PERSONAL CONDITIONS OF PRACTICAL EFFECTIVENESS OF APPLYING SONIC TESTS COLLECTION AND SONIC DIGITIZER IN EDUCATION OF BLIND CHILDREN

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ABSTRACT

In the paper, the results of four years of experimental researches have been presented. In the frame of geographical and biological lessons in the Educational Centre for Blind Children in Wrocław, chosen group of pupils have been individually tested. Ergonomic characteristic as well as sensorial and mental conditions of using a sonic digitizer have been studied. The collection of several special sonic tests creates possibility of ordering the results dependently on observed areas. Theoretical and practical conclusions have been formulated.

As an important part of researches, a manner of controlling the results of pupil's work has been proposed. In the paper the results of experimental researches have been presented.

1. OPERATING PROPERTIES OF NEW EDUCATIONAL TOOL

The association of the movement of the blind's hand along the line coded on the flat operation area (kinaesthetic impressions) and the sequence of sounds (acoustic impressions), related to the course of that line (that is the sequence of the points creating that line) are the essence of the method. Each point of the line has the attributed sound emitted at the moment when the indicator, driven by the blind, meets it.

The method has been patented [1] in 1995.

The system of differentiation of sounds used in the sonic coding is based on the modulation of:

- the frequency – in relation to the vertical movement of the detector in the operation area along the axis OX;
- the volume – in relation to the horizontal movement along the axis OY [2].

Objective characteristics of the sound, defined as the Cartesian co–ordinates x, y, location of the point P (x, y) in the operation area D (X, Y) (Fig. 1) have the subjective equivalents: altitude and loudness of the signal. Linear change of the sound's loudness is related to the non–linear, pseudologarithmic change of the volume (Fig. 2).

The qualified instructor of the blind persons, before the beginning of the course, should connect the location detector, - with the data registration and processing system with the phones plugged into the phonic sockets using of the transfer conduit.

