation in the current world", representatives of the kindergarten: Małgorzata Herbert and Sylwia Krakowczyk presented in their speech entitled "Functioning of Maria Montessori's pedagogy in educational institutions". It was a unique opportunity to present the workshop and effects that this type of alternative pedagogy brings.

Statement of the director of the Private Kindergarten in Kornica: in our kindergarten, the most important place is occupied by the child, experiencing subjectivity all the time. The basis is their natural upbringing, taking into account the child's right to development, to master the reality that surrounds them, in an interesting, engaging way, adapted to their needs and possibilities, giving them satisfaction and leading to success. So that they feel the need to acquire knowledge, self-development and improvement.

In the essence of the concept of education as a process of releasing the child's potential, the most important role is played by a properly prepared environment.

The space of the room is simple, bright forms, uniform colors, dominated by natural wood, which creates a warm, friendly atmosphere, creates the opportunity to concentrate, to polarize attention, to calm down, at the

⁹ Interview with a person performing duties of the Private Kindergarten in Kornica, 21/11/2024. Material at the author's disposal.

same time it is designed to ensure the child's need for movement, manipulation and activity.

Shelves, tables, chairs, and even toilets and sinks - all of this is adapted to the child's height. Aesthetically made, top quality, usually wooden material is at the child's fingertips and there is only one. After finishing work, the child is obliged to prepare a given material for the next child and put it back in its place, which shapes in them a sense of responsibility for the environment and comfort of work for the second child.

The entire space, organized in a way that is clear to the child, is divided into five zones:

Everyday life – introductory exercises that allow them to learn the general rules that govern the group, while also preparing children for independence.

They learn how to spread a rug, move a chair, arrange tables, carry trays with material, develop fine motor skills: for example, they pin clothespins, punch a specific shape, sweep or wash floors, clean tables.

They learn self-service – wiping their noses, using the toilet, fastening buttons, tying bows.

They prepare food – they cut apples, bananas, peel carrots, prepare a fruit salad or squeeze orange juice and then help each other.

They take care of the environment – they water flowers, wash dishes after each other, do laundry.

Sensorics section – a kind of training for children's senses:

Children exercise their sense of sight, experience dimensions, estimating size, height, width, length, learn colours, shapes of flat or solid figures.

They train their sense of touch – rough, smooth, touch different fabrics, check what is lighter and what is heavier, what is cold and what is warm.

They improve their sense of taste and smell, sharpen their sense of hearing (murmur cans), and also develop in the musical field.

My favorite section – Mathematics.

Children experience the shape of numbers sensorially - rough boards, they learn that zero is nothing by working on spindles, the most interesting and engaging Montessori material is the golden material, where the child has the opportunity to learn the concepts of quantity, tens, hundreds or thousands and in a very vivid way move from the concrete to the abstract. They experience sensorially, and then move on to work on symbols, a five- and

sometimes even four-year-old child can add large numbers, multiply, subtract and divide, combining the concrete (golden pearls) with the abstract (graphic symbols of numbers), they learn "teens", "tens", on Seguin boards (Segena).

My second favorite section – Language

This is the section in which children:

Develop their vocabulary by working with rhyme cards, opposites, cards enriching vocabulary, so-called tripartite cards and scientific cards.

Work with rough letters, listen to the first sounds at the beginning of a word, practice writing - they work with metal frames, write in the sand, with chalk on a blackboard, on squared paper.

Build words from a movable alphabet, read starting from the so-called pink material, through blue, green, ending with independent reading of books.

Attention, now my most favorite section of all favorite sections because here is the whole Universe!

Culture, also known as universe, allows children to:

Get to know the world around them from the general to the specific, and therefore - the solar system, our planet, what land, water, air, oceans, continents and atmosphere are, what countries are part of Europe and what provinces make up Poland, the terrain.

Discovery of 5 vertebrate classes, their representatives and structure.

Getting closer to the world of plants - getting to know the structure of a tree, flower, leaf, development cycles of animals and plants. Getting to know the names of months, days, weeks, development cycles of animals and plants.

The entire multitude of materials gathered in these sections, and in my kindergarten we basically have a complete set of them, which should be in a Montessori facility, is subject to certain rules:

- materials are in single copies and single sets
- they are used in accordance with their intended purpose
- the child works with the material where they have chosen the place, without disturbing other children or the teacher
- if they are working with the material they have chosen, they work from beginning to end, if the material requires it, the child completes it, preparing it for the next child and puts it back on the shelf.

It is worth noting that in one of our schools in Racibórz, with the great commitment of the then management and teaching staff, a pedagogical innovation was introduced, opening up opportunities for children and young people to acquire knowledge, develop their potential and broaden their horizons.

A workshop was created with developmental materials according to Maria Montessori's assumptions, which, as we have already mentioned, develop individual personality traits, formulate a correct character, help in acquiring knowledge, school skills and cooperation.

Independence is important: children freely choose the type, place, time and form of work.

Concentration: children practice accuracy and perseverance in performing specific tasks.

Order: children acquire the ability to follow the rules of order in the environment and in their actions¹⁰.

According to the statements of the teachers of ZSOMS in Racibórz, using Maria Montessori's pedagogy, each child works at their own pace, and elementary school students have the opportunity to choose material according to their interests or passions.

Silence lessons: children learn to work in quiet individual and group classes.

