TRAMES, 2000, **4(54/49)**, 1, 53–78

https://doi.org/10.3176/tr.2000.1.03

WRITING DISABILITIES OF ESTONIAN CHILDREN

Karl Karlep

University of Tartu

Abstract. This study deals with the writing disabilities of the Estonian children I have been studying during the last 30 years. It has been demonstrated that the cognitive model of writing in the Estonian language is close to the models in these languages where the phonological system of writing is prevailing (German, Russian and others) and that the model differs from the model of the English language. The language-specific mistakes in writing in Estonian are the mistakes in marking the three durations of the phonemes. Many mistakes are made in the orthography of the plosive consonants and in the marking of the long sounds of the other sound groups. It appeared that the orthography skill depends on the following meta-linguistic skills: the uninterrupted spelling of the word in sounds for determining the phoneme order, the changing of the sound durations for determining the duration degree. In adapting the teaching methods the following standpoints were taken into account: teaching by partial skills (operations), using the symbols and schemes as remedies, regulating the difficulty degree of the activity by means of remedies and with the assistance of the teacher by changing the volume and the complexity of the material. As a result of using the adapted methods, the average number of the orthography mistakes decreased approximately 2 times.

Key-words: Estonian language, quantity, dysgraphia, remedial school, learning difficulties, adapted methods.

Introduction

The article analyses the spelling mistakes and writing process by the Estonian pupils attending the remedial school and also the principles and results of the application of adapted orthography instruction. Spelling mistakes and component skills of the writing process such as sound order analysis, phoneme analysis, selection of graphemes and the role of the self-correction in this process are investigated. The aim of the study was to draw the model of writing process in Estonian and recommendations for teachers, based upon this model.

In the study of writing disabilities the role of developmental disorders of children, as well as the phonetics of the language and the rules of the letter usage have been the issue of interest (Ahvenainen et al 1977, Ellis 1995, Luria 1950, 1969, and others). In this article the attention is first of all paid to the language-specific manifestation of writing disabilities. In Estonian, for example, a specific

problem is to decide upon the usage of a single or a double letter in marking three degrees of quantity (Q_1, Q_2, and Q3) while writing. It depends on the language whether the child acquires the second, i. e. "visual lexicon". In other words, whether the cognitive operations will develop in order to be transferred from the articulated word to the written word and vice versa.

The article serves as a summary of the studies carried out over the last 30 years in the area of special mother-tongue instruction and speech therapy. The results of the studies and the discussion are introduced by sub-themes. The positions of fundamental sciences of the language didactics (linguistics, psychology, and psycholinguistics) are considered. Due to the restricted volume of the article, the above-mentioned aspects are discussed briefly and could be the topic of some other article.

2. Writing disabilities and the language system

Reading and writing disabilities are the most frequently occurring forms of learning difficulties. They are observed either jointly (i.e. dyslexia or, in other words, a compound reading and writing disorder) or as separate phenomena (i.e. dyslexia or a reading disorder, and dysgraphia or a writing disorder). The reason why they are often observed together is that the same child is diagnosed as having both disabilities and both are connected with written language. Although psychologists have been more interested in reading skills, writing disabilities are observed in the same context (Ellis 1995). In special education those disabilities are defined either as language disorders or learning difficulties. The former approach is typical of the German-Russian schools of special pedagogy (Estonia belongs to the same region), where writing and reading disabilities are dealt with in special schools and special classes. The latter is primarily characteristic of the English-speaking countries and of the cultures essentially influenced by them (Smith and Luckasson 1992). For example, some Dutch specialists find that in case of dyslexia the speech therapist is needed only in those instances which call for developing the child's phonological skills (Gersons-Wolfensberger and Ruijssenaars 1997).

The differences of approach may be explained by the distinct roles of particular skills involved in writing and reading in different languages, as was pointed out by Luria in 1950. The author argued that the articulatory and acoustic analysis is the more important, the more homogeneous is the accordance between the phonemes and graphemes in the language; hence, the more active is the involvement of the temporal lobe, the forehead lobe and the frontal parts of the parietal lobe in writing. The normal co-operation of the aforementioned areas of the brain cortex will guarantee the sound order analysis and phoneme analysis, which are the preconditions for correct spelling. In those languages where spelling deviates from pronunciation (e.g. English and French), where stipulated transcription is more relevant, the areas of the parietal-occiput lobe participate more actively in writing,

i.e. acquisition of the letter composition of words is important, and the relative importance of sound order analysis and phoneme analysis in writing is small. Luria (1950: 63) brings as an example a person of Polish origin who, following a trauma in the parietal-occiput area, became essentially dysgraphic in French, whereas his ability of correct spelling in Russian was preserved almost entirely.

Thus in languages with a varying accordance between phonemes and graphemes, children learning to read and write have to acquire the composition of words, more precisely the grapheme composition for a second time. In the case of a large majority of languages (among them Estonian) it is probably more expedient to acquire the algorithms for coding and decoding the phonemes and graphemes. In the latter case reading and writing are more closely connected with oral speech. The cognitive models of reading and writing in different languages reflect this phenomenon. The cognitive models of writing are greatly dependent on the principles of spelling followed by languages. Those principles may be either motivated or not (Zinder 1987). Among the former are the phonological principle and the morpheme principle, which both form the underlying basis of phonological writing. On the other hand, the tradition principle is not motivated.

In all alphabetical writings all these principles are applied, but their relative importance varies. The Finnish and Estonian writings are very close to the phonological principle (Zinder 1987: 30), whereas in English and French the tradition principle predominates.

In all languages, however, the accordance between graphemes and phonemes is governed by definite rules, which can be divided into two groups:

- correspondence between graphemes↔phonemes, which is irrelevant of particular words or morphemes (sound orthographic rules);
- orthographic rules which specify or modify the sound orthographic rules, depending on particular words or morphemes.

A number of reasons have been brought forth for the reading and writing disabilities among children. Disorders are usually caused by several reasons (Myklebust 1965, Salminen 1982, Lalajeva 1983, Reid 1994, and others). Among the most frequently indicated causes are disorders of oral speech, poor intellectual abilities, heredity, sensory disabilities, neurological factors, underdeveloped emotions, poor social circumstances, and inadequate teaching methods. This leads us to conclude that the aforementioned reasons may at least partially be interdependent or can be the result of a common biological deviation. Notwithstanding different aetiologies, disorders are expressed in a fairly similar way in different languages. In order to adapt teaching, it is useful to know what has caused a particular disability and in what forms it is expressed (Ellis 1995, Lalajeva 1983, and others).

In literature there are references to several features of writing disabilities, which do not depend on the language (Levina 1961, Myklebust 1965, Salminen 1981, and others). For example, in every language there exist the following developmental stages: 1) writing unrelated letters or series of scribbles; 2) disfigurement of the words' letter composition, although the words written can

be partially recognised; 3) writing words and simple sentences where many language-specific mistakes are made; 4) writing words and simple texts where besides the specific mistakes there are mistakes with rules (dysorthography); 5) orthography close to standards. All children having orthography disabilities at school do not reach the last stage.

