Abstract

Elementary school students in the Czech Republic learn to write according to the joined-up linear handwriting model, which is different from handwritings used in other European countries. Joined-up linear handwriting is based on natural graphomotor development of children from pre-school education. The preparation for joined-up linear handwriting is initiated at least one year before the start of elementary schooling, which has been compulsory in the Czech Republic since 2017. It is a traditional type of handwriting, which is sometimes replaced by a simpler discontinuous form of handwriting. Therefore, the authors focused on an analysis of joined-up linear handwriting and observed to what extent this type of handwriting varied from the standard, considering several variables. At the same time, the researchers observed to what extent the handwriting was legible for the writers themselves. The quantitative research survey lasted for 5 years and the research sample comprised elementary school students from grades 1 to 5.

Keywords: joined-up linear handwriting, elementary school, research, qualitative elements of handwriting, analysis of students' handwriting, age and gender.

1 INTRODUCTION

Since 2014, students in the first grade of elementary school in the Czech Republic have an opportunity to learn to write according to at least two handwriting models approved by the Ministry of Education, Youth and Sports of the Czech Republic (also referred to as the MEYS CR). These models are the joined-up linear handwriting, i.e. the traditional handwriting model in the Czech Republic, and Comenia Script devised by Radana Lencová.

The current handwriting model places an emphasis on legibility, neatness and also speed of writing. In 2010, some primary schools started to offer a new handwriting model called Comenia Script. This fact inspired the authors to analyse the reasons for the previous joined-up linear handwriting model, i.e. the traditional handwriting model. The choice of the handwriting models was provided by the MEYS CR in line with the current curriculum (school educational programmes, also referred to as the SEPs) in order to accept parents' requirements.

The objective of the present study is to explore the relevance of joined-up linear handwriting in the first stage of elementary schools in specific categories, and to assess whether it is necessary to change the handwriting model in grade one. The research study is based on analysing the graphomotor skills in first-grade students and the writing skills in students in the first stage of elementary schools accompanied by worse writing quality and neatness. The research study has become more significant after schools gained autonomy and chose to use other handwriting models, and due to their possibility to deviate from traditional curricula by means of the SEPs.

2 DESCRIPTION OF THE QUALITATIVE FEATURES OF JOINED-UP LINEAR HANDWRITING

A closer look at handwriting reveals that letters consist of one or more elements, which differ in their shape and graphic form. For this reason it is extremely important for a beginning writer to first learn individual elements of letters and only after that whole shapes and their joining. In this context, joined-up linear handwriting can be assessed for several qualitative features.

Regarding the focus of the study it is desirable to characterize the groups of letter shapes because the observance of shape standards in various grades of primary school justifies the prevalent use of joined-up linear handwriting in the first stage of elementary schools.

2.1 Preparation for research

During the first phase of the research the authors studied Czech as well as international scientific literature, and prepared for data processing. An analysis of available literature suggested that there were no recent studies in the Czech Republic focusing on the qualitative features of joined-up linear handwriting by means of quantitative research methods. For these reasons, the authors formulated the criteria according to which the research was conducted. (Fasnerová, 2014)

2.2 Formulation of the research problem

The main research problem was to determine whether the existing joined-up linear handwriting model is sufficient for elementary school students.

This part will not describe the whole research in this area but only a part thereof – assessment of qualitative handwriting features regarding the respondents’ gender and age.

2.3 Objectives of the research study

The main objective of the present research study was to assess and analyse the degree of observance of the handwriting standard by means of assessing the qualitative features of joined-up linear handwriting through quantitative research methods (Fasnerová, 2014a).

The key question asked in the research study thus is whether the current joined-up linear handwriting model is appropriate for current students and whether it meets the requirements of the present time. This question was further detailed by sub-questions, which became a specific guidance for the selection and modification of the research tool and for the analysis of the collected data:

- What are the changes in the qualitative features of the handwriting model in primary school students, whose handwriting is still assessed, with regard to increasing writer’s experience?
- Does gender affect the neatness of handwriting?

2.4 Research hypotheses

The formulation of the research objective and partial questions relating to the research study was used to define the following hypotheses, taking into account the defined categorical variables (writer’s experience – more experience makes handwriting more automatic, the neatness of handwriting is affected by gender).

**Material hypothesis No. 1:** Students in higher grades deviate more from the handwriting shape standard.

1H₀: The deviation from the handwriting shape standard is not dependent on the student’s grade.
1Hₐ: The deviation from the handwriting shape standard is dependent on the student’s grade.

**Material hypothesis No. 2:** Students in higher grades show decreased handwriting neatness.

2 H₀: Handwriting neatness is not dependent on the student’s grade.
2 Hₐ: Handwriting neatness is dependent on the student’s grade.

**Material hypothesis No. 3:** Girls show a higher level of handwriting neatness compared with boys.

3 H₀: Handwriting neatness is not dependent on the student’s gender.
3 Hₐ: Handwriting neatness is dependent on the student’s gender.

