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Language Audit in the Management of Language and Cultural Competences: Research on the European Program Children's University 'Little Polyglot'

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Abstract:

Purpose: *Identification of key factors in the balance of language competences of school-age children during the COVID-19 pandemic.*
Design/Methodology/Approach: *Statistical techniques and machine learning framework for NET were used in the analysis. The following were used to transform the data: one-hot encoding, replace missing value, normalize the mean variance data transformation, L-BFGS Logistic Regression algorithm (for the first model) and SDCA regression algorithm (for the second model).*
Findings: *The results indicate disproportions in improving English language competences as a result of the reorganization (change of the teaching model) by COVID-19. The average result of the knowledge test dropped by 19-21 percentage points in relation to the first test carried out as part of the language competency audit and, at the same time, by 15-17 percentage points in relation to the test as part of the placement language audit. In the course of remote learning, the disproportions in increasing competences between students increased approximately twice. These disproportions were influenced not only by the test results and the age of the student, but also the financial situation of the student and teacher.*
Practical Implications: *The results obtained are important both for scientific institutions and teaching institutions, but also for economic practice. Results provide information that could be implemented in language education curricula, management of competences from the very beginning of education and cultural communication. The added value of this approach is to find gaps and weaknesses that can be eliminated in order to improve sustainable education.*
Originality/Value: *The originality of the study consists in combining different test methods to conduct a language audit in the management of language competences. On the one hand, methods using artificial intelligence were used. On the other hand, qualitative and quantitative methods and dedicated to didactic evaluation. This is a novel approach, as it combines embedding research alongside trends that are now seen in similar issues.*

Keywords: *Artificial intelligence, balances of competences, cultural communication, language audit, management of competences.*

Paper Type: *Research article.*
Conflicts of Interest: *The authors declare no conflict of interest.*

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1. Introduction

The Children's University 'Little Polyglot' project discussed in the article was implemented at the University of Szczecin (Poland) from 2018 to 2020. The main idea of the project was to teach two foreign languages in parallel with a special focus on cultural elements of a given language area. The educational offer was aimed at children and young people aged 6 to 13 from the region of Western Pomerania. Thanks to obtaining co-financing from European funds (No. POWR.03.01.00-00-U032/17), participation of school children in the classes was free of charge. The idea of the project was to equalize educational opportunities, therefore detailed recruitment criteria were adopted. Equal access to the project was ensured for individuals in a difficult socio-economic situation, those with disabilities and living in both rural and urban areas. Classes were implemented according to original educational programs using a communication approach. It should be noted that in the first year of the project, classes were conducted face-to-face, while in the second year - due to the spread of the Sars-CoV-2 virus - the online form was employed, which may have affected the implementation of the adopted objectives.

The article presents an empirical approach to the language audit as part of the management of language competences of students who started learning a foreign language under the 'Little Polyglot' program. The purpose of the article was formulated as follows, identification of key factors in the balance of language competences of school-age children during the COVID-19 pandemic.

The article consists of 5 sections. The first part is a short introduction, covering the issues under study and the research goal. In the second part, a systematic review of the literature was carried out, paying attention on the one hand to the research methodology, and on the other hand to a similar area of research in other countries. The third part is a description of the primary data and the methods used: statistical techniques and machine learning (in the field of artificial intelligence) as a tool supporting the language audit. The fourth part consists of empirical results modelled in two approaches, qualitative (1) and quantitative (2) along with their discussion. The article ends with short conclusions and further research directions.

2. Literature Background

Topics related to competence enhancement are present in language education research (Nguyen *et al.*, 2014; Tank-Attapol Khamkhien, 2010). Specifically, among the factors affecting the improvement of language competence in language teaching, the following are mentioned: social environment factors (social setting, situational factors); learning environment factors (positive learning environment, instructional strategies); student characteristics and traits (age, attitude, motivation, intelligence, aptitude, cognitive style, personality and cultural factors, learning disabilities); skills and experiences (existing skills, student use of learning strategies, prior knowledge) (Organizing for Instruction, 2017).