This universality is likewise expressed in the types of mistakes: omitting letters and elements from the joined graphemes, removing, and adding. The difference appears in the more precise analysis of the aforementioned disabilities by the expression of language-specific mistakes, which result from the phonological system of a particular language. Specific mistakes, such as the wrong marking of sound duration (Garšviene 1993, Salminen 1981), confusing voiceless and voiced sounds and letters and sibilants (Garšviene 1993, Levina 1961, Luria 1950, 1969) have been recorded. In English, the main groups of mistakes are the "phonetic" writing and the writing of irregularly spelt words on the basis of analogy with regularly spelt words (*skool* pro *school*) (Ellis 1995). While in Russian, Finnish, Lithuanian and other languages with phonological writing systems the errors depend on how well the child is able to recognise the phonemes in the word, in English the mistakes are caused by orientation to the sounds (phonetic writing) (Myklebyst 1965, Ellis 1995).

Different languages adopt differing ways of teaching children to write. They may be either taught to acquire the letter composition of words (e.g. English) or to analyse the order of sounds and phonemes and after that encode phonemes↔graphemes. In the case of orientation to the letter composition of words, correct spelling will depend more on the familiarity of the words. For example, German children made considerably fewer mistakes than their English counterparts in reading and writing non-words as compared with familiar words (Wimmer 1993). In analysis-orientated teaching there appears a specific feature resulting from the phonology and sound orthographic rules of the particular language.

3. Phonology and sound orthography rules of Estonian

In Estonian there are 20 segmental phonemes: 9 vowels and 11 consonants, 3 of them plosives. Four consonants have got palatalised counterparts, but writing does not reflect this. There are no letter pairs to denote voiced-voiceless sounds, and only one sibilant /s/. Therefore Estonian children rarely confuse segmental phonemes in oral speech.

For marking the phonemes, there are 23 letters, 20 of which are used both as single or double. According to the traditional approach, the segmental phonemes have three phonological degrees of duration. The theory of sound duration is nowadays losing its importance (Ehala 1997, 1999, Hint 1998, Lehiste 1997, and others). By Lehiste (1997) Estonian prosody has to be described at several levels, such as segments (phonemes), syllables, feet and words. The manifestation of the quantity system requires interactive contribution of the three prosodic dimensions

(stress, duration, pitch) and specification of the number and position of syllables within the word. The duration of sounds is not an absolute, but a relative indicator and can be analysed within a word or syllable group (foot), and not within one syllable or sound (Ehala 1999, Lehiste 1997, Wiik 1997, and others).

The prosody of Estonian words is only indirectly reflected by orthography – the phonological length of the sounds is partially fixed. Other features of the quantity system (stress, pitch) are not marked in spelling. Thereby no alternative has been found for determining the sound length in teaching orthography (Ehala 1999: 380–381) and the term the length of the sound is still applied in the didactics. The quantity of the sound can be determined only in words or in metric feet. Therefore the student actually fixes the above-mentioned units (and not sounds) and in their composition also the relative phonological length of the sounds bearing the quantity. The analysis is performed for the sake of orthography, presuming identification of the three degrees of quantity. Phonetic duration degrees (seven for vowels, four for inter-vowel consonants) do not require consciousness; furthermore, duration between Q_2 and Q_3 vowels is inconsistent (Eek and Meister, 1997:73). Thus, while specifying "sound length", other features should also be taken into account, such as stress and pitch.

In Estonian the syllables form accentual-rhythmical units – metric feet. Words consist of metric feet (Ehala 1999, Hint 1998, Lehiste 1997, and others). A Q_3 syllable can exhaust a foot but a Q_2 or Q_1 syllable cannot. There are the following foot structures in Estonian: monosyllabic in the Q_3 (*saal* `hall`, *vank-reid* ´carriage´, part. pl.), disyllabic in Q_1, Q_2 and Q_3 (*muna* `egg`, *sammal* `moss`, *kotti* `bag`, part. *mesi-lane* `bee`) and trisyllabic in Q_1, Q_2 qnd Q_3 (*elama* `live`, inf., *kotiga* `bag`, comit. *lükkama* 'push', inf.). A foot or a word in Q_2 may consist only of short sounds (*silmad* 'eyes', *leivad* 'bread', nom., pl.). Thus connecting sound length with the word quantity should be avoided (Ehala 1999: 381).

On the basis of the description of the phonemes and graphemes it is possible to lay down the following rules of accordance between the phonemes and graphemes in Estonian:

- A short vowel between consonants, either at the beginning or end of a word is marked by a single letter, whereas a long or overlong vowel is marked by a double letter (*kala* 'fish', *kaalud* 'scales', *kaalus* 'weighed').
- A single letter marks a short non-plosive consonant between vowels, at the beginning or at the end of a word, e.g. *lamas* 'lay', whereas a double letter, *lammas* sheep, *sammus'* walked marks a long and overlong sound.
- The short plosive consonants are marked by the letters *g*, *b*, *d*, long plosive consonants by the letters *k*, *p*, *t*, and overlong plosive consonants between vowels or after a short vowel at the end of a word by the letters kk, pp, tt (*tuba* 'room', *käpad* 'paws', *kott* 'bag').
- In the diphthongs and consonant compounds only single letters are used (*õis* 'blossom', *sild* 'bridge', *müts* 'cap').
- An overlong plosive consonant following a diphthong or an overlong vowel is marked with a single letter (*eit* 'crone', *taat* 'old man').

Consequently, in order to apply Estonian sound orthography, the following skills are needed:

- ascertaining the sound group (vowel, plosive consonant, non-plosive consonant);
- deciding upon a single or double letter, considering the following characteristics: duration of the sound, group of the sound, group of the preceding or the following sound, ability to discriminate between single sounds and sound compounds.

The plosives need special attention. For marking their duration, there are generally three ways — *g, b, d – k, p, t* and *kk, pp, tt* (*tuba* 'room', *katus* 'roof', *kott* 'bag'). Within consonant compounds, marking of plosives is limited to two ways — *g, b, d* and *k, p, t* (*sild* 'bridge', *silt* 'label').

4. The research method

Reading and writing disabilities have been studied in Estonia for over 30 years. In order to find what kind of mistakes typically occur in writing dictations, copying and correcting exercises have been used. As subjects of the experiments pupils of remedial schools (1st – 6th year) and of ordinary schools (1st – 9th year) have been used, as well as pupils attending special classes for children with learning difficulties in ordinary schools. In remedial schools one and the same text was used for dictation for three times (1968, 1970 and 1988–1990) in order to assess the outcomes of the teaching adapted in 1969. As far as the data collected from different school types varied insignificantly with regard to error types and the numerical relations, the present article will confine itself only to the analysis of the results yielded by children of remedial education.

In parallel with written exercise tasks involving sound spelling and phoneme analysis (ascertaining the group and duration of the sounds) and self-correction was set.

The method was first adapted in 1969 after the level of the pupils had been ascertained. Later on the method has continuously been improved, and the results have been verified in the process of repeated experiments.

5. Spelling mistakes made by children of remedial education

Analysis of the dictations confirmed the fact that Estonian children too exhibit the referred stages of development (Levina 1961, Myklebust 1965). In the 1st year of the remedial school, and to some extent later as well, scribbling and occasional writing of single letters was observed. Next came exercises in which words were deformed to the point of becoming completely unidentifiable. Approximately 1/4 of the pupils of the 1st and 2nd forms of the remedial school appeared to be developmentally in this stage. At this level the following examples were

characteristic: *Velel on velui. Vullo on viud* (*Vellol on vibu* 'Vello has got a bow'). *Mik Lle mnk iuk.* (*Mikk ja Malle nägid tigu* 'Mikk and Malle saw a snail'). *Ema teki Öll kole polel.* (*Ema tegi õele kollase põlle* 'Mother made a yellow apron for the sister').