Silence lessons

It may be hard to believe that Maria Montessori discovered the invaluable role of silence in the upbringing and development of children. Today, it seems almost unbelievable that she introduced the experience and practice of silence into pedagogy over a hundred years ago. We are all overwhelmed by an avalanche of external stimuli. Nowadays, children lack silence, they need it more and more, because they are overstimulated by sounds and images. Such situations cause a feeling of overexcitation or internal chaos. Children are loud or lost in noise. Montessori silence lessons, i.e. short exercises based on performing various activities without saying words. It is walking in silence around an ellipse, carrying an object, a bell, listening to the sounds of the surroundings, touching objects without saying words. This is accompanied by great concentration and coordination of movements.

¹⁰ Interview with a person performing duties of the Private Kindergarten in Kornica, 21/11/2024. Material at the author's disposal.

Silence lessons are of great importance in the development of every child, who becomes calmer, behaves more quietly, and thus it is easier for him to acquire new knowledge. The difference is the ordered external silence, in schools and the school classroom, it is only a temporary "cessation of noise". A silence lesson is never a way to calm down a group, but results from the perception of children's readiness for such an experience, the child himself / herself wants and needs it. Silence is a treasure for the child's development.

The role of the teacher

The teacher treats children with attention and respect, each child is important and unique to them.

In individual work with the child, the teacher takes care of their **intellectual, emotional, social development** in accordance with Maria Montessori's pedagogy, so that they can love and respect themselves, other people and the world.

Thanks to thorough observation, the teacher can recognize the needs of the child.

Observation is nothing more than allowing children to express themselves freely.

The child himself shows us what is important to them, what they need. Their behaviors are suppressed and hidden if they are in an inappropriate environment that does not allow them to be spontaneously active. The teacher observes what the child needs and tries to prepare the environment for their needs.

The teacher is a guide who intrigues the child with the environment and the material, does not interfere, but helps, is one step behind the child, supports and motivates to act.

The teacher does not have to evaluate, correct, praise, because the information contained in the material allows the child to check the correctness of the work done, find a mistake and correct it, most often the material has control cards.

The advantages of the Maria Montessori method are:

Individual approach to each student. Children learn willingly. They do not need and do not expect external motivation in the form of a reward.

Students avoid stress and criticism that their peers often struggle with in traditional schools.

Montessori education is focused on developing talents, finding passions, teaching independence, responsibility, teamwork and respect for others. Students master the material better, maintain concentration on one activity more easily, acquire social skills and learn the rules that govern the group (no harm, no destruction and no interference). Their obedience results from self-control, not external coercion. Another advantage is mutual learning from schoolmates of different ages.

The optimal groups for work are mixed in age. This allows for easier finding of your own level of work, learning from others and teaching others.

A child learns most effectively when dealing with issues that interest them at a given moment.

All children are curious about the world. Everyone has their own interests and passions.

They learn independence, inquisitiveness, inspire each other to work, learn to work with sources, develop their interests and talents. They acquire a sense of responsibility for the time devoted to learning.

Children working with the Montessori method are smart, independent, curious, able to take the initiative and learn on their own. They learn independence, can function well and adapt to the conditions of the changing world¹¹.

Statements of the management staff and employees of the Private Kindergarten in Kornica regarding parents who are sometimes afraid of novelties and what they do not know. They themselves did not have such methods in their education, sometimes doubts arise about something new.

Lack of personal experience causes barriers in the full use of Montessori pedagogy. Parents point out that the didactic resources used in the Maria Montessori method are not common and widely available, children do not have such toys in their family homes. In order to meet the expectations of parents, elements of Maria Montessori's pedagogy are introduced, especially since children spend up to eleven hours a day in the facility, so in addition to didactic elements, care is necessary.

Since March 2000, as a member of the Montessori Europa Association, we have been providing safe care and education to children aged 6 months to high school graduation, taking care of:

- responding to the individual needs of each child,

¹¹ Interview with a teacher from ZSOMS in Racibórz, 20/11/2024. Material at the author's disposal.

- continuous development in all areas,
- awakening children's natural curiosity,
- mutual respect and cooperation,
- learning through practical action and experience.

Maria Montessori was guided by a motto that is particularly relevant today. "A child who has truly loved their environment and all living creatures, who has discovered joy and enthusiasm in work, gives us reason to hope... hope for peace in the future"¹².

Summary

The educational system of Maria Montessori, also known as the Montessori method, is one of the great, still relevant pedagogical concepts that were created in accordance with the slogan "school tailored to the child" in response to criticism of the traditional school. It is one of the best solutions for individualized education of children and youth, used in educational practice in many countries, from kindergarten to secondary school education¹³.

The vision of an educational institution is determined by the management of the institution, including people performing management functions, such as owners, directors and representatives of local governments.

There is a need to engage a group of teachers who will enthusiastically and determinedly undertake new challenges in the field of education.

Parents play a key role as essential beneficiaries in the context of pedagogical innovations. Their acceptance, consent and children's satisfaction are fundamental factors influencing the effectiveness and success of changes introduced in the educational process. The lack of parental involvement in these processes can result in significant difficulties and, in some cases, even complete impossibility of implementing innovative didactic methods. Therefore, understanding the dynamics of the relationship between parents and children and their impact on the implementation of innovations in education becomes crucial to achieving the intended pedagogical results.

I am very impressed by the captivating power of Montessori's idea, which connects people all over the world. On every continent, in every country,

¹² <https://poem.pl/>

¹³ S. Guz, Education in the Maria Montessori system, selected areas of education, vol. 1, vol. 2, Maria Curie-Skłodowska University publishing house, Lublin 2016, p. 378, p. 208.

you can find the same ideas everywhere – love for children and the desire to help them in their natural self-development (Ilona Wysmułek)¹⁴.

