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Acquiring penmanship and writing skills
from the first to fifth grade of primary school:
Joined-up writing vs. Comenia Script

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Abstract
The project presented here deals with a typical human means of communication – writing. The aim of the project is to map the developmental dynamics of handwriting from the first to the fifth grade of primary school. The question remains topical because of the fact that several systems of writing have been used in the past few years. Our project focuses on comparing the systems of joined-up handwriting (the standard Latin alphabet) and the most widespread form of printed handwriting: Comenia Script. The research can be marked as sectional; pupils took a writing exam at the beginning and at the end of the 2015/2016 school year. The total number of respondents was 624 pupils, evenly distributed according to the school year, system of writing and gender. To evaluate handwriting, the evaluation scale of Veverková and Kucharská (2012) was adjusted to include a description of phenomena related to graphomotor and grammatical aspects of writing, including the overall error rate and work with errors. Each area that was observed included a series of indicators through which it was possible to create a comprehensive image of the form handwriting took in the given period. Each indicator was independently classified on a three-point scale. Thanks to that, a comprehensive image of the form of writing of a contemporary pupil emerged.
Key words: writing, italics, Comenia Script, scribal skills, writing skills, evaluation of writing.

Introduction

Writing and reading create the foundations of literacy; these skills develop at the same time. In comparison to readers' literacy, the research on writers' literacy lies at the margin of the interest of Czech researchers, although it is a publicly discussed topic.

Writing is a complex perceptual-motor activity that depends on the maturing and integration of cognitive, perceptual and motor skills. Some children enter school with knowledge of certain letters; the scribal and writing skills develop

during the learning of writing in the period of the development of initial literacy (Kucharská, 2014), i.e. approximately from the first to the third grade. In the fourth and fifth grades, writing should already be consolidated and automatized and a pupil should already be capable of independent expression through writing.

Kucharská and Veverková (2012) state that the development of writing varies between individual pupils. It depends on a number of factors: on the individual skills of a pupil in conditions for writing (cognitive conditions, perceptual maturity and graphomotor skills); further, on the personal characteristics of a child (motivation to write and resistance when overcoming obstacles); third, the experience of a child in the field of drawing as in drawing children "practise" writing strokes and gain awareness of writing. Finally, the actual method and methodology associated with writing play a great role, as does the support from the teacher and the family when acquiring scribal and writing skills.

In recent years, the visual quality of handwriting has begun to be discussed. The worsening level of handwriting and the necessity to modify the model script that is used have already been pointed out, e.g. by Šupšáková (1991).

From the experience of teachers and advisors it is obvious that both children and adults nowadays prefer a more simple form of writing (Wildová & Kucharská, 2014). At the same time, the interest of both schools and parents in the diagnosis of specific learning disabilities which, besides reading, occur in writing as well (developmental dysgraphia, dysorthographia), persists. The second and third grades are considered the most exposed time regarding the interest in confirming the diagnosis of a learning disability, although in the two following grades there are also cases when a child is sent to school advisory offices because of a problem with writing. Many children who have a problem with writing do not necessarily suffer from a specific issue with writing – it may only be the result of an incorrect method of writing, that is not joined up, or just an underestimation of the training that is necessary to acquire scribal skills. At the same time, there is no contemporary study that could provide space for a comparison – what the handwriting of children in the first five grades of primary school looks like on a continual basis, according to the grades. As was pointed out in the diploma theses by Kučerová (2014) and Kubín (2014), the error rate is still quite high and problems with writing are still quite frequent in children in the third grade.

We can say that the act of graphic designer Radana Lencová was a reaction to this state of things: she created an innovative printed writing system – Comenia Script – which is nowadays recommended as an alternative system to the commonly used Latin alphabet. The main aim was to provide a new system of

handwriting, together with a new methodology that would allow a simplification of writing, and therefore, provide better opportunities or practice and better quality of writing.

In relation to Comenia Script, we should not fail to mention a verification study run in 2010-2012 at the Faculty of Education, Charles University, led by Prof. Radka Wildová. From the first results it was obvious that the new method displays similar efficiency to traditional writing. The verification, however, applied only to children in the first and second grades of primary school. It is crucial to follow the development of handwriting in older children as well as the development of writing (the formation of a personal style) is not yet finished in the second grade.