2.5 Preliminary research and development of the research tools

The authors addressed a group of teachers and students for the purposes of a longitudinal research study assessing the handwriting of specific students through qualitative handwriting features. This comprised the principal research instrument.
The authors addressed teachers from 10 elementary schools, who were at the same time SEP coordinators and taught in primary school. To improve the quality of teaching and fulfill the school educational programme the teachers assessed the handwriting of their students. Due to the fact that this activity brought many problems and uncertainties, it was necessary to establish a group of teachers who would be involved for a period of five years (compulsory attendance in primary school) in systematic assessment of the qualitative features of students’ handwriting.

For the purposes of objective assessment of the qualitative features of students’ joined-up linear handwriting, the assessors were selected by means of the snowball technique. A sample of 10 handwritten pieces was originally assessed by three assessors, whose task was to analyze individual groups of handwriting, i.e. specific categories. The snowball technique was used to select the final four assessors – teachers in the first stage of elementary school.

The handwritten pieces were enriched with items that appeared crucial in the context of the issue. They also served as categorical variables in the hypotheses related to the research study. One of these variables was postponement of school attendance by one year, which is an issue presented in this paper.

The data relating to the qualitative features of handwriting of students in the first stage of elementary schools were assessed by means of a quantitative statistical method – Mann-Whitney U-test.

A test criterion was calculated for the null and alternative hypotheses to either confirm or refute the hypotheses. The testing was performed at a level of significance \( \alpha = 0.05 \).

To measure the association, the Kendall’s coefficient of concordance was used. The Kendall’s coefficient involves values in the interval from 0 to +1. The higher the value, the closer the association between the orderings (Chráska, 2007).

During the assessment and processing of aggregate results, it was necessary to well ‘represent’ the measured values, i.e. to describe them aptly and succinctly. For these purposes, the authors used the arithmetic mean and median. The median was used to order the values by their size and the sample was divided into two parts. If no statistical significance was observed, the results were further interpreted by means of the median.

The data obtained were evaluated and processed in the Excel and Statistica 12 programmes and plotted in graphs and tables.

### 2.6 Research sample

For clarity reasons, in the assessment of the data obtained it was necessary to outline factual data used in the process of assessment.

The present research study involved 98 respondents. Of the total number of respondents, 53 were girls (54.08%) and 45 were boys (45.92%).

#### Table 1. Respondents’ age

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
<th>Cumulative Count</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>53</td>
<td>53</td>
<td>54.08%</td>
<td>54.08%</td>
</tr>
<tr>
<td>CH</td>
<td>45</td>
<td>98</td>
<td>45.92%</td>
<td>100.00%</td>
</tr>
<tr>
<td>Missing</td>
<td>0</td>
<td>98</td>
<td>0.00%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

### 2.7 Testing of hypotheses

The formulated hypotheses were tested for statistical significance and the results were commented on in detail.

**Material hypothesis No. 1:** Students in higher grades deviate more from the handwriting shape standard.
Table 2. Handwriting shape deviation from standard by grade

<table>
<thead>
<tr>
<th>Cell No.</th>
<th>TPP_1</th>
<th>TPP_2</th>
<th>TPP_3</th>
<th>TPP_4</th>
<th>TPP_5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1,8571</td>
<td>0,988022</td>
<td>1,000000</td>
<td>1,690814</td>
<td>0,000000</td>
</tr>
<tr>
<td>2</td>
<td>1,8367</td>
<td>0,988022</td>
<td>0,988022</td>
<td>0,044582</td>
<td>0,000000</td>
</tr>
<tr>
<td>3</td>
<td>1,8571</td>
<td>1,000000</td>
<td>0,988022</td>
<td>0,160814</td>
<td>0,063464</td>
</tr>
<tr>
<td>4</td>
<td>1,9490</td>
<td>0,160814</td>
<td>0,044582</td>
<td>0,160814</td>
<td>0,063464</td>
</tr>
<tr>
<td>5</td>
<td>2,0561</td>
<td>0,000000</td>
<td>0,000000</td>
<td>0,000000</td>
<td>0,063464</td>
</tr>
</tbody>
</table>

The statistical calculation according to the Mann-Whitney U-test and Kendall’s coefficient of concordance suggests a statistically significant difference in the average assessment of handwriting shape features by grade. In this case the alternative hypothesis $H_A$ is confirmed and the null hypothesis $H_0$ refuted. It can therefore be stated that in higher grades students make on average larger shape deviations from the handwriting standard compared with lower grades. This can be explained by reduced control of the teacher, who does not assess individual shapes separately, because handwriting is deliberately addressed only in grade 1 to 3, when handwriting is included in the Czech language. After that the teacher monitors the overall neatness of students’ handwriting but does not systematically focus on individual handwriting shapes as is the case during learning and practising.

Material hypothesis No. 2: Students in higher grades show decreased handwriting neatness.