In the third stage, language-specific mistakes prevailed. In Estonian that means incorrect marking of the duration of sounds. For example: *õte emma lukes juutu. Enne nobis lilli.* (*Õde Emma luges juttu* 'Sister Emma read a story'. *Ene noppis lilli* 'Ene was picking flowers'.). Further on the amount of language-specific mistakes decreased and, having passed through the stage of dysgraphia, the children's writing skill approximated normal orthography.

The frequency of errors among children with writing disability is high. For example, among the children of remedial education the percentage of misspelt words in the dictation formed 58% in the 2nd year, 52% in the 3rd year, 41% in the 4th year, 23% in the 5th year and 16% in the 6th year. At the same time, in the 1st and 2nd forms of the ordinary school the percentages of misspelt words in the total amount were 5.7% and 3.1%, respectively (Karlep 1971).

The errors made by Estonian children in writing fall into two big groups:

1. The incorrect marking of segmental phonemes or their order in writing, which is expressed in substitution, omission and wrong sequencing of letters (*tüdluk, tüduk, türduk* pro *tüdruk* 'girl'). The mistakes may all occur together within the same word, as a result of which the word is completely disfigured (*jsnö* pro *jänes* 'hare'). The following cases of substitution of the plosives do not belong to this group (*g↔k, d↔t, b↔p*). The letter couples presented in the example are used for discriminating between degrees of duration of the same segmental phoneme.

Outwardly, the errors of the first type are similar in different languages, but the factors causing them are different. The more homogeneous the accordance between phonemes and graphemes in the language, the larger the dependence of the errors on the skill of performing sound order analysis (Levina 1961, Karlep 1971, Garšviene 1993). It is recognised that in cases where the tradition principle of writing is adhered to, errors occur when the writer relies only on the sound composition of the word (Myklebust 1965, Elbro 1993, and Ellis 1995). Characteristic examples include the following: *surch* pro *search*, *shoo* pro *shoe*, *nea* pro *knee* in English, and *veste* pro *vidste* 'knew', *lavkage* pro *lagkage* 'layer cake' in Danish (Ellis 1995, Elbro 1993). In Danish the letter is usually excluded in those cases when the sound being in accordance with the letter is not articulated in the word. This phenomenon is to some degree also noticeable in Estonian (*ommik* pro *hommik* 'morning'). In English the orthography of irregular words (*yacht, knight*) is considered to be especially difficult.

2. The incorrect marking of the duration of the sound in writing (quantity mistakes) which in Estonian is expressed in the incorrect use of the single and double letters and also in the substitutions *g↔k, d↔t, b↔p*. Writing a single letter instead of a double is a more frequent error, the opposite cases being comparatively rare.

All quantity mistakes together can be called quantitative substitutions. In principle the substitutions *g*↔*k*, or *k*↔*kk* and *a*↔*aa* are all similar if we view double letters as compound graphemes. These mistakes are language-specific and result from inadequate phoneme analysis (ascertaining the group and duration of the sounds) or codification.

At the early stages of learning to write (e.g. in the 2nd form of remedial education) quantity mistakes form up to 50% of the whole amount of errors, later on their relative significance increases (up to 70%, sometimes, depending on the text, even more). However, the higher percentage does not reflect an increase in the absolute quantity of mistakes, appearing as such against the background of the first group of errors, whose amount will decrease considerably faster (Karlep 1971, 1993). Attention should be paid to the fact that one group of mistakes dominates to a great extent over the others. This phenomenon is to some degree comparable to the mistakes with marking the sound duration in Finnish (Ahvenainen et al. 1977, Salminen 1982).

The frequency of quantity mistakes depends on the duration and group of the sounds. More mistakes occur with marking all the three durations of the plosive consonants and with marking the rest of the long sounds. Next by their frequency of occurrence come mistakes with the overlong vowels and non-plosive consonants. The regularity described is reflected by the proportional relationship between the errors and the corresponding number of graphemes in the text. This is illustrated by Table 1 (the data were collected in 1968, n = 444).

Table 1

Percentage of errors

Form	Vowels		Non-plosive	Consonants	Plosive consonants
	Long	Overlong	Long	Overlong	
2nd	54	31	40	51	44
3rd	41	27	37	13	31
4th	13	14	30	16	32
5th	14	9	18	6	17
6th	5	4	15	8	12

Later, after application of the adapted methods, the overall amount of quantity mistakes decreased, but the plosive consonants and the long sounds still appeared to be the most difficult for the children (Karlep 1993, 1996). The reason for the difficulties with the spelling of plosive consonants is the peculiarity of their system of graphemes as compared with the other sound groups (b-p-pp: a-aa, l-ll). The other long sounds cause many mistakes, because ascertaining their duration presumes comparison within a metric foot or word with both short and overlong sounds on the basis of several features (duration, pitch). In writing, however, the long sounds of the above-mentioned groups are marked in the same

way as the overlong sounds, viz. with a double letter. Because of this similarity in writing, in earlier days children were not taught how to discriminate between long and overlong sounds. If a child unconsciously perceived the difference between long and overlong sounds, the marking of a long sound with a single letter could easily be accounted for. According to the child's logic, however, the latter was not necessary, because he had already noticed the difference, i.e. he opposed the two durations in the way he had been taught. Ascertaining which duration is "medium" is difficult even if the child has been taught properly. In the first place, the polar characteristics are always simpler to discriminate between. Secondly, the short sound is opposed to the long one on the basis of duration, to the overlong on the basis of its two qualities – duration and pitch. The prerequisite of determining the sound duration is distinguishing the metric (accent) feet.

A peculiar group of quantity mistakes is made up by those cases where the sound next to a long or overlong one is marked with a double letter (*koolane* pro *kollane* 'yellow', *rõmmustas* pro *rõõmustas* 'delighted'). In this case the child perceives the stressed-rhythmical structure of the word, but is unable to realise which sound is longer than the others. Such mistakes should be evaluated positively, because such a child is in the process of learning to analyse. Likewise should the marking of an overlong sound in a compound (*põttra* pro *põtra* 'elk') with a double letter be evaluated positively. In this case the child has correctly analysed the duration of the sounds, but has failed in coding to ascertain the position of the analysable sound among the others. For example, in the word *põtra* the use of *t*↔*tt* depends on the letter or sound *r* belonging to the consonant compound.

In comparison with dictations, considerably fewer mistakes occur in copying (Karlep 1993) (in the early years of the remedial school, even up to 10 times). Also is the relative significance of quantity mistakes much smaller. In the whole body of errors the omission of diacritical marks formed ca 30%, omission of letters ca 25%, and substitution of letters and quantity mistakes both ca 13%. The mistakes were usually made more frequently when the original text was looked at more rarely. To be more precise, the following developmental tendencies were revealed: 1) frequent use of the original text and writing with a small number of mistakes; 2) looking at the original text more rarely, which resulted in an increased number of mistakes; 3) rare use of the original text and writing with a small number of mistakes. The last variant appears in the case of relatively well-developed orthographic skills.