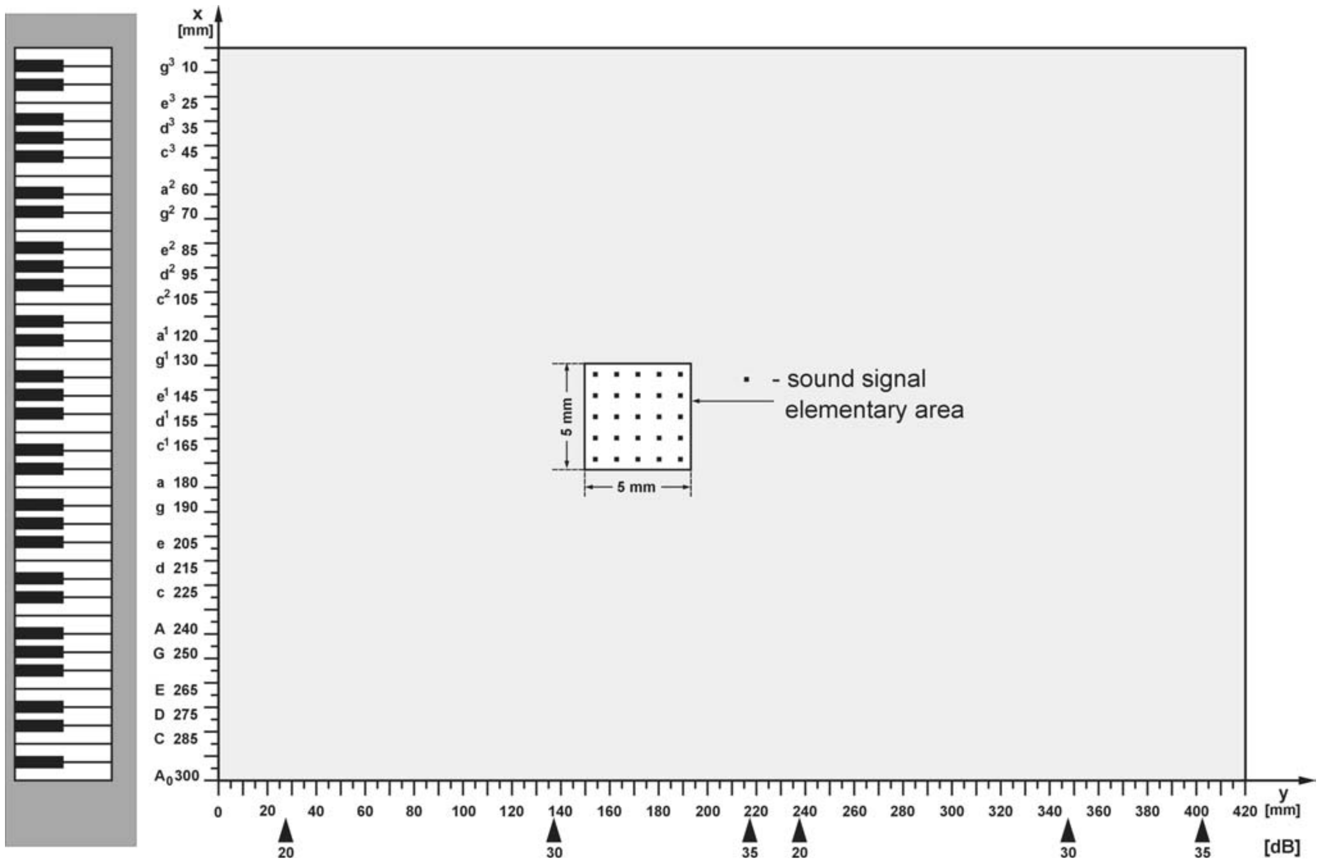

Figure 1. The operational field of the digitizer

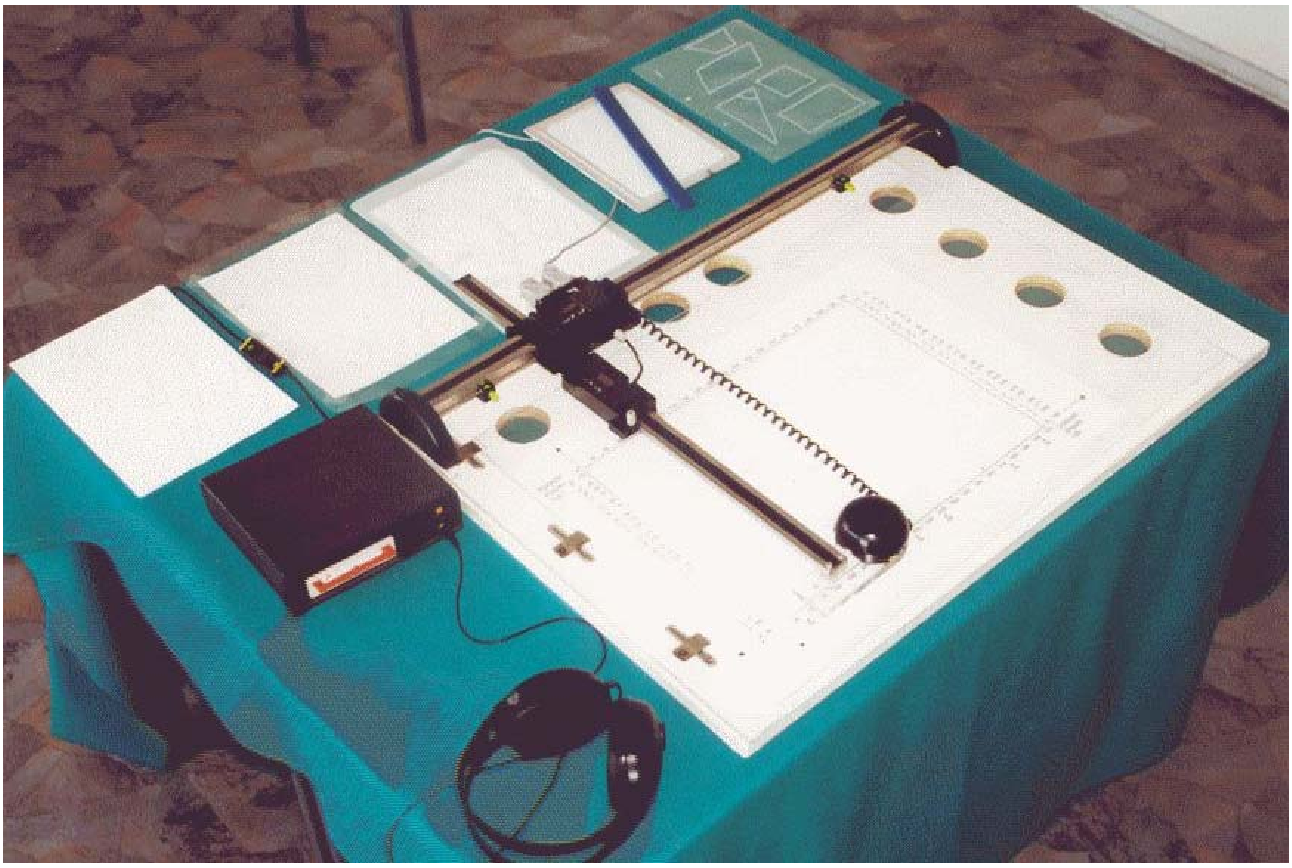

Figure 2. The sonic digitizer

In order to facilitate searching for the coded contents of the test one should put the sheet with the printed image of the scene in the scale 1:1 on the plate (similarly as in sonic coding of the visual form of the scene) and bring adequate pairs of the orienting signs of the plate with the control signs of the sheet into coincidence.

When orientation of the sheet is completed one should listen the sonic contents of the scene saved on the disc at the disc–station.

Decoding of the elements of the scenes may be performed in three different versions:
- the teacher decodes the scene themselves moving the detector in the operation area while the pupil hears out the sounds in the phones;
- the teacher and the pupil decode the scene together (the hand of the pupil and the teacher move the detector in the operation area together) while the pupil listens to the sounds in the phones (Fig 3);
- the pupil decodes the contents of the scene unaided, steering the movement of the detector in the operation area and simultaneously listening to the sounds in the phones (Fig. 4).