Unfortunately in the Czech Republic no project has been realized so far to map the developmental dynamics of the scribal and writing skills of children in the first five grades of primary school. It is not only a matter of the developmental dynamics of writing in Comenia Script but also of "traditional" writing. There is also no information available about what the typical handwriting of children in particular grades looks like, which writing problems a child has to deal with, what the temporary issues with writing look like and when one can start to think about some kind of specific disruption of scribal and writing skills (i.e. dysgraphia and dysorthographia). Not all children who display partial issues with writing necessarily suffer from these specific problems; it is common to have problems when acquiring handwriting, and they should be solved through cooperation between the teacher and parents (Kucharská, 2007).

Aim

The present paper deals with the problematics of the development of handwriting in the first five years of primary school in terms of joined-up handwriting (standard Latin alphabet) and printed handwriting (Comenia Script). We present the first results of the analyses of the research study "The development of handwriting from the first to the fifth grade – joined-up handwriting vs. Comenia Script", the aim of which is a description of the progress of the adoption of particular scribal and writing skills. Furthermore, we compare the developmental dynamics of the adoption of writing in joined-up and printed handwriting. We also deal with the issue of gender influencing the quality of handwriting. The last area we focus on is the evaluation of writing. Here we specify the evaluation criteria used to describe handwriting. To evaluate handwriting we used the scale of Veverková and Kucharská (2012), which was designed to evaluate the handwriting of first-grade pupils in such a way that it does not have to correspond fully to older children's handwriting.

It has to be stressed that we do not want to characterize one type of handwriting or another as more proper but we want to call attention to possible specific features that appear in the course of the adoption of writing in primary school in the above-mentioned models of writing.

Research set and methods used

The research set (see Table 1) consisted of 624 pupils from nine primary schools in the Czech Republic (Prague, Central Bohemia, Liberec Region, Ústí nad Labem Region, Vysočina). In each grade we wanted at least 120 children (equally spread according to the type of handwriting), which we managed to fulfil in each grade except for the first grade – there we worked with ca. 80 children.

Tab. 1: Research set

Pattern of handwriting	Grade	Number of pupils	Boys	girls
Joined-up writing	1	39	16	23
	2	77	41	36
	3	75	35	40
	4	68	34	34
	5	78	36	42
total		337	162	175
Comenia Script	1	40	21	19
	2	58	29	29
	3	61	26	35
	4	68	30	38
	5	60	26	34
total		287	132	155

The schools were both urban and rural and varied in their structure from the point of view of sociodemographic indicators.

The research project can be classified as an overview. The data was collected during the 2015/2016 school year. As we were interested in performance shifts in particular subtests, the assigning of the battery of subtests went on at the beginning and end of the school year. In the first grade, we shifted the initial data collection to midyear, when one might suppose that the basics of handwriting had already been adopted.

The data collection was performed in a group and it never lasted more than two hours. Because of the children getting tired easily, we collected the data only during the morning classes.

The battery of tests contained three parts. The first was a scribal exam from the battery of diagnostic tests of literacy skills (Carravolas & Volín, 2012). In the first grade we assigned Writing words, in the second to fourth grades Scribal test 1 and in the fifth grade Scribal test 2. This division was chosen on the basis of the recommendation in the manuals accompanying these tests.

The second part of the battery of tests was a drawing exam – Test of figure drawing. Through this we wanted to map the level of graphomotor skills of individual writers. The last part of the battery of tests was a test of silent writing. Because of the different reading levels of our sample, we used two versions of the test. In the second grade we assigned the test "Big Friends" (Špačková & Kucharská, 2015), and from the third grade to the fifth grade we used the test "Going for a trip" (Kucharská & Vykoukalová, 2015). The reading test was not assigned to the pupils in the first grade. The battery of tests was the same in both waves except for the Test of figure drawing, which was not included in the second round.

For the initial processing and evaluation of the data that was gathered, quantitative methods were used. Because of the normality of the data, parametric tests were used.

Because of the size of the sample tested, it was necessary to have the individual pieces of writing evaluated by more evaluators. For that reason we did a pilot survey before the actual data collection and we verified the agreement among the evaluators. Thirty written pieces in total, selected at random (evenly distributed according to the model of handwriting) were cross-evaluated by four evaluators. The ICC index (intraclass correlation coefficient, Shrout & Fleiss, 1979) was used as the actual measure of the evaluators' agreement. The calculations of estimations and confidence intervals were performed with the ICC package (Wolak et al., 2015) for R (R Core Team, 2016) (see Table 2).

