

Teaching Deaf Students' Physics and Astronomy in Bulgaria

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Abstract. The article presents a new strategy to be implemented in Bulgarian schools in teaching physics and astronomy to students with impaired hearing, grades 7 (13 - year old students) and 8 (14 - year old students). The strategy provides effective education for students with hearing disabilities in mainstream schools as well as to those attending specialized schools. A multimedia CD has been developed, which offers a large number of basic terms from the corresponding fields of physics and astronomy, accompanied by textual explanation and various illustrations. The terms are explained in Bulgarian, Bulgarian sign language and English. This multimedia product can be used by children with hearing disabilities, as well as by children without disorders.

The introduction

Introducing students with hearing disabilities to the basic concepts of physics and astronomy is a difficult and complex process, because of the abstract nature of the terms used. Sometimes even adults with hearing disabilities have trouble in the understanding.

Description of the Specialized Sign Dictionary Human and Nature, Physics and Astronomy Multimedia Developed by the Authors

All sign languages differ from each other as spoken languages do. Thus, a Bulgarian sign language is different from British, Spanish, and Russian. Sign languages are different even when countries share one spoken language (e.g. UK, USA, and Australia). However, there are similar signs because sign languages are visual languages.

There are educational systems that use signs as part of their programme. Such language programme is Makaton, which offers teaching of people with communication and learning difficulties but Bulgarian sign Language is the language of deaf people, who are members of the deaf culture. Sign language is a product of communication between the members of deaf society with its own grammar and structure like any other spoken language. There are countries that have accepted the sign language of the deaf members of society as their second official language (e.g. USA, Sweden, etc.). Bulgarian sign language is not among these countries yet.

The physics and astronomy as subjects in the Bulgarian school have taught from 7th grade onward (13 - year old students).

The dictionary contains 386 items, presented by 776 signs and 27 articles offering additional information. A number of pictures are also included. Additionally, corresponding articles, definitions and terms contain hyperlinks.

Most of the terms have illustrated with an additional images.

The multimedia CD has developed using HTML and Javascript. The signs have shown in FLASH clips. The audio has dubbed and edited in Cool Edit Pro so that the parasite noises have wiped out and the voice of the performer is clear and nice. The recorded video has edited in Ulead video editor and then imported to FLASH with minimal compression. The FLASH clips have created in the Macromedia Flash. Both HTML and FLASH formats have chosen according to the platform of independence of the product, i.e. the multimedia CD can to play on Windows as well as on UNIX machines with graphical environment and browser installed.

The multimedia CD is trilingual - it uses Bulgarian, English and Bulgarian sign languages. Hyperlinks between the Bulgarian and the English sections have supported as well, so that Bulgarian students without hearing disabilities are given the opportunity to learn English.

At the same time, the students with hearing disabilities are able to achieve easier understanding of physics terms through visualizations of the Bulgarian pronunciation of the English term. Hence, students develop the skills to read terms by the lips in both spoken languages - English and Bulgarian.

Thus, once organized as multimedia education on the subjects of physics and astronomy, it allows students with hearing disabilities as well as those without such disabilities to use a broad informational store, including pictures and video linked to the concrete terms.

The hypertext used in the product provides an opportunity to research additional information concerning a particular topic selected by clicking with the mouse on a related button. The dictionary is useful also to users without hearing disabilities, who are interested in the world of deaf people and the ways they form their opinion and understanding of the world.

Rules, observed while developing new signs:

1. Shortness in sign performance;
2. Closest meaningful richness of content;
3. Closest and adequate perception of space;
4. Closest and adequate perception of the parts of the body.

Goals of the Man and nature, physics and astronomy dictionary:

1. To facilitate the educational process on these subjects for students with hearing disabilities in the specialized schools and mainstream schools, where children with hearing disorders have integrated;
2. To support the visual perception of students with hearing disabilities of a selection of terms referring to certain conditions, phenomena, processes and quantities;
3. To direct the attention of teachers, parents and students to the interesting world, culture and language of people with hearing disabilities;
4. To contribute particularly to introducing bilingualism in the schools for children with hearing disabilities also in mainstream schools, where students with hearing disabilities have integrated previously;
5. To raise awareness in society the educational methods and perception of information the deaf people have;
6. To enrich the existing Bulgarian sign language with specific terms from the field of natural sciences.