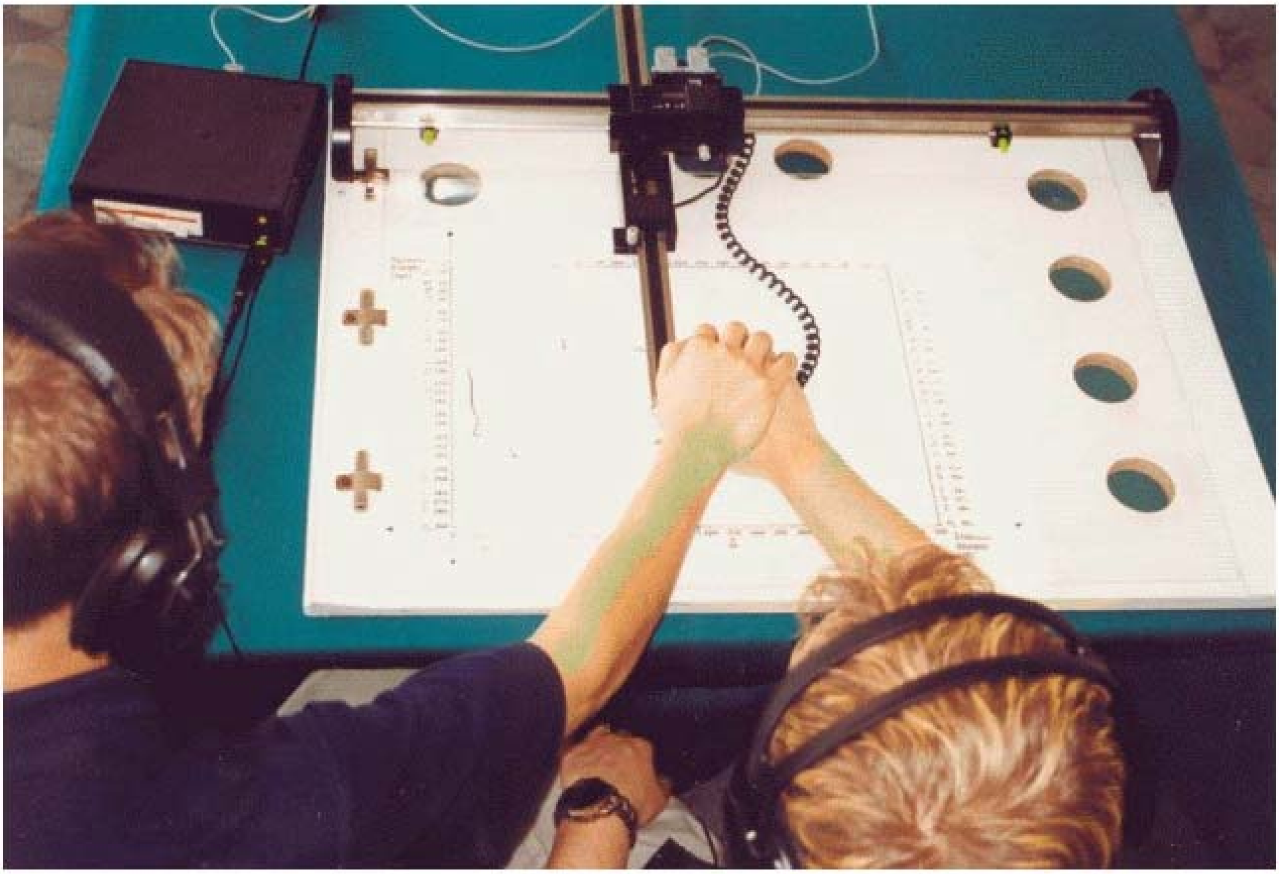

Figure 3. The teacher and the pupil decode the scene together

Usually the educational process includes subsequent use of all versions – A, B and C.

At the beginning of the course the instructor moves the location detector in order to set it over the point which is the closest to the zero–point of the system. Then the sound signal with the specified volume and altitude appears in the both phones. These parameters of the signal are determined by the location of that point in the Cartesian co–ordinate system X, Y. Subsequently, the detector is moved along the linear element of the scene so that the signal in the phones does not disappear. When the instructor does all the described acts the blind pupil is concentrates on listening to the sounds that appear in the phones.

In the second stage of the course the blind person puts a hand or both hands on the location detector so that the index finger rests on the sight–cross. The sight cross is marked on the outrigger in order to be manually detectable. Aided by the instructor, who uses the sheet with the graphically visualised scene, the pupil moves the location detector so that the sight cross covers sharply „the start–point" of