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Abstrakt: Maria Montessori byla italská lékařka a pedagožka, která vyvinula inovativní výukovou metodu známou jako Montessori metoda. Její zájem o vzdělávání začal, když pracovala s dětmi se zdravotním postižením. Vyvinula výukové metody přizpůsobené individuálním potřebám žáků, zaměřené na jejich přirozenou zvědavost a schopnost samostatného učení. Montessori metoda klade důraz na samostatnost, svobodu volby, zážitkové učení a učení vlastním tempem. Dítě je aktivním účastníkem procesu učení, kde

¹⁴ M. Miksza (ed.) My encounter with Maria Montessori's pedagogy, Impuls publishing house, Kraków 2023, p. 161.

je podporováno sebeobjevování, samostatnost, zodpovědnost a holistický přístup se zaměřuje na emocionální, sociální a fyzický vývoj dítěte. Montessori pedagogika má pozitivní ohlasy od ředitelů a učitelů, kteří s touto metodou pracovali a pracují. Názory rodičů jsou však rozmanitější.

Klíčová slova: metoda Marie Montessori, děti, nezávislost, vývoj, vlastní tempo učení, zvědavost o světě

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Traditional Pedagogical Currents in Czech Preprimary Education: Student Reflections and Professional Aspirations

KARIN FODOROVÁ

Abstract: Czech preschool education is defined primarily by the principles and foundations enshrined in the Framework Educational Program for Preschool Education (RVP PV), which is based on long-term stable theories of child development and learning. These theoretical foundations have not changed significantly in recent years, but changes in practice are evident in connection with new social demands – digitization, inclusion, and the integration of foreign children and two-year-olds into kindergartens. This paper presents the results of a survey among students of the Preschool Education program, focusing on whether they are determined to enter the profession after graduation and in which areas they feel the need for further education. The results show that most students plan to enter the profession, but emphasize the need for further professional development, particularly in the areas of communication, dealing with problem behavior in children, creating school educational programs, and playing the piano. The stability of the theoretical framework based on the RVP PV is perceived ambivalently by students – as support and certainty, but also as a lack of innovation. The findings may be an impetus for innovation in the university preparation of future kindergarten teachers and for planning their further professional development.

Keywords: preschool education, kindergarten teacher training students, professional development

Introduction

Preschool education in the Czech Republic has been stable for a long time, and its conceptual framework is defined by the curricular reform of the early 21st century. Since 2004, when **the Framework Educational Program for**

Preschool Education (RVP PV) was issued as a binding curricular document for kindergartens, this program has become a key starting point for the creation of school educational programs (ŠVP) in individual institutions. The obligation to comply with the RVP PV is enshrined in Section 3 of the Education Act No. 561/2004 Coll., which stipulates that a framework educational program is issued for each field of education, which is binding for the development of ŠVP. This system has ensured a high degree of continuity and uniform direction in preschool education, which can be seen as a factor of stability that has long characterized the Czech education system. However, the question arises as to whether this stability also leads to a certain stagnation, as there have been no fundamental changes to the theoretical framework since the introduction of the RVP PV.

We are currently in a period of revision of curricular documents. A revised RVP PV has been prepared for kindergartens, with mandatory implementation planned for 2026. This document brings minor changes rather than radical innovations, but an important shift is the inclusion of digital competences as part of the educational objectives. It is clear that the digital environment has long been a natural part of the social and educational context. At the European level, we can mention, for example, the Digital Education Action Plan 2021–2027 (European Commission, 2020), which emphasizes the development of digital skills in children and pupils from an early age and the need for their systematic integration into the education systems of member states. The Czech framework is thus responding with a delay to a trend that has been developing in Europe for several years. Since the introduction of the RVP PV into practice, a number of fundamental legislative changes have also been adopted that have significantly affected the practice of kindergartens. These include, in particular, the introduction **of compulsory preschool education from 2017** (Section 34a of the Education Act), the possibility of educating **two-year-old children in kindergartens from 2016**, and the extension of the principles **of inclusive education based on the 2016 amendment to the Education Act**. Inclusion in this concept includes not only children with special educational needs, but also foreign children and children from socially disadvantaged backgrounds.

All of these factors bring new challenges to practice, while the curriculum framework itself remains relatively stable. It is precisely in this context that it is appropriate to examine the expectations and preparedness of **female students** entering the profession **of kindergarten teaching**. Do they have the ambition to participate in change and innovation, or do

they focus on development in areas where they do not feel sufficiently confident to practice? This is a question that can significantly influence their future career direction. University students have the opportunity to reflect on theory and practice in a broader context than is usually the case for graduates of secondary pedagogical schools or higher vocational schools. It can therefore be assumed that their ideas about professional development are more complex and can provide valuable input for modifying the training of kindergarten teachers and for the concept of their further education.

Stability and innovation in Czech preschools

The Czech preschool education system can be described as stable, mainly thanks to **the Framework Educational Program for Preschool Education (RVP PV)**, which has been a binding curricular framework since 2004. This defines not only the content and objectives of education through five educational areas (The Child and Their Body, The Child and Their Psyche, The Child and Others, The Child and Society, The Child and the World), but also the key competencies that children should achieve by the end of the preschool period. As Syslová (2014) points out, the objectives of preschool education reflect several important pedagogical theories and approaches – personalistic, sociocognitive, and cognitive-psychological. This represents a shift from the earlier focus on the needs of society and predominantly cognitive goals towards an approach that places the child and their comprehensive personal development at the centre of attention (Methodology of Preschool Education Focused on the Didactic Aspects of Working with Children, 2019). In line with these goals, the OECD (2012) also emphasizes that one of the main criteria for quality education is the balanced development of cognitive and socio-emotional competencies. It is precisely this balance that is systematically supported, for example, by the Swedish model of early education, which is rated very highly in international comparisons. An analysis of the Czech RVP PV shows that in many respects it has similar features to the Swedish curriculum, as it also aims at the harmonious and holistic development of the child (Syslová, Borkovcová & Průcha, 2014, p. 94, cited in In Methodology of Preschool Education Focused on Didactic Aspects of Working with Children, 2019.).

