Readability of CVA Education Materials: Using Mistrík’s Formula and Listening Test

*Romana Chamerová, *Petra Mandysová

* Faculty of Health Studies, University of Pardubice

**ABSTRACT**

**Aim:** The aim of this study was to determine and compare the comprehensibility of education materials (EM) on stroke (CVA) for the public.

**Methods:** The first phase of the research involved the identification of education materials on CVA that can be found in selected healthcare facilities. Using Mistrík's Formula, these EM were subjected to mathematical text analysis, which identified the easiest and the hardest EM to understand among them. Subsequently, a listening test for each of these two EM was developed to establish the comprehensibility of the texts for the public. Through non-random sampling, a group of 37 respondents in two senior citizens' homes was selected for these two listening tests. The inclusion criteria consisted of the age over 65 and the passing of a cognitive screening test.

**Results:** Of the four identified EM, three were of sufficient length (minimum of 300 words) for the mathematical analysis using Mistrík’s Formula to be conducted. Based on the formula, the highest score was 31 of the 50 maximum points – the EM with this score was identified as the easiest EM to understand. The EM with the lowest score (16) was identified as the hardest EM to understand. The result of Listening Test 1 for the easiest EM to understand was 39 %, while Listening Test 2 concerning the hardest EM to understand scored 26 %. The hardest EM to understand recorded a lower comprehensibility than the easiest EM to understand not only according to Mistrík's Formula, but also to the listening tests. It is, however, noteworthy that even the easiest EM to understand showed relatively low comprehensibility.

**Conclusions:** The comprehensibility of education materials for the public requires attention. Research in this field could generate practical proposals how to make EM as clear as possible.

**KEY WORDS**
cerebrovascular accident, educational materials, cognitive screening, Mistrík’s Formula, listening test

**INTRODUCTION**

One of the factors affecting the quality of educational materials (EM) designed for the public is their comprehensibility. If an EM is incomprehensible to the public, it may not be of much practical use. Clients are very likely unable to process and use the information adequately.

The comprehensibility (degree of difficulty or readability) of the text can be evaluated using the mathematical analysis of the text (does not require the client's presence) or with the help of tests that identify the clarity of the selected text directly with clients. (Bastable, 2008, p 258–260)

**EVALUATION OF COMPREHENSION USING MATHEMATICAL ANALYSIS**

Foreign specialized literature lists over 40 methods of mathematical analysis of the text – “readability formulas”, e.g. the SMOG, Fog, Fry, and Flesch formulas. (Clayton, 2009, p 2,230)

These are commonly used in nursing and other health professions when assessing the clarity of health and disease EM designed for the public. (Bastable, 2008, pp. 258–260; Freda, 2005, p 151; Friedman, Hoffman–Goetz, 2006, pp. 354–361; Quirk, 2000, p 26)

The readability formulas mentioned are not available in the Czech language, however. Instead, we can use Mistrík's Formula (Jonák, 2005) or The Difficulty of Educational Materials by Nestlerová–Průcha–Pluskal (Průcha, 2002; Jonák, 2005). Mistrík's Formula was first described for practical application in the Slovak
language. (Mistrík, 1968) This formula (Fig. 1) integrates three parameters: “V” – average sentence length in words (indicates the complexity of ideas expressed), “S” – average word length in the number of syllables (indicates the conceptual load of the text) and “I” – index of word repetition (characterizes the lexical variability of the text). The word repetition index is calculated using the formula \( I = \frac{N}{L} \), where “N” represents the number of all words used in the tests and “L” the number of different words. (Jonák, 2005)

\[
R = 50 - \frac{V \times S}{N/L}
\]

\( V \) = average sentence length in words; \( S \) = average word length in the number of syllables; \( N \) = number of words; \( L \) = number of different words

**Fig. 1** Mistrík’s Formula (Jonák, 2005)

The calculation ranges from 0 to 50 points. Texts that are easiest to comprehend score 40–50 points, while those that are most difficult score from 0 to 10 points. The testing requires a sample text with a minimum of 300 words. (Jonák, 2005)

Available Czech literature indicates that the clarity and readability of the text established by using mathematical analysis – Mistrík’s Formula (Jonák, 2005) or The Difficulty of Education Materials by Nestlerová–Průcha–Pluskal (Průcha, 2002; Jonák, 2005) have in the Czech environment only been studied as part of research that focused on the development and use of primary and secondary school textbooks (Maňák, Knecht, 2007), and not a research connected to health and disease–related education.

**Comprehensibility Evaluation through Client Testing**

Evaluation of the EM comprehensibility carried out by testing clients primarily involves a listening test and a cloze test (replacing missing words). (Bastable, 2008, pp 258–260; Menghini, 2005, p 277) Unlike the above formulas, these methods work not only with the text but also with the client, identifying to what extent the client understands a written or an audio version of the text. (Bastable, 2008, pp 258–260; Cutilli, 2005, pp 374–376)

With a listening test, a passage from EM is selected and read aloud to the client at normal speed. The client is then asked 5 to 10 short questions concerning the key points of the text, and the answers are recorded. The client’s score is determined by dividing the number of correct answers by the total number of questions. EM is considered fully understood if the score is 90% and more.