the scene. Then the specified sound appears in the both phones. After that the blind person moves the location detector along in the operation area in the way, which enables continuous listening to he signal. In the early stages of the course the instructor may help the pupil to move the location detector in the proper direction using the graphic image of the scene.

The disc may contain several different scenes.

The sonic coding of previously visually coded scene may be made by a visually health person. The pencil connected to the detector ensures the control of accuracy of decoding of sonically coded scenes: the route of movement is drawn on the sheet of paper on the operation area.

Figure 4. Coding of memorised shape by the blind girl

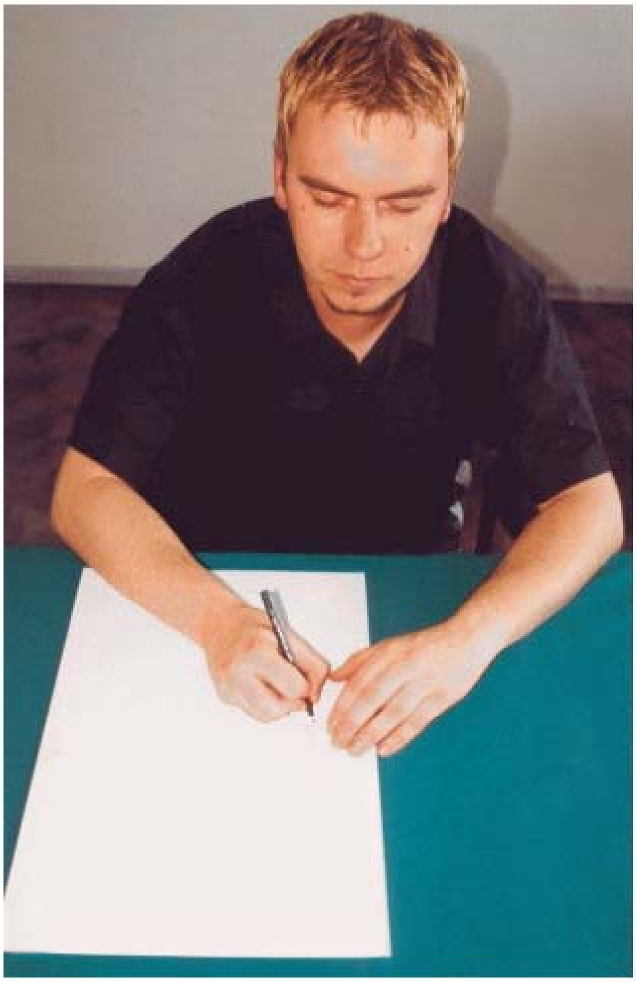

Figure 5. Graphic coding of memorised shape by a blind boy

The blind person may code the memorised scenes through any of accessible ways – acoustic, tactual, kinaesthetic. Visual registration during coding enables reconstruction of the mental scene. The grade of uniformity of the model and the image created in the blind's mind depend on the accuracy of stimulation of linear movement of the hand steering the detector (Figures 5 and 6).