Tab. 2: Agreement of evaluators

ICC *scribal skills*	ICC = 0.985; 95% CI [0.974; 0.992]; F(29.90) = 265.4; p<0.0001
ICC *writing skills*	ICC = 0.994; 95% CI [0.99; 0.997]; F(29.90) = 710.8; p<0.0001

The ICC results above the level 0.9 confirm the very high level of agreement among the evaluators; therefore, it could be assumed that the evaluation criteria for the individual categories are well established.

Evaluation scale
In the evaluation of handwriting we adhered to four large fields, two of which were further divided internally.
1. Scribal skills (shape; the size of a letter in a word; the size of a letter in a sentence; adherence to a line; the slant of the text; slant in a word; quality of joining up letter; quality of the stroke; legibility)
2. percentual error rate (a "collecting" criterion in which the level of writing skills is reflected)
3. work with errors (an independent evaluation criterion; the ability to find a mistake and correct it)
4. writing skills (omission/addition of a letter; exchange of an uppercase letter for a lowercase one and vice versa; misplacement of letters in a word; the length of a syllable; diacritics; a mistake after a soft consonant; a mistake after a hard consonant; a mistake after an ambiguous consonant; punctuation and substitution of a letter).

Each criterion was evaluated on a scale from 0 to 2, with a higher number of points meaning higher quality of the feature in question.

In this paper we focus on presenting the results of the statistical analyses of the initial data collection and we deal with the field of scribal and writing skills.

Results in the field of scribal skills
Before the statistical analysis itself we verified the reliability of the subtest. Because the scores are ordinal, we counted the ordinal α = 0.72 (Gadermann, Guhn, & Zumbo, 2012).

The rough score was calculated as the sum of the individual scores for six criteria. We did not include slant and quality of joined up letter, the former because Comenia Script (CS) does not state an "ideal" slant and children can use

whichever suits them, and the latter because it is "correct" not to attach CS model.

To count the differences between grades, writing method and gender, 3-way ANOVA was used (analysis of variance). None of the interactions proved significant on the 0.05 level; therefore, only the main effects of the grade, gender and writing method are interpreted.

Tab. 3: ANOVA scribal skills

effect	p
Grade	0.000
Pattern of writing	0.003
Gender	0.000
Grade x Pattern of writing	0.067
Grade x Gender	0.707
Pattern of writing x Gender	0.358

In the field of scribal skills the effect of the grade can be marked as significant – $F_{(4, 604)} = 8.61$; $p < 0.001$; $\eta^2 = 0.054$ – which suggests that there are differences among grades. Post-hoc paired t-tests showed that the fifth grade (see Graph 1) is significantly different from all the others. In the other grades, no difference was proved. Overall, it can be stated that the differences among the grades are not too large, which is also indicated by the quite small size of the effect (0.054); about 5.4 % of the entire variance in the writing test could be explained by integrating the grade into the model.

Another effect we followed was the effect of gender (see Graph 2). On the basis of the statistical analysis we consider it significant as well: $F_{(1, 604)} = 9.18$; $p = 0.0025$; $\eta^2 = 0.015$. In general, girls (m=8.5, sd=2.33) score better in the test than boys (m=7.12, sd=2.32). The higher the score, the better the formal shape of the handwriting is. The effect is, however, quite small – it explains only 1.5 % of the total variance.

The last field to be observed is the effect of the system of writing (Graph 3), which also showed itself to be statistically significant: $F_{(1, 604)} = 53.59$; $p <$