The stability of the system is further supported by the **continuing education system for teaching staff (DVPP)**, which is mandatory for kindergarten teachers under Act No. 563/2004 Coll. on teaching staff. According to

Fodorová and Solich (2023), kindergarten teachers' satisfaction with the DVPP offering is not uniform. In their research, they found that teachers with less experience tend to be more satisfied with the content of the courses, while those with more than fifteen years of experience tend to be dissatisfied. More experienced teachers often state that the training offers them information and skills that they already have a good command of and have been implementing in practice for a long time. It should be emphasized that teachers with more than twenty years of experience make up a significant part of the professional population and often have secondary education obtained at secondary pedagogical schools. These schools were, and to a certain extent still are, significantly oriented towards educational components rather than professional and diagnostic competencies. More experienced teachers therefore declare less confidence in areas that are currently essential for practice – especially in working with children with special educational needs and in pedagogical diagnostics, which is now also emphasized in the revised Framework Educational Program for Pre-school Education (Fodorová & Solich, 2023).

Foreign research points out that effective professional education for teachers cannot be reduced to one-off participation in courses or workshops. Fleming and Kleinhenz (2007) emphasize that effective professional learning consists of creating a context and methods that support the frequency and quality of professional reflection on the deeper aspects of pedagogical practice. This approach to education enables teachers to collectively address real problems related to the difference between expected and achieved educational outcomes (Hawley & Valli, 1999, as cited in Fleming & Kleinhenz, 2007). In contrast to so-called "front-end" (superficial) professional learning, which is based primarily on participation in formal courses, Fleming and Kleinhenz (2007) describe "back-end" (deep) professional learning. This provides teachers with the space and support to test new approaches directly in their classrooms (Fullan, 1982, as cited in Fleming & Kleinhenz, 2007). In line with this concept, Soltis (1993, as cited in Collinson et al., 2009) adds that the role of the teacher is no longer seen as static, but as an active process of change in which learning becomes an adventure in meaning-making. Similar aspects are also highlighted by Vujičić and Čamber Tambolaš (2017), who consider the professional development of early childhood teachers to be a key tool for transforming the culture of the entire institution. They point out that professional learning is not only a process of acquiring new skills, but also

a mechanism that changes the way institutions share values, collaborate, and reflect on their own pedagogical practice. This approach leads to the creation of a learning community in which educators become active co-creators of the school culture. This framework is consistent with modern theories of professional learning based on self-reflection, collaboration, and experience sharing, which support teachers as autonomous and reflective professionals.

When it comes to innovation and alternative approaches, more experienced teachers express an increased need for further training in educational programs such as Montessori, Waldorf, and *Začít spolu* (Fodorová, 2024). These programs are perceived as inspiring because they offer new perspectives on the individualization of education, a partnership approach to children, and the development of creativity and self-regulation. This trend shows that while the curricular framework and its conceptual foundations remain stable, innovation in Czech preschool education is mainly driven by alternative methods and approaches. Innovation thus often comes from the bottom up—that is, from the initiative of teachers themselves, who are looking for new ways to connect traditional pedagogical principles with the current needs of children and society.

An interesting question for our research remains how students in the bachelor's program in Preschool Education view the current situation. One may ask whether they also feel the need for fundamental changes and innovations, or whether they focus primarily on developing practical skills in which they are not yet confident. The need for innovation is also reflected in the OECD report (2021), which points out that in the European context, the emphasis in early education is shifting towards diversification of methods, inclusive and individualized approaches, and systematic support for the professional growth of educators.

Sustainability in kindergarten: students' perspectives and international inspiration

In the Czech environment, the issue of sustainability in kindergarten is gradually beginning to be reflected in the training of future teachers. Research shows that students of preschool education perceive environmental development and responsibility towards nature as an important part of their future professional role, but often lack systematic education in ESD (Education for Sustainable Development). In undergraduate training, it is therefore desirable to strengthen students' competencies not only in environmental

behavior, but also in the social and economic dimensions of sustainability, as recommended by OMEP.

To monitor and support sustainable development in preschool education, an evaluation tool for assessing sustainable development in kindergartens was created, based on the international Education for Sustainable Development (ESD) Rating Scale and adapted to the Czech environment as "Preschool Education for Sustainable Development" (2019). This tool allows teachers and students to reflect on the conditions, processes, and educational strategies leading to sustainability () and serves as a means of self-evaluation for kindergartens. Its aim is not to compare schools with each other, but to encourage self-reflection and develop the quality of the educational process in relation to the principles of sustainable development (OMEP, 2019). For Czech universities that train teachers for preschool education, the key challenge is to transfer the principles of sustainability into teaching and student practice—that is, to teach them how to help children understand the world through active discovery, participation, and responsible decision-making (Syslová & Najvarová, 2021; MŠMT, 2021). Experience from OMEP ESD projects and the results of Czech bachelor's and master's theses (e.g., Koptišová, 2021; Véllová, 2022) confirm that the topic of sustainability in kindergartens is gaining increasing attention among students and contributing to their professional maturation.