2. ERGONOMICAL DIFFERENTIATION OF WORK DEPENDENT ON PLACE OF ELEMENT WITHIN OPERATIONAL FIELD AND TERMINAL LIMITATION OF WORKING; GENDER AND AGE OF USERS

The A–4 format of operate area appears to be the most convenient. Assessments of ergonomic aspects of pupil's unaided work with a device make it possible to formulate some opinions connected with optimal place within operational field.

The central part, limited by c–a1/20–28 dB lines, is the best usable one for coding the elements. The speed of work within this part of operational field progresses about 20% comparing with the work within the whole area.

The efficient time of operating in a group of 7–10 years old pupils is about a quarter of hour but in a group of 11–17 your olds it is about half an hour.

Small–size mouse (or other location detector) would be more appropriate for the first group.

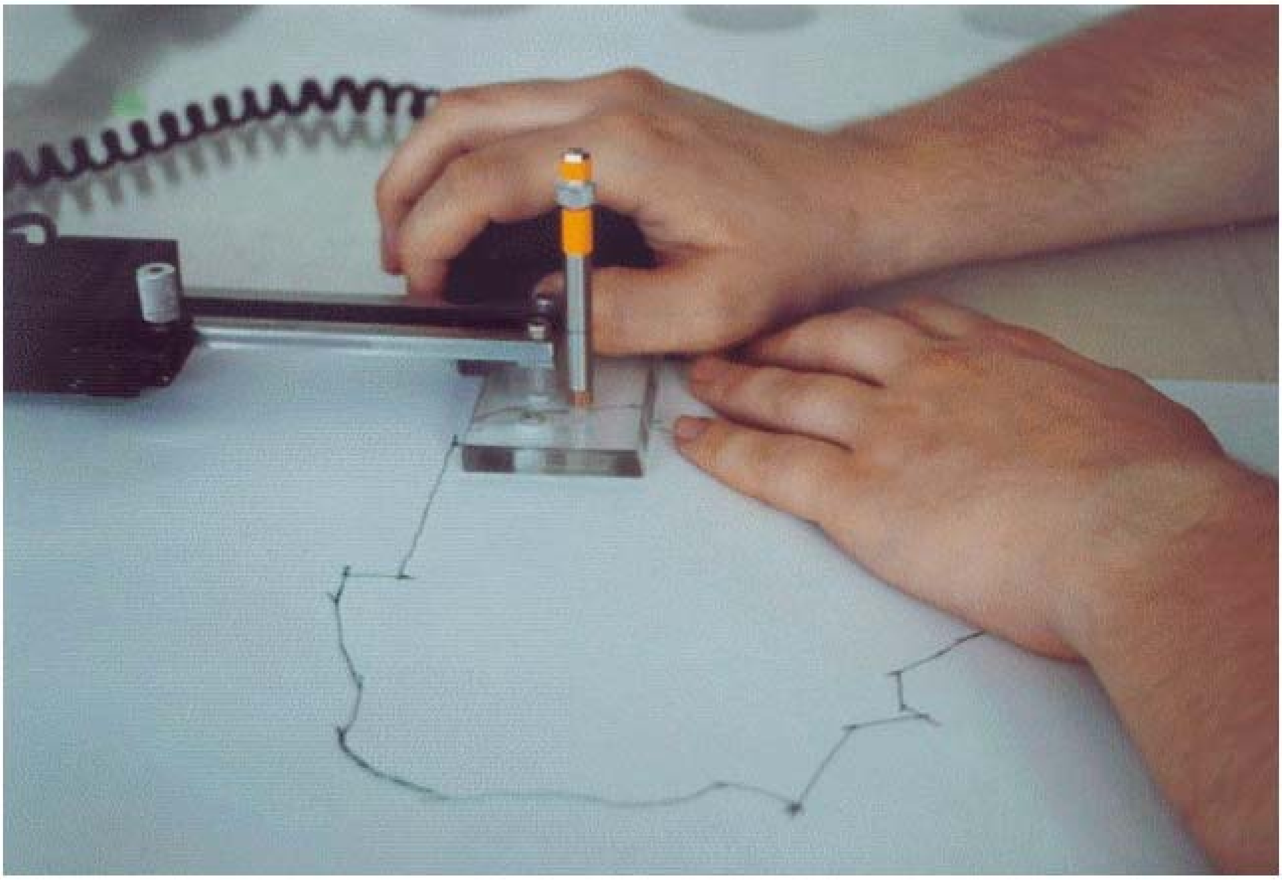

Figure 6. Sonoric coding of memorised shape by a blind boy

Only 30% of users search the coded line working with two palms (see Fig. 4) and the majority of group steers using only right palm when the left palm lays on the moving vertical guide – bar. The loss of code line causes, as the user's reaction, returning to the frames with coded x, y system of sound's characteristics.

3. DIFFERENTIATION OF PERCEPTIVE ABILITY OF CHILDREN DEPENDABLY ON THE AGE AND GENDER, CAPACITY OF MEMORY (MEMORISING THE NUMBER OF ELEMENTS, SUCCESSION OF POINTS, LOCATION AND RELATIVE LOCATION OF POINTS AND LINES, SHAPE OF LINES)

Capacity of memory depends on the age (see Fig. 7). In the chosen group of 9 totally blind pupils the usable number of characteristic points of the closed broken – lines representing contour of Poland is not more four.

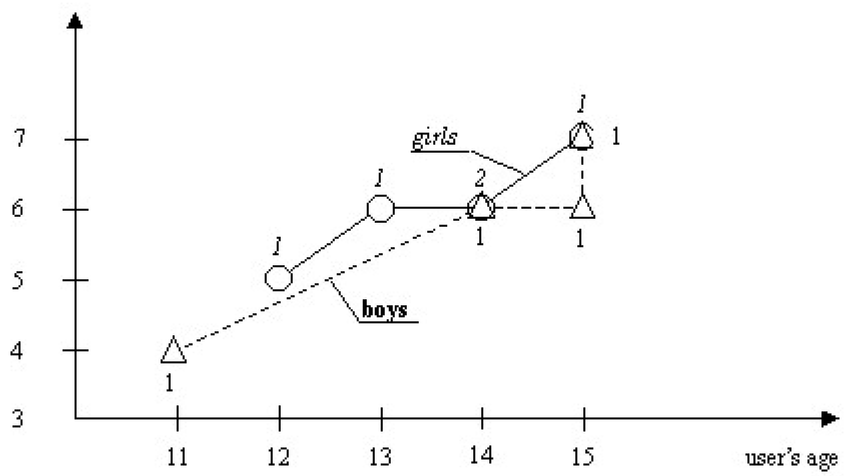

Figure 7. Results of memorising the shape of Poland coded as a multiangular contour

The recognition of change of orientation represented by characteristic points' of broken line requires apply of nearly equal lengths of neighbouring sectors.

The trial between comparison of the length and relative location of segments should be organised between a pair of elements because the results of comparison within the group of three and more segments is not satisfying.

4. DIFFERENTIATION OF RESULTS DEPENDABLY ON THE PART OF OPERATIONAL FIELD

The accuracy of determination of length is higher according to vertical lines than according to horizontal ones.

The percentage of direct hits into elementary 5 mm × 5 mm appears varied dependably on the sector of the operational area. The mean value of right location for tenfold hitting is presented on the Figure 8.