More than by the number of mistakes the skill of copying is characterised by the frequency of using the original text. The latter is arrived at when dividing the overall number of times the original text was looked at by the number of letters in the text. The development of skills in the elementary school is indicated by the following relative numbers (n = 87): the 1st form – 0.76; the 2nd form – 0.63; the 3rd form – 0.46. Children tend to look at the original text most frequently before writing double letters, plosives and consonant compounds. In the 1st and 2nd forms the complicated shape of the letter also has some role to play. From the 4th

form up the text is written down mainly on a word basis, whereas from the 6th form up it is done mainly via groups of words and short sentences. An essential connection with the development of reading skill is observed: in the 3rd and 4th forms children go over to reading by words, and the pupils of the 6th form are able to read by syntagmas. Pupils of the same form show largely differing results in copying. For example, the minimal and maximal relative numbers were the following in the 1st form – 0.50 and 1.25; in the 2nd form – 0.23 and 0.99; in the 3rd form – 0.19 and 0.80. The relative number which is bigger than one indicates that the child looked at some letters more than once.

6. The problem of marking sound duration in different languages

Sound duration has a phonological function in many languages. Usually short sounds are opposed to long ones, mostly vowels. The Estonian child has to discriminate between three degrees. In the case of a sound articulated separately, it is not possible to determine the three degrees. The short and overlong sound can be discriminated between in a syllable. For marking a long sound, we need a combination of at least two syllables. From this it results that the duration of the sound in Estonian cannot be ascertained concurrently with sound order analysis. An additional stage of analysis is needed, in the process of which different phonological units will be opposed, consisting of the same segmental phonemes whose duration and/or intensity is different. For correct spelling it is also not enough if the duration of the sound has been ascertained. The rules of spelling depend on the group of the sounds (plosive consonants and the rest of the sounds) and whether the sound is part of a compound (excl. double letters) or not. Although Estonian orthography can be easily algorithmised, the two-step analysis makes writing comparatively complicated for children. Furthermore, deficiencies in the children's intellectual activity and/or development of speech are usually accompanied by their inadequate meta-linguistic abilities.

In Finnish too the phonological role of sound durations is very important, but Finnish sounds have only two durations and by the double letter both the long vowel and the geminate (*tulppaani* 'tulip') are marked. Although the use of the double letter in Finnish seems to be simpler than in Estonian, the incorrect marking of the sound durations is widely spread among Finnish children as well: *tulpani* pro *tulppaani* 'tulip', *akuri* pro *ankkuri* 'anchor' (Ahvenainen et al. 1977: 251). The same authors give as an example a child who wrote 20 words, making 22 mistakes; among them he wrote 10 times a double letter as single. In Latvian also the short and long vowels differ. In writing the long vowel is denoted with a diacritical sign (*māja*, 'house'). L. Keire (1994) revealed that orthographic errors with the long vowel were widely spread among Latvian children.

In Estonian, Finnish and Latvian, sound duration is ascertained by way of analysing the acoustics and articulation. Although in all these languages the marking of sound duration in writing has been regulated by rules, learners are still

liable to make many mistakes. A probable reason may be the need to conduct the analysis separately from determining the order of sounds.

In German, writing is generally considered to be phonological, but the marking of sound durations presumes adherence to the principle of tradition. For example, long vowels can be indicated in writing as follows: *Meer* 'sea', *Hahn* 'cock', *bar'* deprived'. In English the marking of long sounds is entirely governed by the principle of tradition. For example the phoneme [i:] is realised very differently in writing: *me, fee, sea, key, subpoena*. Hence the learner must either rely on analogy or simply learn the orthography of whole words, i.e. to acquire the "visual lexicon".

On the basis of the given examples one can argue that the mechanisms causing erroneous marking of sound duration in writing in different languages vary. Consequently, the treatment of sound duration in teaching to read and write should be different, primarily the relative role of visual memory in the writing.

We presume that Estonian children would not make the same mistakes repetitively in writing the same word over again. To get answers the pupils of the 3rd and 4th forms of the remedial school (n = 50) wrote the same dictation 9 times during one week (on three days in the first, third and fifth lessons); and the mistakes were analysed independently from the pupils. The repeated mistakes made in the nine exercises by the same child numbered only 121, forming 17.6% of the total amount of mistakes (1089 mistakes from 6703). The small percentage of repeated mistakes confirmed the opinion that in Estonian the memorised picture of the words' letter composition is not as essential for writing as in English (see Ellis 1995). The number of mistakes also varied greatly in the exercises of approximately 1/4 of the children. The best or the worst result could be achieved in any of the writings. Consequently, at least among one part of the pupils of the remedial school, success in orthography depends on their ability to work at the time of the writing. This points to the need to enhance the efficiency of teaching self-correction.

7. Skills of analysing the order of sounds and phoneme analysis

Whether it is necessary to teach sound order analysis prior to teaching children to read and write has been the object of debate since the 16th century (Kampmann 1918). Regarding phonological writing, nowadays there is usually no doubt about the need for such analysis. At the same time, what concerns the traditional system of spelling, like for example, English, there is no consensus about it (Ellis 1995, Cardoso-Martins 1995, Sanchez and Rudea 1991). Depending on the language, morpheme analysis could be useful as well (Elbro 1990).

The essence and function of sound order analysis in the case of phonological writing is understood quite differently (Elkonin 1991). The main problems involved are: whether the analysis is limited to recognising in the word the sound being learnt in order to identify the phoneme with a grapheme, or whether the

word is broken down into constituent sounds and the order of the phonemes is ascertained; whether the analysis is performed only on the basis of hearing or is articulation also involved; whether the word is divided into sounds at once or will there be an intermediate stage of recognising syllables, after which the sounds will be identified in the syllables. According to Elkonin (1991), the aim of the analysis is to determine the order of sounds (phonemes) in words. Spelling by sounds helps to overcome the need to divide words into syllables. If the pupils of the 1st and 2nd forms were not allowed to articulate at the time of writing, the amount of orthographic errors increased several times (Luria 1969). Elkonin (1991:59) suggests the repeated articulation of a word. Different sounds will be stressed and articulated in a longer duration in turn. For example: *mmama, maama, mamma, mamaa*. This method is not suitable in Estonian, where differences in the duration of sounds are already reflected in spelling. Suitable for Estonian is the so-called uninterrupted spelling of words by sounds – i.e. sound spelling – so that every sound forms a syllable or its analogue (sammal→s-a-m-a-l). As early as the beginning of this century, a similar method was proposed by Kampmann (1918:186). When the method is used, the pauses between the sounds should be ignored, as they would otherwise ruin the unity of the word. The naming of the sounds which follows such spelling can be seen as verbal confirmation of the results of the analysis (the sounds within the word are *s, a...*).

Consequently, the psycholinguistic mechanism of sound order analysis consists of the meta-linguistic skill of sound spelling. Elkonin (1991), a representative of the activity theory school of Russian psychology, considers it necessary that at the initial stage of developing this skill the analysis would be followed by marking down the phonemes into a scheme with symbols. The scheme reflects the phoneme composition of the word spatially and thus guarantees the possibility of self-correction. In addition to that, Elkonin proposes another interesting idea - estimating on the basis of sound order analysis the highest level of the skill mentioned - phoneme analysis. The latter presumes those phoneme characteristics important for any particular language will be established. In Russian this means ascertaining two sound groups (vowel, consonant) and discriminating between the pairs of voiced-voiceless and palatalised-unpalatalised sounds. The choice of graphemes in Russian will depend on the above characteristics, while the results of phoneme analysis are fixed by symbols.