According to some researchers, student characteristics and traits are decisive factors in language teaching (Khasinah, 2014). Of the factors mentioned above, researchers have paid a lot of attention to the issues of language learners' age (Sikora-Banasik, 2009). They prove that an important aspect of education is the early start of language education, allowing to achieve high competence in a given foreign language (Nikolov, 2009). It is also worth noting the impact of socio-economic inequalities on the language education of children and adolescents. Research also indicates that Polish students from socially disadvantaged families have worse language learning outcomes, which should be compensated in the course of school education. However, it proves that the support of schools in this regard is insufficient (Krzysiak, 2020), therefore projects counteracting social exclusion such as the Children's University 'Little Polyglot' play a particularly important role.

In addition, the importance of external factors related to the educational process should be emphasized, in particular the teaching methods used by language teachers (Cook, 2013; Larsen-Freeman and Anderson, 2011; Richards and Rodgers, 1986). In particular, the communicative approach is distinguished to overcome communication anxiety which is a significant barrier in language learning (Banciu and Jireghie, 2012).

The pandemic caused by the spread of the Sars-Cov-2 virus undoubtedly had an impact on the organization and course of education at different levels of education (Kim, 2020; König *et al.*, 2020; *The impact of COVID-19 on higher education: A review of emerging evidence : executive summary*, 2021). It caused the necessity of temporary closure of schools, transferring various forms of education to remote mode and adapting teaching methods to the new conditions. These issues have become the subject of numerous studies (Basilaia and Kvavadze, 2020; European Commission. Joint Research Centre, 2020; Hopp and Thoma, 2020). While the authors recognize that this situation does not affect all students equally, they also note that these changes may have long-lasting consequences. In addition, recent data show that the pandemic has had an unprecedented impact on teaching worldwide in virtually all aspects, both in terms of the current situation, as well as in terms of its impact on teaching in future years (The Impact of COVID-19 on Higher Education - Publications Office of the EU, 2021). The pandemic caused changes in the ways of education and learning and accelerated the transformation of the education system (George, 2020).

The conducted research is important because it takes into account both the factors – already described in the literature – influencing the improvement of language competences and the impact of the change of education caused by the spread of the Sars-Cov-2 virus on the development of knowledge among students.

Knowledge development can be examined by means of a language audit. This concept is understood as a continuous and detailed verification of the level of students' language knowledge taking into account the different language skills (i.e.,

speaking, writing, reading, listening comprehension). Language audit provides both an examination of baseline knowledge as well as a verification of language competence development (Evans, 2016; 'Language Audit according to CEFR scale', 2021). Language audit is presented later in this article as a framework and includes data analysis and identification of key factors for improving language competence.

3. Data and Methods

3.1 Data

The data came from each student's progress assessment questionnaire. The selection of students for the study was purposeful in terms of participation in the program in 2019/2020 and the choice of the English language. The data has been animated. They included information such as, student code (instead of first and last name), age, gender, financial situation (defined as difficult or other than difficult), place of residence according to the Degurb scale ([1] cities, i.e., densely populated areas; [2] small towns and suburbs, i.e., areas with an average population density; [3] rural areas, i.e., sparsely populated areas), results on a percentage scale obtained from tests (baseline and three knowledge tests), final (descriptive) grade, assessment according to the balance of competences (confirmed improvement of competences or the improvement of competences has not been confirmed) and the teacher (hidden variable - teaching style).

Table 1 presents selected descriptive statistics for the results of individual tests checking language competences. 58 students participated in the study (for comparison: the entire study was attended by 311 students during 2018/2019 and 2019/2020 in six foreign language groups[4]). The age of the students (58 persons) ranged from 6-13 years old[5], the average age was 8.74 years. The age differentiation of students was moderate and amounted to 23.23%.