The importance of this approach is also highlighted by an international study from Greece (Papavasileiou et al., 2017), which shows that preschool education students perceive sustainability as a broader educational framework that goes beyond mere environmental education. They emphasize experiential learning, values of responsibility, empathy, and solidarity, while they have a weaker understanding of systems thinking and the importance of local knowledge in a globalized world. The study also points to the importance of children's participation in decision-making and rule-making in kindergarten, which promotes the development of responsibility and civic competencies. These findings suggest a need to strengthen the environmental and sustainability dimension of future teacher training as a cross-cutting value permeating all areas of education (Papavasileiou et al., 2017).

Studies from Finland (Härkönen, 2003) also provide inspiring ideas for discussion about sustainable kindergartens. For more than three decades, theoretical frameworks for early and preschool education have been in place there, which also serve as a starting point for education

for sustainability. These include Bronfenbrenner's ecological approach emphasizing the relationships between the child, family, and environment; Vygotsky's sociocultural theory of development emphasizing interaction and cooperation; and constructivist learning theories focused on the active formation of knowledge. These approaches show that sustainability cannot be understood merely as a thematic area, but as a systemic principle permeating all education. The Finnish reflection further points out that each of these theoretical frameworks has its benefits and limitations, and therefore it is desirable to create a comprehensive model that links ecological, psychological, and sociocultural aspects. Such a framework allows us to understand children as active participants in education, whose development is closely linked to the environment, community, and global challenges (Härkönen, 2003).

Another European inspiration that strongly emphasizes the environmental dimension of preschool education is the Swedish model. The first curriculum document from 1998 already established environmental education as an integral part of preschool education (Halldén, 2011). The new Lpfö 18 curriculum (Skolverket, 2018a) subsequently explicitly incorporated the concept of education for sustainable development (ESD) (Borg, 2019). Swedish kindergartens can obtain "Green Flag" certification or the designation "Preschool for Sustainable Development." Both programs are based on the principle of a whole-school approach, in which sustainability permeates not only the educational content, but also school management and cooperation with families and the wider community (Henderson & Tilbury, 2004; UNESCO, 2017; Borg, 2019). Research shows that educators link environmental, social, and economic dimensions through thematic units, such as "Human and Planetary Health." However, the most difficult aspect seems to be incorporating the economic dimension, which is often reduced to energy conservation and recycling (Ärlemalm-Hagsér, 2013; Davis, 2008). Nevertheless, children around the age of six are already able to understand basic social and economic relationships (Borg, 2017b), suggesting that kindergarten can be a place where these issues are raised and developed naturally (Borg, 2019). A key element of the Swedish model is child participation—their active involvement in planning activities and deciding on the form of educational projects, for example, as part of the Earth Hour event. This approach promotes responsibility, empathy, and meaningful learning and shows that even young children can be active co-creators of the environment in which they live (Borg, 2019).

From the approaches presented, it is clear that a sustainable kindergarten is not just a pedagogical ideal, but a concrete framework that combines tradition with innovation and also has an impact on the professional training of future teachers. In the case of our students, it can be assumed that they do not perceive sustainability issues in isolation, but in the context of their own professional development and their vision of what kind of teachers they want to be. Although their attention is often focused on acquiring the basic didactic and practical skills necessary to enter the profession, their attitudes also reveal an effort to think about education in a broader social context. Sustainability becomes both a challenge and an opportunity for them to connect the traditional methodological foundations of Czech preschool education with the new priorities of the present. In this regard, their responsibility is key – their desire to be high-quality and professionally competent teachers motivates them to pursue further education. The following chapter therefore presents the results of an analysis focused on the professional needs of our students, specifically what they are unsure about when entering the profession and in which areas they want to develop further.

Analysis

The aim of the research was to find out how students of the Preschool Education study program reflect on traditional pedagogical approaches embedded in Czech preschool education and what their professional aspirations are in the context of current social demands, especially in relation to innovations and the sustainability of the preschool teacher profession. The research focused on the subjectively perceived readiness to perform the profession, the degree of professional motivation, concerns associated with entering the profession, and areas in which students identify the need for further education.

The research was conducted in the form of a quantitative questionnaire survey. A self-designed questionnaire was used, which contained mainly closed items with the option of one or more answers, or the addition of a free response. The content of the items was designed to capture the students' attitudes towards traditional pedagogical approaches in Czech preschool education, professional readiness and aspirations, while also responding to current trends emphasized in the RVP PV (e.g., inclusion, working with a heterogeneous group of children, communication with parents, use of digital technologies).

The research survey was conducted among 29 third-year students of the bachelor's program. The data were processed using descriptive statistics. The absolute frequencies and percentage representations of individual responses were calculated, which made it possible to identify the prevailing trends in the attitudes and planned professional direction of future teachers. The results were interpreted in relation to the current state and development trends in Czech and international preschool education, with a specific emphasis on the relationship between traditional pedagogical approaches and current innovations in kindergarten practice. The research was conducted in accordance with the ethical principles of pedagogical research. Participation was voluntary and anonymous, and participants were informed about the purpose of the survey and given the option to withdraw at any time. The data obtained was used exclusively for the purposes of this study.

The results showed that the most significant motivating factor for entering the study was clearly an interest in working with children, which was mentioned by 21 students (72%). Other motives mentioned were the opportunity for creative and meaningful work (7 respondents; 24%) and the influence of family and surroundings (4 students; 14%). None of the respondents mentioned motivation based on job security in the public sector. It can therefore be concluded that students in this field enter undergraduate training with predominantly value-oriented expectations.