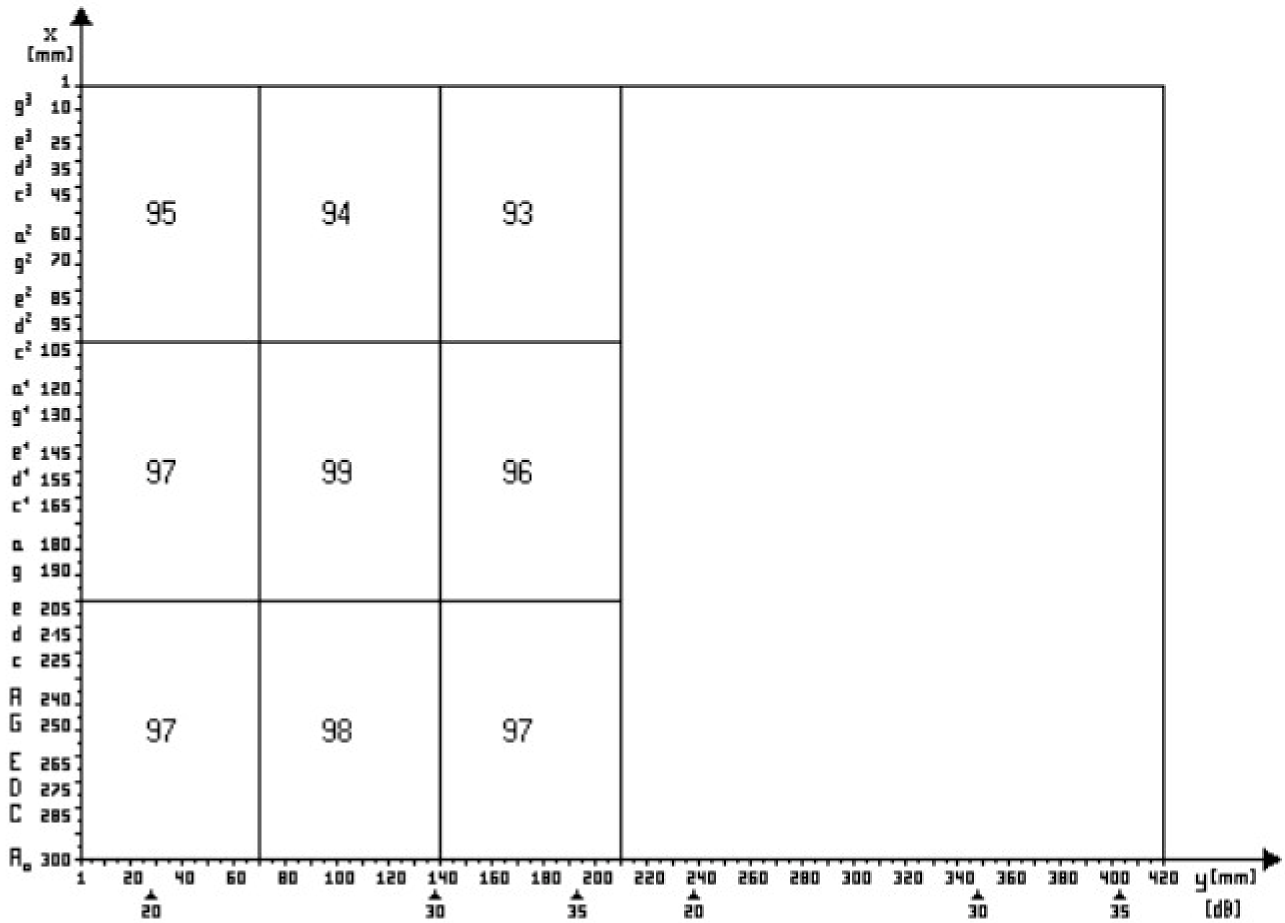

Figure 8. Percentage of right hitting dependably on a sector

The gender differentiation in the work, mobilisation and concentration during the action has been observed. The right decoding by leading has been noticed more than ten times within the boys' group and right decoding by hearing within the girls' one.

5. REFERENCES

[1] K. Ćmielewski, E. Krzywicka-Blum, J. Kuchmister, "Sposób sonory0cznej lokalizacji zbioru punktów", Patent UP B1178328 (1995).

[2] E. Krzywicka-Blum, J. Kuchmister, "Modelowanie sonoryczne w edukacji niewidomych, Wrocław. (1999).

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Biography

Mr. Janusz Kuchmister was studied in 1976-1981 at the University of Agriculture in Wroclaw at the Department of Geodetic Agricultural Engineering. He was bestowed the title of Master Engineer in the discipline of Geodetic Agricultural Engineering.

Since 1981 he began to work at the Department of Geodesy and Photogrammetry as the assistant and furthermore, he was promoted to the senior assistant.

In 1992, after the defence of his doctoral thesis at the Faculty of Military Engineering and Geodesy, Military Technical Academy in Warsaw, Ph.D. Janusz Kuchmister was promoted to the senior lecturer in the Department of Industrial Geodesy, University of Agriculture in Wroclaw.

In 2000 Ph.D. Janusz Kuchmister was granted the 1st class engineer of professional specialisation. Since 1993 he has been a member of the 4th Working Group “Geodetic Instrumentation” within the section of Industrial Geodesy of the Polish Academy of Science. He is also the member of the Assembly of Science and Technology in the field of Geodesy, Cartography, Cadastre and Navigation of the Engineering Academy in Poland.