[4] *36,654 persons in 2018 and 38,450 persons in 2019 learned foreign languages in primary school (6/7-15 years old children) in Szczecin with powiat status (Statistics Poland - Local Data Bank, 2021). With this population size and the number of people in the study (311), for a fraction size equal to 0.5 and a confidence level of 95%, the maximum error is equal to 6%.*

[5] *26,573 persons in 2018 and 26,786 persons in 2019 learned English (as foreign language) in primary school (6/7-15 years old children) in Szczecin with powiat status (Statistics Poland - Local Data Bank, 2021). With this population size and number of people in the study (58), for a fraction size equal to 0.5 and a confidence level of 95%, the maximum error is equal to 13%. However, this error is overstated. Because it was impossible to exclude a significant part of the students (i.e. people aged 14 and 15) from the population. Aggregated data includes all students up to 15 years of age. And the research sample included only children from 6-13 years of age. Due to the nature of the study and the conclusions drawn from it, a maximum error of 13% was adopted. It will inform about how much the actual results could differ in plus/minus in the population from those carried out in the study based on the sample, with 95% certainty of the results obtained.*

Table 1. *Selected descriptive statistics*

Variable	Number of students	Average	Min	Max	Standard Deviation	Coefficient of variation
age	58	8.74	6	13	2.03	23.23
baseline test [1]	58	0.67	0	1	0.27	40.44
knowledge test [2]	58	0.71	0	1	0.35	48.95
knowledge test [3]	58	0.50	0	1	0.47	95.34
knowledge test [4]	58	0.52	0	1	0.47	90.11

Note: *Baseline test [1] and knowledge tests [2-4] are as number. They were changed from percentage, for example 0.67 means 67%. Age is expressed in years.*
Source: *Own computation.*

As shown in Table 1, all students (58 persons) took the baseline test [1] and knowledge tests [2-4]. The lowest score was 0% and the highest was 100% (equal to 1). On average, the results of the baseline test [1] differed in plus/minus by 27 percentage points from the mean value, which is equal to 67%. The coefficient of variation (i.e. the quotient of the standard deviation and the mean) of language competences expressed by the baseline test was 40.44%. This value means a moderate differentiation of linguistic competences at the beginning of learning English under the project 'Little Polyglot'. With the acquisition of new skills and new knowledge as part of learning English, the level of variation in language competences has increased.

On the one hand, there are students who have achieved great progress, and on the other hand, those who have made a slight progress or those who failed to confirm the improvement of their language competences. Knowledge tests [2-4] following certain stages of acquiring new language and language skills were key in recognizing the improvement of competences.

The highest mean result of the test was obtained in the knowledge test [2] and it was 71% (0.71). The variation in language competences among students was recorded at the level of 48.95%. It was moderate. The highest coefficient of differentiation was recorded for the knowledge test [3], at the level of 95.34%. Such a high value means that in the group of students the results of this test differed significantly. The group of students was not homogeneous in terms of the level of improvement of foreign language competences at this stage of education. The mean of this test was 50% (0.5) and the results on average deviated from the mean value (50%) in plus/minus by 47 percentage points. Similar results were obtained for the knowledge test [4].

The mean result was higher by 2 percentage points than the knowledge test [3], and the differentiation coefficient was lower by approx. 5 percentage points. However, also in the case of this test, it can be concluded that the competences of students were very diverse and the group of students was heterogeneous in terms of language competences at this stage of education. Overall, it can be seen that there is a large

difference between the results obtained in the knowledge tests [3-4] and the tests [1-2]. Language learning preceded by the verification of these tests coincided with the introduction of distance learning as part of the program related to the health risk of COVID-19. The knowledge test [4] was also the last, final knowledge test, which clearly confirms that there are key factors for improving language competences, differentiating the use of students' potential.

Therefore, it is reasonable to identify the key factors in improving language competences [more in section 4, Results and Discussion]. It can be assumed that one of them is i.a. a change in the model of education caused by the COVID-19 situation, which is confirmed by a decrease in the average score on the knowledge test [3 and 4] with a simultaneous increase in the coefficient of variation (differentiation of language competences at a given stage of education).

3.2 Methods

In the study, the main emphasis was placed on the use of artificial intelligence, especially machine learning algorithms from ML.NET (machine learning framework for .NET) to identify key factor in improving language competences. ML.NET is used to train machine learning models to find the appropriate functions (*Power BI Uses Key Influencers Using ML.NET | .NET*, 2021). For categorical key factors, logistic regression and data transformations are used, i.e., one-hot encoding (*CategoricalCatalog.OneHotEncoding Metoda (Microsoft.ML)*, 2021), replace missing value (*ExtensionsCatalog.ReplaceMissingValues Method (Microsoft.ML)*, 2021) or normalize the mean variance data transformations (*NormalizationCatalog.NormalizeMeanVariance Method (Microsoft.ML)*, 2021), and L-BFGS (limited memory Broyden–Fletcher–Goldfarb–Shanno algorithm) Logistic Regression algorithm (*How to Choose an ML.NET Algorithm - ML.NET*, 2021).