As we have mentioned before, in Estonian, in order to choose the appropriate grapheme, the characteristics of phonemes one needs to determine are their duration and into which of the three sound groups they belong. How can that be done? Spelling by sounds does not enable one to ascertain sound duration. As we have mentioned earlier, it is a relative indicator, which becomes evident within metric feet consisting of 1–3 syllables. Sound durations within foot can be changed intentionally. The result is either some other word (*saal* 'hall'→*sall* 'shawl') or meaningless phonetic segments (*muna* 'egg'→*muuna*-Q_2, *muuna*-Q_3, *munna*-Q_2, *and munna*-Q_3). Such alternation of duration is the other meta-linguistic operation, which can be instrumental for acquisition of orthographic

skills. Having tried different sound durations, the child can then draw comparisons, which will help him/her determine the duration of a particular sound. The same skill is relevant in reading, helping one to choose the correct stressed-rhythmical structure from among several alternatives.

Consequently, for learning Estonian orthography, two meta-linguistic skills have to be acquired: firstly, how to establish accordance between speech segments and phonemes (spelling the word by sounds), and secondly, how to alternate sound durations (changing the sound duration).

The inadequate skill of spelling sounds in writing is characterised by the following mistakes (Karlep 1971): some sounds are not separated (*p-l-ats, s-sa-l*), some sounds are omitted (*p-l-t-s* pro *plats* 'square', *t-a-l-t-i-k* pro *taldrik* 'plate', *k-o-r-s-n* pro *korsten* 'chimney'), some sounds are substituted (*t-a-r-t-r-i-k* pro *taldrik* 'plate'), instead of smooth spelling, pauses are made in between sounds (*s, a, l* pro *s-a-l*), the order of sounds is wrong (*s-i-u-t-s* pro *suits* 'smoke'). The errors mentioned occurred both separately and together (*p-a-n, ts* pro *p-l-a-t-s* 'square').

The errors in spelling sounds will cause omission, removal, and substitution of letters in writing. Sound compounds cause more difficulties. In writing, it is common to substitute some letters for others because of their similarity (*m*↔*n, b*↔*d*↔*g*). As a result, the word may get completely disfigured in writing. The results are illustrated by the examples in research reports.

Jüri (2nd form, remedial school)

E: Name the sounds in the word *plats* 'square'. J.: *pall* 'ball'.

E: The word is *plats*. Subsequently the word is spelt together.

E.: Name the sounds. J.: *p-l-a-t-s*.

E.: Name the sounds in the word *tüdruk* `*girl*`. J.: *t-üt-t*.

Jüri was only able to repeat the task. In analysing a longer word the activity stopped. In writing Jüri changed the phoneme composition of the words. It is necessary to use co-operative activity and materialised methods.

Heldur (3rd form, remedial school)

E: Name the sounds in the word *plats* 'square'. H.: *p-l-t-s*.

E.: Name them again. H.: *p-l-t-a-s*.

Heldur failed to ascertain the vowel and its position. In writing he omitted and misplaced letters in words. It is necessary to use materialised methods.

To be able to determine whether a sound is overlong, long or short, the learner has to initially juxtapose all the three durations, in this way generating a comparative material for him/herself. It appeared, however, that the pupils were even unable to repeat correctly word pairs or word triplets by the duration of one sound (*kala* 'fish' – *kalla* 'calla', *tigu* 'snail' – *tiku* 'match+GEN' – *tikku* 'match+PART') before they had been specially trained to do so. Among the 77 pupils of the remedial school only 11 were able to perform the task completely (Karlep 1971). As a typical error they pronounced a long sound in a word either in the first or the third duration – pattern Q_2 is substituted by patterns Q_1 or Q_3.

Next, 15 word lines composed on the basis of varying durations of some sound were orally presented to the same children. The task was finding in which of the

words the sound was short, long or overlong. Only 5 pupils could correctly indicate the words containing a long sound, 40 pupils could perform the task partially. Somewhat more successful was the task of finding the words with short and overlong sounds. From among the words containing a short sound, 53% were determined correctly, while among the words with an overlong sound the percentage was 55%, and among the words with a long sound only 38%. Consequently, the reconstruction of the stressed-rhythmical structure of the words has a great impact on ascertaining sound duration. Those children who made more mistakes in performing the above task also made more quantity mistakes in writing. The results described were quite interesting, unfortunately, no comparative data could be found in pertaining literature.

As a rule, it is in their second year of life that Estonian children start to correctly realise the duration relations of sounds in their speech. The normally developing three-year-old children rarely commit errors with word quantity (Vesker 1985). At the age of two only 15 out of 25 children examined made some quantity errors. Children with undeveloped speech continued to make quantity mistakes even at school. 14.2–19.2 % of the words were articulated in Q_3 instead of Q_2 by pre-school children with undeveloped speech, and 12.0% of the words by children with undeveloped speech in their initial years at the speech school. Opposite mistakes were considerably less frequent (2.2–4.7%).

Vihman (1997) presumes that the pitch contour within the early word production associated with Q_3 and the timing distinction between Q_2 and Q_3 will be established only with the onset of grammatical learning.

The spelling and reading of word pairs or three-unit word lines based on varying sound durations are always characterised by a high percentage of mistakes. According to Kõdar's data (1996), 36% of normally developed six-year-old children and 32% of five-year-old children repeated the word lines correctly (n = 120). In the case of children of the same age with undeveloped speech only 9.4–9.8 % of the results were correct (n = 90). According to Vesker (1985), approximately every second child entering school makes mistakes when repeating word lines, and at the end of the 1st form about one fourth of the children still make the mistakes.

The pupils of the remedial school made fewer mistakes in reading than in repetition of the word-lines. In the repetition task the articulation was more influenced by the following word in the line and in reading by the preceding word. For example, the word-line *tigu-tiku-tikku* (`snail`, `match` , gen., `match`, part.) was repeated as *tigu-tikku-tikku* and read *tigu-tigu-tikku*. The word in Q_2 was replaced by the word in Q_1 or Q_3 that was previously articulated or perceived.

Subsequently, the skills of ascertaining sound durations were examined (Karlep, 1983). For this purpose 28 words were presented orally to the children. The durations of the critical vowels were determined correctly by 76.7%, of the consonants by 70.1% (in the 2nd form by 58.7% and 55.9%, respectively). The percentage of mistakes in the task of ascertaining sound durations came close to the percentage of incorrectly produced words in the task of repeating word lines.

Most difficulties were caused by the plosives, long sounds and sound compounds. It was observed that in ascertaining sound duration, the children tried to alternate the sound and gesticulate when doing so, i.e. they applied the methods they had learnt. If in the case of mistakes assistance was got from the symbols and schemes used in the adapted methods, it was possible to correct some of the mistakes. But this kind of slow analysis which relies on external means does not accord with the normal speed of writing.