0.001; $\eta^2 = 0.081$. Children writing with Comenia Script (m=8.14, sd=2.34) score higher than children writing with joined-up writing (m=7.58, sd=2.46). Moreover, this effect is the biggest in terms of the explained variance (8.1 %) of all the effects that were observed. Because of the absence of interrelationship with a grade we think that the difference between the systems of writing is similar in all grades.
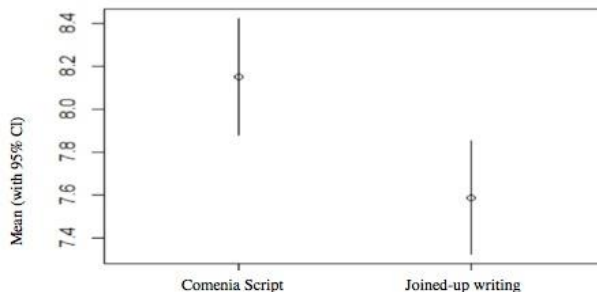
Graph 1: Difference among grades in the scribal test
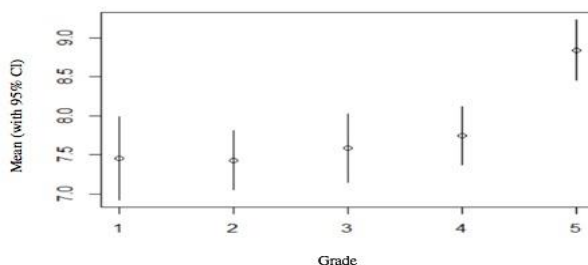
Graph 2: Difference between genders in the scribal test
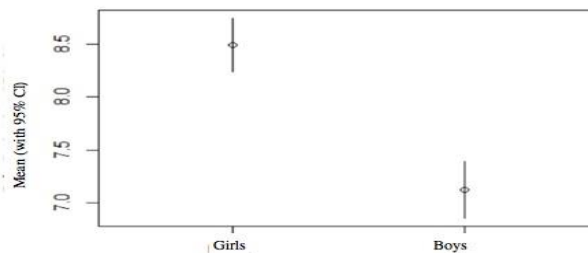
Graph 3: Difference between pattern of writing in the scribal test

Results in writing skills

In the subtest of writing skills (i.e. those related to the application of grammatical rules) we also first proved its reliability. Because of the ordinal character of the data we counted ordinal α = 0.81 (counted from all 14 entries on the subtest given).

The score in the grammar test was counted as a sum of the individual scores for the criteria for the grade in question divided by the number of criteria that were followed in the grades. In the first grade there were eight criteria, from the second to the fourth grade 10 criteria, and in the fifth grade 14 criteria. The score thus gains values from 0 to 2.

For the analysis, a similar method to that used for the test of scribal skills was used. We calculated 3-way ANOVA with the following factors: grade; gender; writing method.

Table 4: ANOVA writing skills

effect	p
Grade	0,000
Pattern of writing	0,002
Gender	0,000
Grade x Pattern of writing	0,003
Grade x Gender	0,275
Pattern of writing x Gender	0,304

Regarding the fact that a statistically remarkable interaction of the grade with the system of writing was displayed ($F_{(4.604)}=3.89$; $p = 0.0039$; $\eta^2 = 0.025$), it is necessary to consider the finding below. It means that the differences in grammar among children writing in Comenia Script and those writing in joined-up handwriting are not stable through the different grades.

A more detailed analysis showed (t-tests comparing children within individual classes according to the writing method), that children in the second and third grades differ if we compare them according to the writing method. Children in the second grade who used Comenia Script (m=1.03; sd=0.298) achieved higher scores than children using the joined-up writing system

(m=0.91; sd=0.286); t(120.18) = 2.399; p = 0.0179. In the third grade, a similar difference occurred; children using Comenia Script (m=1.4, sd=0.24) were more successful than children using the joined-up writing system (m=1.19, sd=0.389); t(125.65) = 3.813; p = 0.0002. Differences were not observed in the other grades (all t<1).

Graph 4: Differences among grades in an interrelationship with the pattern of writing
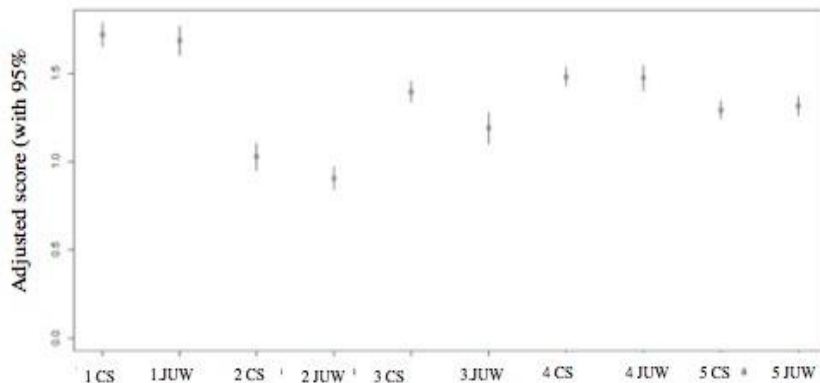
The analysis of the dispersion showed a great effect of the grade: F(4.604) = 105.81; p < 0.001; η^2 = 0.41. After adjustment of the overall score within the grades for gender and the system of writing, the differences (pairwise t-tests) among the individual grades were calculated. The differences among all the grades were significant (even after Bonferroni's correction to the level 0.005 – 0.05/10) except for the third and fifth grades mutually. Graph 5 illustrates the average scores in the grammar test. The least difficult is the writing test for the first grade. From the second to the fourth grade there is a gradual improvement. The difficulty of the grammar test for the fifth grade is comparable to that of the one for the third grade. We point out that writing tests with three levels of difficulty were assigned. The easiest was assigned in the first grade. The middle level was assigned to pupils from the second to the fourth grade. The most difficult option was the one for pupils in the fifth grade.