Even in the group model of integration (currently in Bulgaria there exist 3 classes being educated under this method), students practice verbal communication with their teachers and coevals and sign language among themselves.

The individual integration is different. There are students who are not familiar with sign language. However, there are some people who even teach their schoolmates sign language communicate through signs everywhere – at school, at home, etc. In this type of situation, the family environment is of great importance, especially the way of communication the family will choose. It is important to pay attention to the educational aspects of this process [8], as well as to the psychological aspect and development in time of education in a specific environment - hearing or the one of coevals with hearing disabilities [5]. The strategies of education at home and at the school should be complementary [7].

The bilingual education of student with hearing disabilities has its supporters and opponents [3]. It is a fact that long-term efforts in education particularly designed for these students achieve higher results than verbal education [2, 4]. The scientists have researched the connection between bilingualism, intelligence and thinking [10]. Nowadays it has accepted that there are “*cognitive benefits including enhanced creative thinking, cognitive flexibility, and metalingual awareness*” [1].

Many pedagogues take the challenge to teach students with hearing disabilities. All of them are supposed to use methods and strategies for teaching, different from those used in teaching students without these disabilities [6]. All teachers should use different kinds of approaches, strategies and methods to attract and keep the attention of their students. Some of the language approaches for people with hearing disabilities are very useful in teaching physics and astronomy.

It is important to mention that the role of the teacher when using the multimedia dictionary in classes is of great importance. The teacher should explain, add and communicate the information effectively to every student in accordance with student’s individual needs.

Description and Performance of Signs in Bulgarian Sign Language

The presentation of the terms consists in very simple compact signs illustrating the essence of the word or phrase. For example, the term gravity has presented by signs *force* and *attraction*, and not by the sign used for *fall* (Fig. 1 and Fig. 2). *Attraction* has conveyed by pointing the body of the signer, because in the cosmos it is not moving down, as it seems to the observer of the Earth, but it is in all directions.



Fig. 1 Gravity, Sign for force



Fig. 2 Gravity, Sign for attraction.

In the first sign (Fig. 1) of the term *gravity*, the second finger of the left hand outlines the shape of the muscle. This is the sign for a *force*. In the second sign (Fig. 2) the finger tips of both hands move uninterruptedly. The hands movement is toward the body. This shows the attraction of the object.

The explanation of a particular term has led by its meaning and not by its literal translation. For example, *Brownian motion* has explained with signs for *particle* and *movement*, but not with *B*-letter from the two hands Bulgarian alphabet and *movement*, because this does not match the meaning of the term (Fig. 3 and Fig. 4). In the first sign (Fig. 3), the tip of the first finger has placed under the tip of the second finger. This is the sign for *particle*, *little*. In the second sign (Fig. 4), the palms of both hands move side wards. The sign has shown this way because of the essence of the term – the Brownian motion is the motion of the particles. R. Brown is the discoverer of this motion and this can to easily explaine by the teacher.



Fig. 3 Brownian motion, Sign for particle



Fig. 4 Brownian motion, Sign for motion

Some physics terms consisting of a single word can be explained by three gestures, and terms consisting of several words (for example *space stations and drills*) can be represented by two signs (Fig. 5 and Fig. 6). The first sign of the term *space stations and drills* depicts space (Fig. 5). The palms of both hands point to the person performing the sign. They move up and sideward, showing the infinity of space and the universe. Eyes have directed upwards.



Fig. 5 Space stations and drills, Sign for Space



Fig. 6 Space stations and drills, Sign for artificial satellite

The second sign depicts the space station (Fig. 6). The right hand forms a fist and is static. The back of the wrist points to the interlocutor. This hand signifies the Earth. The first, third, fourth and fifth fingers of the right hand are bent and only the second one is straight and points down. This hand is the satellite, which goes round in the earth orbit. The sign is a combination of the sign for Universe and the one for artificial satellite. It becomes necessary because of the location of the stations and drills around the Earth – similar to artificial satellites.

The physics terms have presented as singular, however sometimes the sign indicates plurality. It results from the necessity to reflect the richness of the term. For example, the term double star is singular, but the sign should show plural, since it signifies two rotating round each other bodies (Fig. 7 and Fig. 8). In the first sign, the index finger and the middle finger show two (fig. 7). In the second sign, the index finger and the thumb draw the rays of the star high above the head (Fig. 8).