The results of the sound and phoneme analysis confirmed the hypothesis that mistakes in marking segmental phonemes in Estonian are largely due to inadequate sound spelling analysis skills, whereas quantity mistakes are caused by inadequate phoneme analysis skills. The alternation of sound duration, which actually means going over from one stressed-rhythmical structure (foot) to another, should be considered a special meta-linguistic skill or operation unavoidable to apply Estonian orthography rules. No direct analogy to this has been found in pertaining literature. The Finnish methodology experts (Ahvenainen at al. 1979, Salminen 1982) suggest syllabification as a method for ascertaining sound duration. In this case the long consonant (geminate) will be divided between two syllables, and the long vowel will be found by relying on both the articulation and hearing in the syllable. Not without interest is the method suggested in the preliminary study of the Russian language, viz. transforming the stress from the stressed syllables to the unstressed ones: *molokó* 'milk'→*molóko*→*móloko* (Elkonin 1991:62).

8. Self-correction in writing

One can distinguish between the control of results, the accompanying or operational control, and the anticipating control (Markova 1974). Any learning process involves self-correction. According to Podolski (1987), for a rewarding self-correction, one has to know the pertaining methods (what and how to control), their role (for what), and how to join the acquired operations into a motivated activity. Therefore self-correction forms one partial skill of the orthographic skills. It has even been suggested that at the ordinary school approximately every fourth child with learning difficulties who has a writing disability has it because of undeveloped self-correction (Loginova 1996).

The control of results in writing is divided into two: comparing the written text with the original, or using special methods of control after writing. There is some ground to presume that the control operations are language-specific, depending primarily on the sound orthography rules applied in any particular language. The differences should be more evident in those cases, where the original texts for controlling are not available.

To examine how self-correction of orthography is performed by children of the remedial school, a series of experiments was arranged (Karlep 1996). First a text with mistakes was presented to the pupils together with the faultless original

(n=57). Without external assistance, the 2nd year pupils did not spot 23.5% of the mistakes, 32.6% by the 3rd year pupils, and 14,2% by the 5th year pupils. It became evident that children in the initial forms of the remedial school have not sufficiently developed skills for comparing the letter composition of words.

Subsequently a text with mistakes without the original text was presented to three 5th form groups of the remedial school (n = 63, 27 mistakes in the text). The pupils corrected approximately 71.0–79.7% of the mistakes, 9.8–24.3 % of the mistakes was not spotted, and 4.8–10.8% of the corrections was incorrect. When correcting, one can rely on the orthography of a familiar word in the memory, but inexperienced Estonian writers seldom use this method. This is also confirmed by the fact that when one and the same text is repeatedly re-written, the same mistakes are rarely made again.

As Estonian orthography is sound- and phoneme-analysis orientated, one can expect that the correction of mistakes is associated with the reading skill. If one is able to read in accordance with spelling and not by guessing the words, it is quite often that students successfully find errors in writing and vice versa. After the stage of correcting the mistakes the pupils were asked to read those words in which the mistakes had not been found. Only 5% of the words were read in accordance with their spelling by the 3rd form, and 24% by the 4th form. The essential correlation (0.89–0.95) became evident between the stages of correcting the mistakes and of reading in accordance with the spelling. All the experiments conducted in the remedial school revealed significant variance for within-class and between-class results obtained during the same school year.

Next it was examined how the pupils of the 4th form (n = 34) and 5th form (n = 22) of the remedial school were able to predict quantity mistakes in simple sounds. From among the words dictated to them the children had to write out all the variants of quantity mistakes and finally supply the correct orthography of that word. For example, in the case of the word *veeres* 'to roll, to wheel`+ PAST TENSE the correct performance of the task was the following: *veres* 'blood` + INESSIVE, *verres* - *veeres*. In the words with plosive consonants there were considerably more mistake variants: *kabis, kaabis, kapis, kappis* - *kaapis* 'scraped'. 71% of the 4th formers were able to do this and 75% of the 5th formers. Also it became evident that the combination vowel+plosive was considerably more difficult than vowel+non-plosive combinations. For example, the 4th formers could write out correctly only 51% of the words with plosive consonants.

The percentage of correcting mistakes in the tasks of self-correction is close to the skill of predicting mistakes. The correlation among the orthography of the dictated words and the skill for predicting mistakes were the following: the 4th form — 0.48; the 5th form — 0.65.

The results of all self-correction experiments combined suggest that systematic self-correction exercises should be introduced starting from the 4th form of the remedial school. Some simpler methods could be used earlier as well.

9. Models (strategies) of orthography

The models of writing and reading reflect the mental processes, which have to be performed in writing or reading (Ellis 1995). By Luria (1950; 1969) operations of writing depend on the correspondence between the phonemes and graphemes in the language. The same author draws attention to the following issue: as a result of extensive practice in branching, the operation itself decreases. In other words, articulation almost stops participating in writing and the writing of the familiar words may become a "movement stereotype". At the same time, the role performed by particular brain areas in writing changes (Luria 1969: 415). As writing skills develop, operation differences between different languages decrease.

According to Ellis (1995), the model gives a survey of those cognitive subsystems participating in reading or writing, which are partially independent of each other. In writing and/or reading disabilities some of those subsystems and modules may operate normally, while others may be dysfunctional, giving rise to various disabilities. Multiple variants of disabilities give information for composing the model of the usual process (Ellis 1995: 24). The models of the same process may rely on different theories and therefore reflect different characteristics of the process. For example, the models of writing and reading may reflect actual linguistic operations, their generalisation on a logical-psychological level, or neuropsychological operations. Moreover, the subjective vision of the composer of the model will be added (Leontjev 1997). Let us now look at the models of writing as exposed by the Finnish, Russian and English children.

In Finnish (Ahvenainen et al. 1997: 126) the operations in writing a word are described as follows:

* Repetition of the word.
* Distinction of the syllable (spelling).
* Distinguishing between the sounds within the syllable.
* Marking the sound letter by letter within a syllable.
* Separation of the next syllable, etc.

The finding of the long sounds belongs to syllabification as well: the long consonant as geminate is divided between two syllables, the long vowel will be determined in the syllable on the basis of hearing. Salminen (1982: 77) suggests that auditory analysis should be supported kinaesthetically and also explored by touch.

The presented model reflects linguistic and meta-linguistic operations. The precondition for performing these is considered to be the following normally developed perception types: optical, kinaesthetic, rhythm, phoneme and melody perceptions. When examining phoneme perception in the early years, more attention is paid to the skill of distinguishing between short and long sounds. German scientists too consider the same perception types as important in writing (Salminen 1982).

According to some Russian researchers (Luria 1969; Tsvetkova 1988; Elkonin 1991), the logical-psychological structure of the writing process in Russian is the following:

* Sound order analysis: distinguishing between the sounds, determining the phonemes and their order.
* Phoneme analysis: distinguishing between vowels and consonants, voiced and voiceless, and palatalised and non-palatalised consonants.
* Coding: choosing graphemes and writing letters (composing).
* Self-correction.

This degree of generalisation enables one to raise the pupils' performance thanks to the relevant instructional approach. In other words, depending on the language, it is possible to elaborate a language-dependent methodology to elaborate each partial skill. More language-specific are phoneme analysis and coding, in the case of which the phonology of any concrete language and sound orthography rules should be taken into account.

Depending on the language, sound order analysis may be more or less difficult for the child. For example, in Russian, children have difficulties with finding the group of sibilants; the reduced vowels may also cause problems. Among the preconditions, attention is paid to the following abilities/skills: auditory discrimination of phonemes, articulating, optical-spatial analysis, and operative memory, rhythm perception (Luria 1969, Tsvetkova 1988). Melody perception has not been mentioned as the precondition, whereas the relative importance of the mnemonic processes has been emphasised. The addition of self-correction into the model as an important partial skill may be considered.