In terms of subjective perceptions of readiness to practice the profession, 18 students (62%) feel somewhat or definitely prepared, while 4 respondents (13%) reported a neutral attitude and only one student (3%) feels somewhat unprepared. Although the results show a predominantly positive assessment, there are areas of uncertainty that may negatively affect entry into practice.

In terms of career plans after graduation, 18 students (62%) plan to start working in a kindergarten, with 11 of them declaring their decision to be firm. Two students (7%) state that they do not plan to start working in a kindergarten, and the same number are undecided. This data is significant in terms of the risk of possible departure from the profession at an early stage of their careers. Similarly, 15 students (52%) report expectations related to long-term career prospects, while 6 (21%) are uncertain about their future careers in the field and one student considers working in a kindergarten to be only temporary.

A very important finding is that 18 students (62%) are concerned about starting their practical training, with 10 of them describing their concerns as significant. The specific sources of concern are most often related to communication with parents (11; 38%) and insufficient support from colleagues during the adaptation period (10; 34%). These results reflect insufficient preparation for the social and communication skills necessary for high-quality teaching practice. Other factors mentioned were the risk of burnout (7; 24%), working with larger groups of children (6; 21%), and low financial remuneration (6; 21%).

The assessment of preparation for practice within the study program is predominantly positive – 14 students (48%) rate it as rather good and 4 (14%) as very good. However, 4 respondents (14%) rate it as neutral and two (7%) as rather insufficient, which corresponds to the identified areas in which students feel the need to strengthen their competencies. These areas are again dominated by communication with parents (16; 55%) and dealing with children's problem behavior (15; 52%), followed by the creation of curricular documents (11; 38%) and playing a musical instrument (6; 21%). Special educational preparedness and working with digital technologies were mentioned less frequently (3 students each; 10%), but this should not be interpreted as meaning that they are unimportant, especially in view of current trends.

The need for further education is expressed very strongly – 12 respondents (41%) plan to continue their education and 7 (24%) are considering this option, which means that up to 65% of students expect to continue their professional growth. As for the focus of this development, 14 (48%) students declare an interest in remaining in preschool education, while 10 (34%) plan to continue with master's studies or professional specialization. Only a small percentage are considering changing the education sector or transitioning to special education.

Discussion

The results confirm that the traditional concept of Czech preschool education—based on the principles of children's play, holistic development, and a humanistic approach—is perceived by students as a stable pillar of professional identity and certainty when entering practice. This stability is closely linked to the Czech pedagogical heritage, from the inspiration of Fröbel and Comenius to the current form of the RVP PV. The research

shows that students appreciate the continuity of pedagogical values and their applicability to the education of preschool children.

At the same time, however, students are sensitive to aspects in which traditional approaches may not fully meet the current requirements of practice. In particular, communication with parents, working with children with diverse needs, digital technology skills, and the ability to preventively address children's problem behavior are topics that are not sufficiently emphasized in traditional teaching frameworks.

It is precisely this discrepancy between the stability of theory and the dynamics of practice that creates professional tension, which is reflected in students' concerns when entering employment (62%).

The research also provides important findings on the sustainability of the profession. Low prestige and financial remuneration can undermine the long-term motivation of graduates to remain in the field. In some countries (e.g., Finland, Germany), the position of preschool teacher is valued significantly higher in terms of social trust, systematic supervisory support, and career advancement opportunities. This foreign inspiration can help in the search for strategies to strengthen the attractiveness and long-term stability of the profession in the Czech environment.

However, there is great potential in the high level of interest among students in further education (65%), which can be a source of pedagogical innovation in kindergarten practice. If undergraduate and subsequent support for professional learning is set up correctly, future teachers can become active agents of change – and at the same time continue the high-quality Czech pedagogical tradition.

Conclusion

Czech kindergartens are based on both a strong tradition and a growing need for innovation. Research results show that students are aware of this dual role of the institution and understand it as part of their own professional identity. A stable theoretical foundation based on the RVP PV (Framework Educational Program for Preschool Education) is an important support for them, but its full implementation in practice requires expanding professional support for beginning teachers and updating training with an emphasis on the actual operation of a kindergarten: communication with parents, working with a heterogeneous group of children, specifically with children with special educational needs, and the use of digital technologies as a means of learning.

If the profession of kindergarten teacher is to be sustainable, it is necessary not only to strengthen the mentoring and supervision system, but also to improve material and social conditions to meet the high demands of the profession. Increasing professional prestige and long-term motivation of graduates are closely linked to the quality of kindergarten services. International experience suggests that a combination of clear professional standards and systematic professional support can ensure the stability and innovative development of preschool education. The results of this study can serve as inspiration for interventions that would make it easier for future teachers to enter the profession and enable them to actively develop Czech preschool education in line with current social challenges.

In conclusion, it can be said that the future of kindergartens in the Czech Republic lies largely in the hands of young teachers who combine respect for tradition with a desire for innovation. If their professional growth is purposefully supported, this combination can be a powerful factor in the sustainable development of the entire system.

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Abstrakt: České předškolní vzdělávání je definováno především principy a základy zakotvenými v Rámcovém vzdělávacím programu pro předškolní vzdělávání (RVP PV), který vychází z dlouhodobě stabilních teorií vývoje a učení dětí. Tyto teoretické základy se v posledních letech výrazně nezměnily, ale změny v praxi jsou patrné v souvislosti s novými společenskými požadavky – digitalizací, inkluzí a integrací cizinců a dvouletých dětí do

mateřských škol. Tento článek představuje výsledky průzkumu mezi studenty programu Předškolní vzdělávání, který se zaměřuje na to, zda jsou odhodláni po absolvování studia nastoupit do profese a v jakých oblastech pocítují potřebu dalšího vzdělávání. Výsledky ukazují, že většina studentů plánuje nastoupit do profese, ale zdůrazňuje potřebu dalšího profesního rozvoje, zejména v oblastech komunikace, řešení problémového chování dětí, tvorby školních vzdělávacích programů a hry na klavír. Stabilita teoretického rámce založeného na RVP PV je studenty vnímána ambivalentně – jako podpora a jistota, ale také jako nedostatek inovací. Zjištění mohou být podnětem k inovacím v univerzitní přípravě budoucích učitelů mateřských škol a k plánování jejich dalšího profesního rozvoje.