The effect of gender also proved significant in the writing subtest: F(1.604) = 13.91; p < 0.001; η^2 = 0.023. The girls (m=1.36; s=0.35) attained higher average scores than the boys (m=1.26; sd=0.39). Because of the absence of interrelationship with the method of writing and grade, one can state that the effect is constant across grades and types of writing. This effect is, however, rather small (gender explains ca. 2.3 % of the variance in the grammar test).

Graph 5: Writing skills related to grade
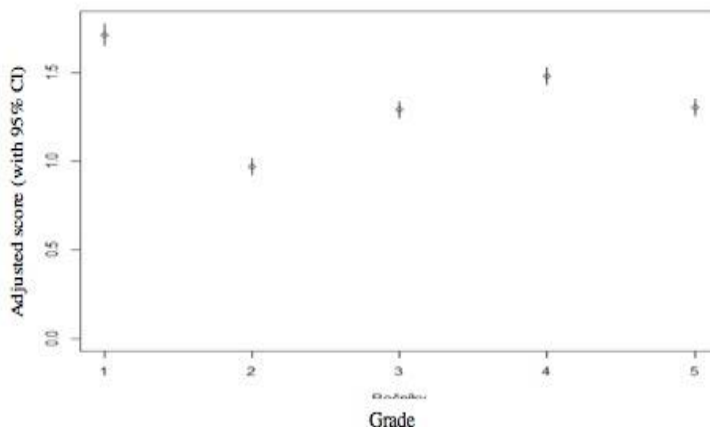
Conclusion and summary of the results

The research project described here aims to map the field of the development of handwriting during the first five years of primary school. It is the time when a pupil acquires and refines the skill of writing. Since 2012 (after two-year piloting by the Czech Ministry of Education) we have also been able to find a printed system of writing – Comenia Script, designed by Radana Lencová.

In this project we do not want to characterize one system or the other as better or worse; rather, we want to map the developmental dynamics of scribal and writing skills in both systems. We want to describe the fields in which they differ and vice versa.

If we sum up the initial results, we can claim that for certain criteria the joined-up and the printed models differ significantly.

In the area of scribal skills (these connected with the form/layout of handwriting) we marked the effects of gender, grade and the system of writing as statistically significant. It was no surprise that girls have neater handwriting than boys. The difference was confirmed in all five grades. This difference may be caused by better hand-eye coordination or finding copying the model to be easier.

In the area of the effect of the grade on the quality of scribal skills we discovered a significant difference no sooner than in the fifth grade.

In terms of the effect of the system of writing, it could be expected that pupils using Comenia Script would achieve better scores. This difference appears significant in each grade. The explanation can be seen in the very character of the new model as Comenia Script was designed to be a graphomotorically easier variant of standard joined-up handwriting. For that reason it is probably to be expected that a pupil will adopt its shapes faster and better.

In the observed field of writing skills (using grammatical rules) there is a statistically remarkable correlation of the grade with the system of writing: that could be interpreted such as the differences between system and grade are not stable. Different results are obtained by children in the second and third grades. It means that pupils using Comenia Script make fewer grammatical mistakes than children who use joined-up handwriting. In the fourth and fifth grades the differences are eradicated, and the results become equal. We also explain this fact through the lower graphomotor demands of Comenia Script. Pupils who write with this model acquire it more quickly, and therefore, they can focus more on the application of grammar rules.

In further phases of the research we want to pay attention to qualitative analyses of individual criteria and capture their developments within grades (thanks to the two waves of data collection).

Acknowledgement

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