The functional models of the cognitive processes applied in writing words in English differ considerably from the previous ones (Ellis 1995, Smith and Whiteley 1998). The reason lies in the difference of the alphabetic and orthographic skills needed as compared with more phonological writing systems. Ellis (1995: 63) discusses the writing of the learnt or not learnt words, and non-words separately. The writing of the familiar word may be different as well – either through the speech issue of the lexicon or not: semantic system → (speech output lexicon) → graphemic output lexicon → graphemic level → writing.

The connections between the levels are bilateral so the person writing may always turn back to the level of semantics and/or speech issue. For example, in case of homophones it is expedient to seek assistance from the semantics system (*peace* or *piece*). In insufficient knowledge of the grapheme lexicon, the influence of the speech lexicon is expressed in the "phonetic" writing (*bikoss* pro *because*, *skool* pro *school*).

In the case of unfamiliar words and non-words, the phoneme level should be applied additionally, but the grapheme lexicon could not be used directly. The model is the following: semantic system (not in the case of nonwords) → speech output lexicon → phoneme level (dividing the word into phonemes) → graphemic level → writing. In reaching the grapheme level there raises the need to find analogy in the grapheme lexicon. The orthography of irregular words should be

familiarised word by word. The latter could be compared with the learning of foreign loanwords in Estonian (*baas* 'basis', tiraaž 'edition') or with using the letter *h* at the beginning of the word (*allikas* 'source'- *hallikas* 'gray').

The model seems to be similar to the models applied in Finnish or Russian, but the coding; i.e. going over from the phoneme level to graphemes differs considerably. English-speaking children characteristically rely on analogy. For example, as pointed out by Campbell, the dictated non-word "*prein*" was written as *prain* after analysing the familiar word *brain*, and as *prane* after analysing the word *crane* (Ellis 1995: 66).

Comparing the model described with the strategies applicable in phonological writing there appears the following remarkable difference. In the English language, it is not enough to master the skill of sound order analysis and know the letters of the alphabet; it is also necessary to master the rules of grapheme: phoneme correspondence in the word depending on the grapheme composition of the whole word. In writing on the basis of spelling we have "phonetic" writing (*jragin* pro *dragon*, *chribls* pro *troubles*) (Ellis 1995:90). Those readers who make many mistakes in writing are "visual" readers, in other words, they use the whole-word strategy. They possess the logographic skills, but suffer shortages in alphabetic and orthographic skills (Smith and Whiteley 1998).

It is clear why in the examining of the preconditions for learning to read and write in English attention is paid to the skill of finding the rhyming words, and in teaching it is considered to be important to rely on analogy (*cat, rat, map; made, pane, table*). At the same time, it is logical that the teaching relies more on copying than in the case of phonological writing. Accordingly, it is easy to see why there are differing opinions towards criticism of excessive use of copying (Levina 1961).

Estonian writing is phonological like those of Finnish and Russian. The correspondence between graphemes and phonemes in Finnish are somewhat similar to those in Estonian. On the other hand, in Russian the relative importance of the morphological and tradition principles is bigger than in Estonian writing. By its general features the cognitive model of writing words in Estonian resembles the models composed for the two languages mentioned above, although the applicable linguistic and meta-linguistic operations are partially different (Karlep 1971, 1993).

* Sound order analysis: separating sounds, ascertaining phonemes and their order. The skill relies on the specific spelling by sounds – sound spelling. It is not expedient to syllabify like it is done in Finnish. Recognition of sounds is easier than in Russian (there is only one sibilant, the vowels do not get reduced, etc.).
* Phoneme analysis: differentiating between the vowels and plosive consonants and non-plosive consonants, determining the duration of sounds. Phoneme analysis in different languages is always specific and is dependent both on the phonetics of the language and the orthographic rules of sounds. The need for differentiating the three sound groups in the Estonian language results from the

Estonian alphabet, the differentiating of the three sound durations (more exactly of feet) is the specific nature of the Estonian phonetics. For determining the sound durations the children have to acquire the meta-linguistic operation - changing of the sound duration (foot). As we have mentioned before the differentiating of the short and long sounds in the Finnish language relies on the other meta-linguistic skill – syllabising. In the Russian language there is a need to determine the different characters of phonemes: voicedness and palatilisedness.

* Coding: choosing the single and double characters, using *g→k, b→p* and *d→t*. The grapheme choice is easy to be algorithmed but it presumes the skill of phoneme analysis.
* Self-correction: repeating analysis, comparing with the original, reading in accordance with the orthography etc.

The cognitive strategy of writing the words in Estonian are comparable with the writing in those languages where the phonological writing is used (e.g., Finnish and Russian). However, some differences between the strategies remain. Accordingly, the teaching methods used in other languages could not be taken over. Moreover, there is a danger of serious flaws when attempting to transfer the methodology of remediation of writing disabilities. The latter presumes complete consideration of the peculiarities of the language.

10. Teaching methods

The mastering of orthography is a long-lasting process. It appears especially in the case of writing disabilities. In the remedial school, it become further complicated due to the personality disorders and disorders of the cognitive development of pupils. Two models on which to base a sound instructional methodology in this case are as follows. First, the cognitive model of writing in this particular language. Secondarily, the pupil- or group-relevant instructional approaches (Karlep 1993).

The instructional methodology elaborated, proposed and applied by the author has the following four components (A to D).

A. Teaching component skills first, followed by the application of the new component skill into the complex skill (higher level operation). These component skills have been described above as a relevant cognitive model. In teaching to analyse sound order (determination of phoneme order) the main approach is to spell the word in sounds but definitely without pauses. In doing so the complexity of the phoneme composition of the words is taken into account (*uus* 'new', *suu* 'mouth', *saal* 'hall', *muna* 'egg', *eesel* 'donkey' etc.). At the same time the other well-known methods are applied like determining the number of the phonemes, comparing the phoneme composition of the words, grouping the words etc. Mastering the component skill has to be performed in the following sequence: (1)

spelling by sounds at different speed, (2) whispering, and (3) internal performance without outer articulating.

The aim of the phoneme analysis is to define the sound groups and the sound duration. To determine the sound group, the sheet tables (visual aids) of phonemes and graphemes are used where every group has been presented by a different colour. In the process of spelling the coloured paper strips are indicated where red is for vowels, green for plosive consonants and blue for non-plosive consonants. For determining the sound duration, the changing of sound duration, comparing and determining the duration on that basis are used. In the selection of single or double letters these tables and word schemes assist the child. The methods of self-correction are repeating the exercises, comparing the written word with the original, reading in accordance with the orthography, tasks for finding and correcting the mistakes, writing out the possible mistakes before the correct writing of the word etc. To ensure the completion of the entire set of component skills, algorithms or instructions consisting of symbols are used.

B. Teaching at increasing levels of complexity.

1. Treating the three durations of every phoneme (a) separately, (b) differentiating in pairs and (c) differentiating all three durations of the sound. Mainly the monosyllabic and disyllabic words are used.
2. Treating the three sound durations in phonemes. In the case of the plosive consonants the sound durations could at first be differentiated in the pairs as well. Mainly the words with up to three syllables are analysed and written.
3. Treating the sound durations in the sound groups. The four-syllabic words are used as well.
4. Treating the sound durations in the range of the mistake-dangerous sounds. More attention is paid to the second quantity and consonant compounds.