Klíčová slova: předškolní vzdělávání, studenti učitelství mateřských škol, profesní rozvoj

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Helping Hands at Home: Positive effects of chores on students' success in social and academic life by promoting teacher-parent collaboration

ERDAL OZYURT

Abstract: Helping Hands at Home is a project that is focused on collaboration between parents and teachers in the field of children's chores, which has many benefits for pupils. Once children contribute to work in the house, they learn responsibility, develop empathy, time management and strength moral development. With the help of teachers, parents easily overcome the struggle of giving jobs to kids at home.

Through the project's activities we would like to conduct empirical research on the positive effects of chores on pupils' success in both social and academic life.

The main purpose of the project is to prepare the initial research, which will be held the basis for the main research of the dissertation, which is called Teacher Training and Parent-Teacher-Child Triad.

The paper was supported by the project *Children's Life and Teacher-Parent Collaboration* No. IGA_PdF_2024_021.

Keywords: chores, children, children's duty, parents and teachers, children's life, communication

1 Introduction

Several studies have shown that there are many benefits of chores for kids. According to Marty Rossmann's research, it demonstrates that early domestic chore involvement can benefit children in the long run. Parents can instill in their children a lifelong sense of competence, self-worth, responsibility, and self-reliance by getting them involved in duties. Rossmann examined the results for 84 young adults based on a thorough examination of their parents' communication style, their involvement in family work during three different life stages (ages three to four, nine to ten, and fifteen to sixteen),

and a quick phone interview conducted when they were in their mid-20s. Utilizing success indicators for individuals, such as finishing school, beginning a career path, IQ, maintaining relationships with friends and family, abstaining from drug use, and assessing a child's participation in household chores at all three earlier times.

2 Research topic background – inspiration for carrying out own research

2.1 Research abroad

Jolanta Barszcz-Skowronek from Maria Curie-Skłodowska University in Lublin analyzed pictures which represent house chores illustrated by children aged 3-5 attended Kindergarten. This is a small part of a two-week project which is called "Conscious preschooler today – conscious citizen tomorrow" and kids were asked to draw their house chores as illustration. The findings from analyses indicate that tasks, even if limited to just one activity, are already undertaken by three-year-olds. In addition to simple cleaning tasks, children assist their parents by setting the table, taking care of pets, and looking after their siblings.

2.2 Research in Czech Republic

Through this project, our goal is not just to assign tasks to children but also to draw parents' attentions to the significance of chores for children in both academic and social aspects within the school context. Additionally, there are educators who have limited interaction with parents. Through the course of the project, teachers will develop a deeper comprehension of the significance of communication with parents.

Within this initiative, parents will seek assistance from schools in allocating tasks for their children to perform at home. This collaboration enhances communication between two significant adults in the lives of children.

3 Evaluation Surveys of the Project

3.1 Activities Conducted with Students Over One Month

3.1.a Preschool (Age 3) Students

Discussions were held about tasks that can be done at home, and examples were shown using pictures. Parents were kept in communication to identify the activities their children participated in at home. These activities were then discussed with the children for evaluation.

3.1.b Primary School Students

A daily schedule tracking system was implemented. However, teachers did not communicate with parents. Instead, tracking was conducted using paper forms, which students filled out at school daily. Parents were not contacted to verify the information provided by the students.

Through this process, we observed that some teachers deliberately avoided contacting parents, choosing to follow the project exclusively with the students. However, survey results contradicted this, as explained in the section where we evaluate survey outcomes.

3.1.c Middle School (1st Year) Students

A daily schedule tracking system was also implemented. Parents were only informed via email. Some students filled out the tracking forms online, while others collected paper forms from their teachers and tracked their activities themselves. However, many students either lost their forms or forgot to complete them. In some cases, teachers kept the forms themselves and had students had to fill them out in class.

3.2 Teacher and Parent Survey Evaluations

At the end of the project, surveys were conducted with teachers and parents involved. The surveys contained multiple-choice questions, and some notable results are as follows:

3.2.a Preschool

Teachers spoke with children daily about the tasks they completed at home. These discussions aim to inform children and encourage them to take responsibility at home. One parent commented:

"Since my child knows that the teacher will ask about it the next day, they now clean up their toys and put them in the toy basket after playing."

Assigning responsibilities at home significantly contributes to children's physical and mental development. However, many parents either do not realize this or avoid assigning responsibilities for various reasons. Even parents who want to give their children responsibilities may face challenges, the most common being the child's reluctance.

According to our survey, 67% of parents reported that their children complained about doing household chores. This is where our project plays a crucial role: it encourages teachers to support parents in assigning

responsibilities to their children. When teachers monitor children's household tasks, children feel more motivated, as they get to share their experiences with their teacher and classmates the next day.

When asked whether teacher-assigned household tasks encouraged children, 83% of parents found this approach beneficial.

3.2.b Primary School

In the survey given to parents, 92% stated that teacher-parent collaboration is essential in fostering children's sense of responsibility and discipline.