The score of 75–89% means that the client has understood EM quite well, while scores below 75% indicate that the materials are difficult to understand. When using this test, it is recommended that clients do not have much previous knowledge on the topic, which they could draw on in their replies and which could lead to a false high score. (Bastable, 2008, p 260)

In foreign nursing literature, the use of listening tests is mentioned by, for instance, Menghini (2005, p 277), in the development and the assessment of the difficulty of EM designed for parents of children admitted in the intensive care unit.

In the Czech Republic, listening tests are mostly used in foreign language education; the generally available Czech literature on nursing has not described yet their application in the evaluation of the comprehensibility of EM for clients–patients.

**OBJECTIVES**

The main objective of the research was to establish and compare the clarity of EM on CVA for the public over the age of 65 with the help of Mistrík’s Formula on the one hand and of the relevant listening test on the other. The research formed a part of the thesis of the first author of this article. (Chamerová, 2011)

**METHODS**

The first phase of the research (June 2010) involved the collection of EM on CVA at selected healthcare facilities (Table 1). In the second phase of the research, all acquired EM were subjected to the calculation of the comprehensibility of the text using Mistrík’s Formula. Based on the outcome, two EM were selected – one with the highest score, which was described as “the easiest to understand” and one with the lowest score, which was described as “the least comprehensible” – to be used in the development of Listening Tests 1 and 2 (each EM required its own listening test).

For each EM, a 300-word passage was selected and a list of possible questions regarding its content was compiled. Each passage contained a different piece of information about CVA (definition, risk factors, treatment, prevention). Then (in the third phase of the research), for both the passages and the relevant list of questions a preliminary research was carried out for two purposes. Firstly, a small group of members of the general public that had not read the text before were given questions in order to establish their general knowledge about CVA. The aim was to identify any questions based on the text that proved too easy and could have been answered correctly in the research even without listening to the EM, and eliminate them from the final version of the listening test.
Secondly, the preliminary research served as a rehearsal for correct reading of the listening test by the researcher and for test evaluation.

The actual research with respondents (the fourth phase of the research) was launched with a cognitive screening involving a minute-long verbal production in the category of animals. (Kopeček et al., 2009) The respondents were required to name at least 12 animals in one minute. The number of animals was tallied by the researcher. The cognitive screening was prerequisite to the listening tests; it eliminated respondents whose potential difficulties with the listening tests would have been caused by cognitive impairment rather than the difficulty of the text itself.

The screening was immediately followed by Listening Test 1. Respondents listened to a passage from the “easiest to comprehend” EM, after which they were immediately given 8 open questions. The answers to these questions were all in the text the respondents had just heard. The same procedure was applied for Listening Test 2, which involved the “least comprehensible” EM; it was carried out directly after Listening Test 1.

Each listening test covered different CVA issues, but the gist of every question was that respondents were to repeat information contained in the passages that had been read aloud. Listening Test 1 contained general information about CVA, its development, risk factors, consequences, types, and frequency of occurrence. The test included 8 questions such as: "What is the cause of ischemic CVA?"; "What is the cause of hemorrhagic CVA?"; "How many people a year suffer a stroke?" etc. Listening Test 2 described the treatment of CVA. The test included 8 questions such as: "What are the treatment basics for CVA?"; “What is the principle of the treatment?”; “Name at least one medical complication after CVA”, etc.

Based on Listening Tests 1 and 2, the EM comprehensibility was established in the fifth phase of the research in terms of percentage. For both analyzed EM the comparison was made of the resulting level of clarity obtained with Mistrík’s test and the relevant listening test respectively.

### Table 1 Overview of research methodology

<table>
<thead>
<tr>
<th>Phase</th>
<th>Collection of EM at selected healthcare facilities (4 EM acquired)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 2</td>
<td>Calculation of Mistrík’s Formulas for all 4 EM obtained in Phase 1, and identification of the “easiest to understand” and the “least comprehensible” EM</td>
</tr>
<tr>
<td>Phase 3</td>
<td>Preliminary research and development of listening tests concerning 2 EM identified in Phase 2; rehearsal of the application of the listening tests</td>
</tr>
<tr>
<td>Phase 4</td>
<td>Testing of respondents: Cognitive screening, followed by: a) Listening Test 1; b) Listening Test 2</td>
</tr>
<tr>
<td>Phase 5</td>
<td>Evaluation of the listening tests and comparison of the scores based on Mistrík’s Formula (percentage)</td>
</tr>
</tbody>
</table>

EM = educational materials

### PARTICIPANTS

Research participants were members of the public over the age of 65. The sampling method employed was non-random – a total of 50 respondents from two senior citizens’ homes in Central Bohemia were addressed. In the first senior citizens’ home 30 respondents were addressed. Six of them failed the cognitive screening and cooperation with them was therefore terminated. Listening tests 1 and 2 were thus completed by 24 respondents. In the other senior citizens’ home, 20 respondents were addressed, of whom 7 refused to participate. Listening tests 1 and 2 were completed by all of the remaining 13 respondents as they had all passed the cognitive screening test. Ultimately, 37 results of listening tests 1 and 2 were collected to be further processed.