This approach allows you to analyse data patterns. In the case of numerical variables (key factors), linear regression and data transformation are used, i.e., one-hot encoding, replace missing value or normalize the mean variance data transformations, and SDCA (Stochastic Dual Coordinate Ascent) regression algorithm (*How to Choose an ML.NET Algorithm - ML.NET*, 2021). Using these methods, two models were constructed, the first - a qualitative model and the second - a quantitative model. These are presented in the next section.

4. Results and Discussion

4.1 Key Factors – Qualitative Model

Five variables were included in the qualitative model. The input variable 'balance of competences' explained by categorical key factors was analysed, i.e., financial situation, gender, place of residence and teacher (Table 2).

Table 2. *Key factor in balances of competences in qualitative model*

Analyse	Explain by	Key Factor	Type of key factor
balance of competences	financial situation	true	categorical
	gender	false	categorical
	place of residence	false	categorical
	teacher	true	categorical

Source: *Own elaboration.*

As Table 2 shows, only two variables, 'financial situation' and 'teacher', which are statistically significant and explain the 'balance of competence'. Therefore, they can be considered as key factors for the balance of competences. Table 3 presents the impact of key factors on the balance of competences. On the one hand, the factors of improving the competences were identified, and on the other, the factors of the lack of improvement in language competences.

Table 3. *Assessment of the impact of key elements on the balance of competences - qualitative model*

Balance of competences	Key Factors	Likelihood	% of data	Number of students
the improvement of competences **was confirmed**	financial situation is other than difficult	1.29x	58.62	34
the improvement of competences **was confirmed**	teacher is A	1.29x	50	29
the improvement of competences **was not confirmed**	teacher is B	4.00x	50	29
the improvement of competences **was not confirmed**	financial situation is difficult	3.31x	41.38	24

Source: *Own computation.*

As shown in Table 3, the improvement of language competences was caused by a situation other than difficult (good or average) and teacher A (teaching model A). The difficult financial situation and teacher B (teaching model B) contributed to the lack of confirmation of language competences. Discussion of the results of the qualitative model follows:

1. When 'financial situation is difficult', the 'balance of competences' is 3.31 times more likely to be the 'improvement of competences was not confirmed' compared to all other values of 'financial situation'. This factor contains approximately 41.38% of the data.
2. When 'financial situation is other than difficult', 'balance of competences' is 1.29 times more likely to be the 'improvement of competences was confirmed' compared to all other values of 'financial situation'. This factor contains approximately 58.62% of data.
3. In 41.38% of students (24 persons) a difficult financial situation was reported, which resulted - in case of part of those students - in the failure to confirm the improvement of language competences. The probability of not confirming the

improvement of competences as a result of a difficult financial situation is high. While 58.62% of students (34 persons) did not experience a difficult financial situation and the better financial situation had an impact on improving language skills. The probability of improving language competences as a result of a good or average financial situation is high, but lower than in the case of a difficult financial situation and failure to confirm competences. In order to provide equal opportunities in raising competences, it is recommended to provide financial support to people who have potential. The lack of equal opportunities is a waste of the potential of young people.