In a similar question posed to teachers, they were asked whether teacher-parent collaboration positively affects children's social and academic success. Half of the teachers strongly agreed, while the other half agreed.

3.2.c Middle School

At the middle school level, students were less motivated. Teachers informed parents about the project, but many parents remained unresponsive. Several factors might have contributed to this:

- Parents receive many school messages and may not pay attention to all of them.
- Parents may not have time to read the messages.
- Some parents may not consider the topic important.
- School emails may not be reaching parents.

Even if parents see the messages, they may not want their children involved in household chores.

According to the survey, only 16% of parents reported assigning household responsibilities to their children. Those who did not assign responsibilities gave various reasons, such as:

- They think that children already have too much schoolwork.
- They can complete household tasks more efficiently and quickly themselves.
- They believe their children are too young for responsibilities.
- Addressing these concerns:
 - Assigning household responsibilities can contribute to children's academic success.
 - Children learn by doing. Though they may struggle initially, they will improve over time and perform tasks more efficiently.

- If children are not accustomed to responsibilities from a young age, they may find it harder later in life. Therefore, introducing simple tasks early prepares them for greater responsibilities in the future.

These findings indicate that parents need pedagogical support in this area. This support could be provided through seminars or short training programs. Indeed, 84% of the parents surveyed stated that they would be willing to attend such a program.

Additionally, 50% of parents reported that they had never received any parenting advice from teachers. Teachers also emphasized the importance of effective communication with parents. However, 84% of teachers stated that they had never received training or certification related to parent communication. If schools or administrators were to organize training on this topic, 73% of teachers expressed willingness to participate.

In summary, both parents and teachers appear willing to engage in educational programs on this subject. The responsibility for organizing these initiatives falls on schools and government authorities.

4.2 Application outputs into educational reality

Education for parents and teachers

As mentioned earlier, some parents and educators may not fully comprehend the significance of household chores and collaborative efforts in achieving these objectives. Continuous training for educators is essential at all levels, enhancing not only their academic knowledge but also their social and communication skills with both parents and students. Teachers are not solely responsible for imparting academic knowledge; they also bear the responsibility of nurturing responsible citizens and future adults. To address these aspects, educators need to be educated about the importance of household chores through seminars and be encouraged to engage in effective communication and collaboration with parents.

In situations where teachers require continuous training, it is equally important for schools to provide education to parents on how to treat their children at home. Some parents may lack awareness of what is crucial for different age groups of children, and others might possess inaccurate information or be hesitant to assign tasks to their own kids. Furthermore, some parents may not fully grasp the significance of communication with schools.

Discussion

During the experimental phase of this project, there are numerous expectations from various stakeholders. Children are expected to undertake household chores, and some may exhibit reluctance. Parents, despite being able to perform certain tasks faster themselves, are required to provide instructions and often assist younger children. Occasionally, children may create messes, leading parents to perceive it as a waste of time. Teachers are anticipated to motivate and monitor students' progress in these daily activities, while for older students, managing points or bonus grades becomes an additional workload. Furthermore, attempting to communicate with some parents may prove challenging, as they may not respond to emails, answer phone calls, or attend parent meetings at schools.

Although these possible obstacles, it's worth doing this project. Mikalsen highlights that a common inquiry at their pediatric mental health clinic is, "How do I get my kid to do chores? Why does my kid never want to do them?" "She emphasizes that a key strategy to prevent conflicts over chores is to initiate the process early. Mikalsen advises parents to begin as early as 18 months and certainly by age two, noting that starting with a 16-year-old for the first time is likely to be less effective, as the battle is already challenging at that point". (Hurley, 2023)

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Abstrakt: Helping Hands at Home je projekt zaměřený na spolupráci mezi rodiči a učiteli v oblasti domácích povinností dětí, který má pro žáky mnoho výhod. Jakmile se děti zapojí do práce v domácnosti, naučí se zodpovědnosti, rozvíjejí empatii, time management a posilují morální vývoj. S pomocí učitelů rodiče snadno překonají potíže s přidělováním domácích povinností

dětem. Prostřednictvím aktivit projektu bychom rádi provedli empirický výzkum pozitivních účinků domácích prací na úspěch žáků v sociálním i akademickém životě. Hlavním cílem projektu je připravit počáteční výzkum, který bude základem pro hlavní výzkum disertační práce s názvem Vzdělávání učitelů a trojice rodič-učitel-dítě.

Práce byla podpořena projektem Život dětí a spolupráce učitelů a rodičů č. IGA_PdF_2024_021..

Klíčová slova: domácí práce, děti, povinnosti dětí, rodiče a učitelé, život dětí, komunikace

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Informations for authors

The purpose of the magazine is emerging to give space for the publication of different cell types (they published articles, essays, research reports, reviews, etc.), which will apply to a specific level of education – primary and pre-primary schools.

All texts will go through the standard review process. Due to the fact that the magazine is present aspiration quality work, the articles presented to two reviewers (in the case of bipolar positions the text entered third reviewer), the review process will be anonymous authors.

Author applying for publishing his article declares that it is the original text.

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Thanks to all who are interested to work with us, publish, comment on and promote the line helping shape the knowledge in our field of pedagogical sciences.

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Účelem časopisu je dát prostor pro publikování různých typů článků (uveřejňovány budou stati, studie, výzkumné zprávy, recenze atp.), které se budou vztahovat ke specifickému stupni vzdělávání – tedy primární a preprimární školy.

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Děkujeme všem, kteří máte zájem s námi spolupracovat, publikovat, komentovat a tím podporovat spoluutváření poznatkové linie v naší oblasti pedagogické vědy.