Table 3. Neatness of handwriting by grade

<table>
<thead>
<tr>
<th>Variable</th>
<th>Average Rank</th>
<th>Sum of Ranks</th>
<th>Mean</th>
<th>Std.Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upr1</td>
<td>2,831633</td>
<td>277,5000</td>
<td>1,346939</td>
<td>0,478443</td>
</tr>
<tr>
<td>Upr2</td>
<td>3,005102</td>
<td>294,5000</td>
<td>1,418367</td>
<td>0,495827</td>
</tr>
<tr>
<td>Upr3</td>
<td>2,903061</td>
<td>284,5000</td>
<td>1,377551</td>
<td>0,507984</td>
</tr>
<tr>
<td>Upr4</td>
<td>3,056122</td>
<td>299,5000</td>
<td>1,438776</td>
<td>0,538542</td>
</tr>
<tr>
<td>Upr5</td>
<td>3,204082</td>
<td>314,0000</td>
<td>1,500000</td>
<td>0,613424</td>
</tr>
</tbody>
</table>

The statistical calculation according to the Mann-Whitney U-test and Kendall’s coefficient of concordance suggests no statistically significant difference in the qualitative assessment of handwriting neatness by grade. In this case the null hypothesis $H_0$ is confirmed and the alternative hypothesis $H_A$ refuted. Handwriting neatness is not dependent on the student’s grade. In the assessment of the feature, the value of the median was 1, which suggests a high level of handwriting neatness in all grades. The overall impression of the students’ handwriting in all primary school grades was very good.

Material hypothesis No. 3: Girls show a higher level of handwriting neatness compared with boys.

Table 4. Neatness of handwriting by gender

<table>
<thead>
<tr>
<th>Effect</th>
<th>SS</th>
<th>Degr. of Freedom</th>
<th>MS</th>
<th>F</th>
<th>p</th>
<th>Partial eta-squared</th>
<th>Non-centrality</th>
<th>Observed power (alpha=0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercep</td>
<td>979,7717</td>
<td>1</td>
<td>979,7717</td>
<td>1227,460</td>
<td>0,000000</td>
<td>0,927463</td>
<td>1227,460</td>
<td>1,000000</td>
</tr>
<tr>
<td>pohlavi</td>
<td>0,4411</td>
<td>1</td>
<td>0,4411</td>
<td>0,553</td>
<td>0,49054</td>
<td>0,005724</td>
<td>0,553</td>
<td>0,113990</td>
</tr>
<tr>
<td>Error</td>
<td>76,5263</td>
<td>96</td>
<td>0,7982</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R1</td>
<td>1,3865</td>
<td>4</td>
<td>0,3471</td>
<td>2,303</td>
<td>0,058023</td>
<td>0,023426</td>
<td>9,211</td>
<td>0,668626</td>
</tr>
<tr>
<td>R1*pohlavi</td>
<td>0,7600</td>
<td>4</td>
<td>0,1900</td>
<td>1,260</td>
<td>0,285088</td>
<td>0,012959</td>
<td>5,041</td>
<td>0,394653</td>
</tr>
<tr>
<td>Error</td>
<td>57,8849</td>
<td>384</td>
<td>0,1507</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The statistical calculation according to the Mann-Whitney U-test and Kendall’s coefficient of concordance suggests no statistically significant difference in handwriting neatness between boys and girls by grade. In this case the null hypothesis $H_0$ is confirmed and the alternative hypothesis $H_A$ refuted. Handwriting neatness is not dependent on the student’s gender. This conclusion applies to those results that are associated with handwriting neatness. It should be noted however that although the median in both girls and boys was around 1, boxplot values in girls were between 1 and 2, while in boys the values were between 1 and 3. However, boys reach the value of 3 in grade 5, which implies that handwriting neatness is at a very high level in all primary school grades.

3 DISCUSSION AND CONCLUSION

The testing of the hypotheses formulated for the purposes of the research suggest very interesting conclusions and findings. A total of three hypotheses were tested – these were partial hypotheses of an extensive research study conducted in the Czech Republic by the Faculty of Education, Palacký University in Olomouc. The conclusions of the research study suggest that the shape features of various groups of handwriting are not dependent on the student’s grade. A statistically significant result was observed in handwriting shape features between girls and boys.

The assumptions of the authors and the general beliefs concerning weak handwriting performance in primary school that significantly deviate from the standards were not confirmed. This supports the assumption that it is not necessary to significantly change the joined-up linear handwriting model because most primary school students adhere to the standard or slightly deviate from the standard. This however does not suggest any need for a revision of teaching handwriting in elementary schools according to the joined-up linear handwriting model. In this context, however, it should also be mentioned that there are multiple ways and methods of evaluating the results of the five-year observation. It was impracticable to present all results in this paper because the research study would be too extensive; only those results were described that the authors believed were relevant to the issue. The authors believe it is desirable to further address other results obtained in the course of the research study.

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REFERENCES