4. When 'teacher is B', 'balance of competences' is 4 times more likely to be 'the improvement of competences was not confirmed' compared to all other values of 'teacher'. This factor contains approximately 50% of the data.
5. When 'teacher is A', 'balances of competences' is 1.29 times more likely to be 'the improvement of competences was confirmed' compared to all other values of 'teacher'. This factor contains approximately 50% of the data.
6. 50% of students (29 people) were taught by teacher B (teaching model B) and the same number - by teacher A (teaching model A). The model of student assessment by the teacher is also strongly related to the teaching models. The probability of not confirming language competences as a result of using Model B was high and much higher than in the case of the likelihood of confirming language competences as a result of using Model A. Both the first and the second teaching models were not ideal. However, neither of them can be judged as inferior to the other. They were based like 'carrot and stick' motivation systems in further scientific education. Model A is focused on the 'carrot' and Model B is focused on the 'stick'. In the short term (project time perspective), the 'stick' system is stronger than the 'carrot' system - it can act as a demotivator. However, the effects of which education system will bring long-term benefits can only be measured in several years with a dedicated survey addressed to the same students. It is recommended to pay attention to factors that may have a demotivating effect in teaching and be counterproductive. It is worth modifying the assessment criteria, as well as the method of transferring knowledge adapted to the group and individually - to the student. It is a contemporary challenge for almost everyone.

4.2 Key Factors – Quantitative Model

The quantitative model is complementary to the qualitative model. The analysis of the balance of competences takes into account numerical key factors, such as, age, the result of the baseline test [1] and knowledge tests [2-4] (Table 4).

The key factors in explaining the balance of competences include age, knowledge test [2] and knowledge test [4] - they were statistically significant. The others in this study were not significant, but it has no practical interpretation and is not related to the balance of competences. The research sample was too small and the cut-off level resulted in the rejection of the remaining variables. In addition, the results of the

basic test [1] and the knowledge test [2] are statistically significantly correlated with each other (critical value at the bipolar 5% critical area = 0.2586) at the level of 0.7331, and the knowledge test [3] and the knowledge test [4] at the level of 0.5311.

Table 4. *Key factor in balances of competences in quantitative model*

Analyse	Explain by	Key Factor	Type of key factor
balance of competences	age	true	numeric
	baseline test [1]	false	numeric
	knowledge test [2]	true	numeric
	knowledge test [3]	false	numeric
	knowledge test [4]	true	numeric

Source: *Own elaboration.*

Table 5 presents the assessment of the impact of key factors on the balance of competences. On the one hand, the factors of improving the competences were identified, and on the other, the factors of the lack of improvement in language competences.

Table 5. *Assessment of the impact of key elements on the balance of competences - quantitative model*

Balance of competences	Key Factors	Likelihood	% of data	Number of students
the improvement of competences **was confirmed**	knowledge test [4] goes up 0.47	97.99x	82.76	48
the improvement of competences **was confirmed**	knowledge test [2] goes up 0.34	6.90x	82.76	48
the improvement of competences **was confirmed**	age goes down 2.01	3.43x	82.76	48
the improvement of competences **was not confirmed**	knowledge test [4] goes down 0.47	98.19x	17.24	10
the improvement of competences **was not confirmed**	knowledge test [2] goes down 0.34	6.91x	17.24	10
the improvement of competences **was not confirmed**	age goes up 2.01	3.43x	17.24	10

Source: *Own computation.*

As shown in Table 5, the same factors affect both the confirmation of the improvement of language competences and the lack of confirmation in the improvement of language competences. The turning point are the thresholds for knowledge and age tests (values provided in the key factors column), which differentiate the balance of competences. These thresholds should be close to the standard deviation (Table 1). In the case of knowledge tests, it can be seen that an increase in the score by 34 percentage points (0.34) in the knowledge test [2] and above 47 percentage points (0.47) in the knowledge test [4] increases the probability of confirmation in increasing language skills. In the case of age, the younger a student (i.e. the earlier he starts education) by approx. 2 years, the higher the probability that he will increase his language competences.

In the absence of confirmation of competence, the relationships are opposite and the probabilities are similar. At the same time, the probability of not confirming linguistic competence is higher than the probability of confirming linguistic competence, which results from the division of data in the relation 48:10 (82.76% and 17.24%). Discussion of the results of the quantitative model follows:

1. As 'age' decreases, the likelihood of 'balance of competences' is 'the improvement of competences was confirmed' increases. For example, a fall of 2.01 in 'age' leads to a 3.43x growth in likelihood of improvement of competences. This factor contains approximately 82.76% of the data.
2. As 'age' increases, the likelihood of 'balance of competences' is 'the improvement of competences was not confirmed' increases. For example, a fall of 2.01 in 'age' leads to a 3.43x growth in likelihood of failure of competences. This factor contains approximately 17.24% of the data.
3. The younger the child, the earlier it starts learning, the greater the likelihood of improving language skills. This is due to the extension of the teaching time. Therefore, foreign language education should start at the earliest possible stage of the child's development, then the student can achieve more spectacular results.
4. As 'knowledge test [4]' results increases, the likelihood of 'the improvement of competences was confirmed' in 'balance of competence' also increases. For example, a growth of 0.47 (of 47 percentage points) in 'knowledge test [4]' leads to a 97.99x growth in likelihood of improvement of competences. This factor contains approximately 82.76% of the data.
5. As 'knowledge test [2]' results decreases, the likelihood of 'the improvement of competences was not confirmed' in 'balance of competence' increases. For example, a fall of 0.34 (of 34 percentage points) in 'knowledge test [2]' leads to a 6.91x growth in likelihood of failure of competences. This factor contains approximately 17.24% of the data.
6. As 'knowledge test [2]' results increases, the likelihood of 'the improvement of competences was confirmed' in 'balance of competence' also increases. For example, a growth of 0.34 (of 34 percentage points) in 'knowledge test [2]' leads to a 6.9x growth in likelihood of improvement of competences. This factor contains approximately 82.76% of the data.
7. As 'knowledge test [4]' results decreases, the likelihood of 'the improvement of competences was not confirmed' in 'balance of competence' increases. For example, a fall of 0.47 (of 47 percentage points) in 'knowledge test [4]' leads to a 98.19x growth in likelihood of failure of competences. This factor contains approximately 17.24% of the data.
8. Along with the extension of the teaching time, a change in the threshold from 34% of the score for the knowledge test [2] to 47% of the score for the knowledge test [4] was noticed, and the probability of obtaining competences increased from 6.9x to almost 98x. Obtaining these scoring thresholds for a given test increased the chances of obtaining confirmation to improve language competences. Teaching and the knowledge test [2] were conducted in the form

of full-time students. On the other hand, the teaching and knowledge test [4] were carried out remotely. Thus, on the one hand, there is an increase in rigor in the student's assessment (increased average threshold), and on the other hand, distance learning has had a two-dimensional effect. The average passing score was significantly lower in the knowledge test [4] than in the knowledge test [2], but when the student mastered a little less than 50% of the material, the probability of obtaining confirmation of linguistic competence increased drastically, incomparably than in the knowledge test [2]. The 'Little Polyglot' program is also proof of the systematic increase in skills.

5. Conclusions

The presented analyses show that the Children's University 'Little Polyglot' project has influenced the improvement of English language competence in children aged 6 to 13 from the Western Pomerania region. Our research is innovative in nature. Its conclusions can be used in foreign language teaching, competence management and language audit in different groups of children and adolescents.

The research is interdisciplinary and falls into many research fields, management, linguistics, literary and cultural studies, sociology, cognitive science, statistics and IT. The research methodology combines machine learning tools with the tools of classical statistics and the aforementioned fields. The aim of the study has been achieved, and the research results are consistent with the conclusions included within other theoretical, analytical and pragmatic studies. Namely, the key factors of competence enhancement were identified, good financial situation of the student's family, teaching techniques of one of the teachers (motivational system), age at which the language learning started and systematic learning and acquisition of the material (verified by the pass rate of competence tests).

On the other hand, the lack of confirmation of raising competence was influenced by difficult financial situation, other teaching techniques (demotivational system), later age of starting learning or not reaching the pass level of competence tests. The change in teaching method from face-to-face to online due to the spread of the Sars-Cov-2 virus, despite the use of alternative teaching methods, resulted in lower knowledge gains compared to the previous year of the project. The results were not influenced by student gender or place of residence.

It is the intention of the authors to expand this study to include a mixed model that captures both quantitative and qualitative factors. In the long run, the study will be expanded to cover two additional methods in order to present the differences in identifying key factors in mixed approaches (multidimensional methods). Similar research will be conducted in the future on a group of learners of other languages in the project (i.e., German, Norwegian, Russian, Spanish, Italian).

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