### RESULTS

#### Selection of education materials

A total of 16 outpatient and inpatient healthcare facilities were visited (with an emphasis on visiting neurological, internal and geriatric departments and hospitals for terminal illnesses), where 4 different EMs were collected. These EMs were designed to educate the public about recovering from CVA and prevention of this disease. One EM was not included in the subsequent mathematical analysis of the clarity of the text because it was too short (with only 150 words it did not qualify for the application of Mistrík’s Formula).

#### Comparison of results obtained through Mistrík’s Formula and results of listening tests

As the EM titled "Stroke is Fast! How About You?" (2008) scored 31 points based on Mistrík’s Formula, it was evaluated as “the easiest to understand” from the collected EM (Table 2). It was then used to create Listening Test 1, which scored 39% on average when
used with the respondents. Listening Test 2 involved a passage from EM titled “Acute CVA” (Kalita, 2010). Using Mistrík’s Formula the passage scored a total of 16 points, which meant it was evaluated as the “least comprehensible” of all the three collected EM. Average score on Listening Test 2 of this EM was 26%. Using Mistrík’s Formula, the EM titled “Why Prevent a Stroke” (2010) scored 23 points – this EM, nonetheless, was not used to create the listening test.

**DISCUSSION**

The research findings indicate that according to Mistrík’s Formula, none of the three analyzed EM is very clear: even the “easiest to understand” text – “Stroke is Fast! How About You?” (2008) – appears to be only slightly above average in terms of its comprehensibility (having scored 31 points of the maximum of 50). The other two EM – “Why Prevent a Stroke?” (2010) and “Acute CVA” (Kalita, 2010) – were, based on Mistrík’s Formula, even more difficult to understand.

The results of listening tests concerning EM which Mistrík’s Formula had shown to have the highest and lowest scores, indicate that both the EM were difficult to understand for the respondents – the respondents were able to correctly answer 39% of questions based on the text of the EM which Mistrík’s Formula had rated as “the easiest to understand”, and correctly answer about a quarter (26%) of questions based on the text of the EM which Mistrík’s Formula had rated as “the least comprehensible” (Table 1). As mentioned previously, Bastable (2008, p 260) states that comprehension below 75% means that the material is difficult to understand – the results of the present research are far below this limit.

Furthermore, the comparison of results generated by Mistrík’s Formula for the above two EM on one hand and the listening tests on the other, revealed that both Mistrík’s Formula and the relevant listening test identified the EM “Acute CVA” (Kalita, 2010) as the harder to understand than the other EM – “Stroke is Fast! How About You?” (2008). The result of this comparison is logical and supports the idea of the validity of both types of the instruments (Mistrík’s Formula and the listening test) that measure the clarity of the text.

However, there are still questions concerning the validity of these assessment tools. In terms of the listening test, a question is if listening to texts that were originally intended for reading (in a generation of clients who are used to gather information visually) could affect the understanding of the text and if the comprehension would improve were the clients allowed to read the texts for themselves.

**CONCLUSION**

The results based on Mistrík’s Formula and listening tests reflect the difficulty of EM on CVA that are available for the public at healthcare facilities.

In conclusion, several basic recommendations for practice are suggested, relating to the development of EM: It is important to pay attention to the difficulty of educational materials, without assuming that the public understands them; replace technical terms with generally known equivalents (if possible); make information short and concise; closely cooperate with the target group when compiling educational materials.

Further research on the clarity of EM – including research on the use or development of other tools for the assessment of the EM readability and the validity and reliability of these instruments – could improve understanding of this issue and lead to detailed proposals on how to make EM as clear as possible.

**REFERENCES**


---

**Table 2** Comparison of results generated by Mistrík’s Formula and results of listening tests

<table>
<thead>
<tr>
<th>Education material</th>
<th>Mistrík’s Formula</th>
<th>Listening test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke is Fast! How About You? (2008)</td>
<td>31 points</td>
<td>39% (Listening Test 1)</td>
</tr>
<tr>
<td>Acute CVA (Kalita, 2010)</td>
<td>16 points</td>
<td>26% (Listening Test 2)</td>
</tr>
<tr>
<td>Maximum score</td>
<td>50 points</td>
<td>100%</td>
</tr>
</tbody>
</table>