The performance level of pupils allowing, relevant instruction may start at stages two or three. In the remedial education, the mastering of every skill may take up to one school year. Instruction following these levels starts in form 2. In form 1, instruction is concentrated on the skills of sound order determination. Meanwhile, preliminary survey of sound durations and groups is provided.

C. Regulating the degree of difficulty in learning.

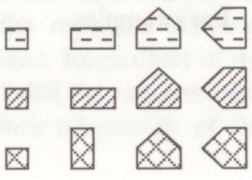
For this aim, the teacher's degree involvement is changed, practice material strictly grouped, visual aids are used (schemes, signs, guiding-marks). In the actual learning, all this is used simultaneously. To determine the sound groups and durations the child is assisted by visual aids which reflect the sound group (colour), sound duration (magnitude) and assist in the selection of single or double letters (longness of the lower edge).

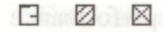
The following symbols are in use:

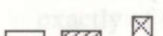
Symbols of the vowels (red) –

Symbols of the non-plosive consonants (blue) –

Symbols of the plosive consonants (green) –



 – symbols of short sounds, marked by single letters, *g,b d* included

 – symbols of long sounds, marked by double letters (*aa, ss*) or single *k, p* and *t*

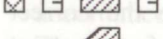
 – symbols of overlong sounds, marked by double letters

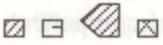
 – symbols of overlong sounds, marked by single letters

The symbols placed fourth in the word are actually the figures being in the third position in a different pose. They are used in the case of sound compounds (the symbol will be raised "upright").

For example:

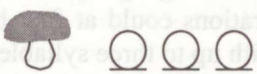
 – *kallas* 'shore'

 – *sild* 'bridge'

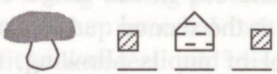
 – *kool* 'school'

At first the scheme will be composed in stages:

1. The dictated word (*seen* 'mushroom') or in accordance with the picture the order of phonemes will be fixed by means of the spelling in sounds.



2. By means of the changing of sound duration the sound durations will be found (*seen-senn*). Sound group will be determined by means of the table.



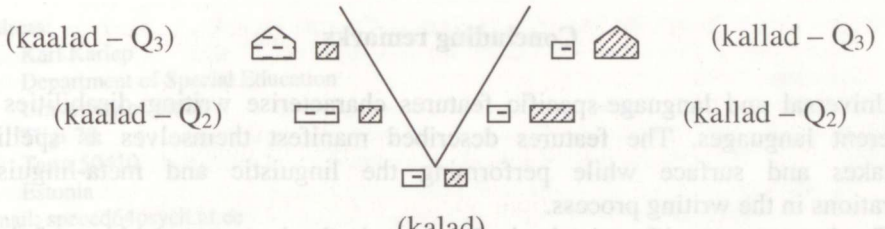
As an intermediate stage the white symbols may be used, the white ones will be replaced with coloured symbols.

3. Single or double letters are chosen on the basis of the scheme. The word will be either composed or written.

The schemes composed of the symbols are compared with the letter composition of the words more generalised but at the same time more concrete as well (they fix the sound group, sound duration and are the "bridges" between phonemes and graphemes).

Later on the symbols will be used only for analysing the sounds with the big mistake-risk on the border of the first and second syllable. Schemes will be composed of those symbols and the schemes will be the guiding-marks in changing the sound durations - they reflect all the variants of articulating the word.

For example:



D. Complex skills are mastered step by step. The initial learning of a new skill begins with the introduction to the visual aids (schemes, signs) which is accompanied by external speech (often by turns or with the teacher). Afterwards the relative importance of the visual signs decreases and the tasks are fulfilled relying on the speech. In this stage the change of the speed, transfer to whisper and finally the silent articulating are practised. The mastery or automation of the complex skills is of utmost importance: if not mastered, writing will be performed without any analysis. This occurs because the psychomotor movements in writing by far exceed the speed of complex skills of analysis. In other words, the child may write faster than analyse the word.

The component and complex skills under scrutiny have been examined repeatedly.

Table 2 presents the data about performing the task of writing identical dictations.

Table 2

Average number of mistakes in the dictations of the remedial school pupils

	Year		
	1968	1970	1988-1990
Form	n = 426	n = 588	(n = 210)
III	14,1	8,2	–
IV	15,5	8,2	7,9
V	10,5	6,6	5,04
VI	9,9	8,0	5,9

Overall, the average number of mistakes decreased considerably during the two first years when the novel instructional methodology was applied. The results improved to some degree, based upon the methodology, introduction of textbooks and printed sheets, and relevant teacher training. Pupils of the same schoolyear demonstrated high variability of their results, e. g., in the repeated identical dictations. Almost no-one completed the tasks without mistakes. Regardless of the adapted methods, 25-35% of the pupils remained unable to fulfil the requirements of remedial school curricula. These pupils will need further adaptation of the curriculum (IEP).

Concluding remarks

Universal and language-specific features characterise writing disabilities in different languages. The features described manifest themselves as spelling mistakes and surface while performing the linguistic and meta-linguistic operations in the writing process.

The language-specific mistake in Estonian is the incorrect marking of three sound durations, constituting up to half of the mistakes in the first two forms of the remedial school, later on app. 75% of the mistakes as other difficulties are overcome faster and more easily. In Estonian, the biggest number of mistakes is made in the orthography of plosive consonants. This is caused (1) by the different system of graphemes applicable when compared to the other sound groups and (2) in marking long sounds (which differ from short sounds mainly by relative duration, from overlong sounds by pitch in foot). Actually there are other phonetic features of Estonian quantity system as well – stress, duration, pitch, the number and position of syllables in the word. Therefore the length of the sound can be determined either in the foot or in the word.

In the case of writing disabilities either all or some component skills of the writing process (such as sound analysis, phoneme analysis, the choice of the letter and self-correction) have not been fully mastered. It is expressed in the poor performance in the skills of sound spelling, changing the duration of sounds, spotting and correcting the mistakes.

Models of writing reflect the mental processes in writing – linguistic and meta-linguistic operations. The strategy of writing in Estonian is comparable with the models in those languages where the phonological writing is used (Finnish, Russian and others). Other strategies are applied in the languages where the orthography is governed by the tradition principle (English, for example). In the present article the following model considering the peculiarities of Estonian is presented – sound order analysis – phoneme analysis – coding – writing – self-correction. Of these, language-specific operations are the phoneme analysis and coding.

The adapted teaching methodology for the children with writing disabilities is based upon the model of writing process. The method is characterised by the following – teaching component skills, regulating the degree of difficulty in learning, teaching at increasing levels of complexity, step by step mastering of the complex skills.

There has been a remarkable improvement in writing skills by remedial school pupils during the past three decades in Estonia. This should serve as an assurance of the relevance of the applied methodology. Follow-up experiments seem to prove the relevance of the analysis and the model as well.

Address:
Karl Karlep
Department of Special Education
University of Tartu
Tiigi 78
Tartu 50410
Estonia
E-mail: speced64psych.ut.ee

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