Fig. 7 Double star, Sign for number two



Fig. 8 Double star, Sign for star

It is no surprise that in the Bulgarian sign language as well, several signs mean the same word or a combination of words (which has clearly seen in the Swedish sign language). For example, in spoken Bulgarian some synonyms have used throughout the

communication process. In addition, when a foreign language has learned, one of the goals of the educational process is to develop the student's ability to express the same notion in different ways. This is a sign for the richness of a language and presents good prospects for its further development. A term may to explain through the different characteristics and specificities it possesses. For example, Sun (Fig. 9) has shown by the rays of light: but that does not mean that the Sun is not warm or does not have the shape of a disc. One or several characteristics of an object have chosen and these have presented visually. The tips of the fingers of the right hand are held together focusing on a point and then they move away from each other, signifying the spreading of sunrays. The sign has performed high above the head of the performer.



Fig. 9 Sun. Sign for light, The Sun

The signs for measuring devices have developed using a common system. Each of them has presented by the sign for its first letter in the Bulgarian two-hand alphabet plus the sign for meter (measuring device). For example, aerometer: A+meter, Barometer – B+meter, etc.

The term barometer has described with two signs (Fig. 10 and Fig. 11). In the first sign, the letter B in the Bulgarian two-hand sign alphabet has shown (Fig. 10). In the second sign (Fig. 11), the thumb and the index finger of the left hand form a semi-circle (the device) and the index finger of the right hand moves from left to right and vice versa (the pointer of the device).

It is additionally explained waw and what exactly a device measures [9].



Fig. 10 Barometer, Sign for the letter B from the Bulgarian two-hand alphabet.



Fig. 11 Barometer, Sign for device

Basic terms can be combined with each other thus allowing the increase of the number of physics terms by derivative terms of the ones already suggested. For example, sign 1 for exposure and signs 1 and 2 for gamma-rays can be combined like 1, 2 and 3 for *exposure of gamma-rays* [9].

In general, most physics terms consist two or more signs (five at most). All signs can be used when students are taught the term for the first time, thus avoiding a misunderstanding of the word. During the following classes, the teacher and the students can use one or two signs of the term that are most typical for its meaning. This has been

suggested, since during the regular class time is not sufficient for both teaching new signs and practicing terms previously acquired.

Conclusions

1. A new method has been developed which facilitates the education in subjects *Human and nature, physics and astronomy* of students with hearing disabilities in fifth grade (11 - year old students), sixth grade (12 – year old students), seventh grade (13 - year old students) and eighth grade (14 - year old students) of specialized and mainstream schools.

2. A new technique has developed that helps overcoming the differences in using different formulas of sign language.

3. The need to refer on the formal character of the physics term.

4. The developed sign methodology can to use successfully in educating children in other curriculum subjects such as biology, chemistry and geography.

The multimedia sign dictionary has created for education of students with hearing disabilities on physics and astronomy in seventh grade (13 - year old students) and eighth grade (14 - year old students) in specialized and mainstream schools. It aims to meet the needs of the students, their parents and teachers from the specialized and mainstream schools by providing a visual presentation of terms from the fields of physics and astronomy, and to the related fields of biology, geography and chemistry.

The multimedia CD is an interactive tool, which can be very useful and helpful to students. It can depict dynamically various physical processes and phenomena, otherwise difficult to describe through words. The categorization of the terms in the CD provides the students with hearing disabilities with quick access to adequate information in accordance to their level of knowledge. Furthermore, complex and abstract terms are visualized which proves extremely helpful during the educational process.

The introduced innovative strategy is highly effective. It has used by students with hearing disabilities for self-education in physics and astronomy. The information, presented in the dictionary (the textbook and the CD) became an object of interest for healthy people and for those with hearing disabilities. The education of people with disabilities should not be accepted like trivial, just as part of the school plan and school program, but as an opportunity to widen the viewpoint of the student with disabilities.

The challenge for teachers of the Deaf is to ensure as realistic images as possible, stimulus and studiosness for everything that surrounds us - the world, the Earth, the Universe and all laws and rules that we obey.

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