

OFFICIAL DRIVING LICENCE EXAMINATION ADAPTED FOR THE DEAF

EGZAMIN PAŃSTWOWY NA PRAWO JAZDY W WERSJI DLA OSÓB NIESŁYSZĄCYCH

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Summary

The article highlights the problems encountered by the deaf people who want to obtain a driving licence and describes the steps taken by a Consortium that run a project named GŁUSI (THE DEAF) within the "Social Innovations" Programme of the National Centre for Research and Development. The project objective was to make it more realistic for the deaf to obtain a motor vehicle driving licence by creating such examination conditions that would remove barriers preventing the access of the deaf to a success in the tests. In the regulations in force, not all examinees were equally treated by the legislator, who failed to provide a possibility of verifying the theoretical knowledge of the citizens who cannot use Polish language because of their disability. The fact that people who needed extra care from state authorities were burdened with requirements beyond their capacity was unjustifiable from social justice point of view; conversely, it made the unfair treatment of the disabled even worse. Since, according to legislator's opinion, disabled people can obtain the right to drive motor vehicles, the depriving them of such a possibility solely because of the lack of appropriate examination tests and impossibility of communication when they drive a car is irrational. The regulations that govern the principles of examining the candidates for drivers do not provide any possibility of departure from the general rules. Thus, they limit the right of the deaf to live on their own and to move freely as the fully able people do. They also weaken the position of the deaf in the labour market and, in consequence, make it more difficult for such people to improve their and their families' standard of living and quality of life.

Keywords: deaf persons, driving licence, training, examination

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Streszczenie

Artykuł wskazuje problemy osób niesłyszących w uzyskiwaniu praw jazdy i opisuje działania w ramach Programu NCBiR „Innowacje Społeczne” podjęte przez konsorcjum, realizujące projekt o akronimie GŁUSI. Celem projektu było urealnienie możliwości nabywania uprawnień do kierowania pojazdami przez osoby głuche poprzez stworzenie takich warunków egzaminowania, które usuną bariery w dostępie do uzyskania uprawnienia. Ustawodawca w obowiązujących przepisach nie traktował równo wszystkich przystępujących do egzaminów, ponieważ nie przewidywał możliwości weryfikacji wiedzy teoretycznej części obywateli, którzy z racji niepełnosprawności, nie posługują się językiem polskim. Obciążenie niewykonalnymi obowiązkami osób wymagających dodatkowej troski ze strony państwa nie znajdowało uzasadnienia na gruncie zasady sprawiedliwości społecznej, wręcz przeciwnie, pogłębiało niesprawiedliwe traktowanie osób niepełnosprawnych. Skoro według ustawodawcy, osoby niepełnosprawne mogą zdobyć uprawnienia do kierowania pojazdami, to nieracjonalne jest pozbawienie ich tej możliwości wyłącznie z powodu braku odpowiedniego testu egzaminacyjnego oraz z braku możliwości porozumienia w samochodzie. Przepisy regulujące zasady egzaminowania na kierowców nie przewidują żadnych odstępstw od obowiązującego powszechnie kanonu. Tym samym ograniczają prawo osób niesłyszących do samodzielnego prowadzenia życia i swobodnego przemieszczania się, na takich samych zasadach, z jakich korzystają osoby w pełni sprawne. Stawiają osoby niesłyszące w gorszej pozycji na rynku pracy, a w konsekwencji utrudniają możliwość stałego polepszania warunków życia ich samych oraz ich rodzin.

Słowa kluczowe: głusi, prawo jazdy, szkolenie, egzamin

1. Introduction

The problem of the driving of vehicles by deaf persons came up almost at the same time when the motorcar began to be actually used as a transport means. In the initial practices and legal regulations, a tendency could be seen towards imposing considerable restrictions on the availability of a driving licence to the deaf. This was explained not only by the deafness as such but also by associating this affliction with the supposed probability of other disorders of mental nature. Insufficient medicine level and lack of adequate methods to compensate hearing defects did not conduce to changes in recognizing the ability of such persons to drive vehicles on their own.

It has turned out, however, that deaf persons can effectively manage difficult situations and this includes the driving of motor vehicles.

This could be seen in particular during the two World Wars in soldiers. The front-line fights were characterized by tremendous bangs of shots and explosions. Many soldiers became deaf due to injuries to their organs of hearing. Many of them were drivers of military vehicles (trucks, personnel carriers, tanks, etc.). The disability of this kind did not eliminate them from further service as vehicle drivers. Above all, they were soldiers and their driver's skills were invaluable. Therefore, they kept successfully fulfilling their functions and by no means downgraded the combat capability of their troops and the army as a whole.

After the World War II, in particular in the USA, but in the West European countries as well, medicine and sciences in general began to attach more attention to research into, and

counteracting, the negative effects of the deafness, especially a reduction in the share of active or often even outstanding people in the social life and career. The problems of communication with deaf persons were already overcome far earlier by using sign language. However, the sign language was not, and neither is now, capable of solving all the problems that arise from the discomfort related to a lack of hearing. This particularly applies to the occupations and activities where not only simple communication with another person takes place but also signals of another type must be correctly perceived when various things are being done that require the making of correct decisions and adequate behaviour in the circumstances when the deaf person can exclusively rely on himself/herself.

The present day

Thanks to the huge qualitative jump that has taken place in the medicine of hearing and speech organs for the recent 30 years, deaf people increasingly often and courageously participate in social life. The special-needs educational system and medical engineering supporting the internal hearing organs created considerably better opportunities for the deaf not only to function in the society but also to succeed in various areas of sciences, arts, and business. The social and professional activity of any person will never be full unless it is accompanied by mobility understood as capability of migration in time and space with the use of a motor vehicle. And these problems will be the subject matter of this article.

Motor vehicle driving lessons

The decision concerning the will to obtain a driving licence and to acquire the ability to drive a motor vehicle in a safe way is, at the beginning, very individual for everybody, not only for a disabled person; it also requires a high degree of responsibility and awareness. Without any doubts, the ability to drive a motor vehicle makes individuals more social. However, it has to be remembered that the driving of a motor vehicle means also a possibility of starting a sequence of events that either might be coincidental or for which the driver might be to blame but, anyway, their effects may be very negative or even tragic. Therefore, the decision must be first made by a physician, who is both obliged, and provided with appropriate tools, to verify and notice any circumstances immediately disqualifying the candidate for driver. The state of health and predisposition of the candidate are the basic criteria for the physician to give his/her consent for the candidate to take a driver training course.

Motor vehicle driving lessons for people with disabilities

A disability of a candidate for driver may be the main reason why the candidate not only should not take a driver training course but also, and above all, why he/she is unable to drive a vehicle in a safe way. The list of people's disabilities that may result from past diseases, accidents, or just unknown or random reasons is very long. For people with disabilities, the role played by a physician, or even by a number of doctors of various specialties, becomes immeasurably more important.

In practice, an overwhelming majority of the disabled persons who take driver training courses are people with dysfunctions of the organs of motion (lower or upper limbs). The present-day automotive engineering has already created a variety of excellent technical solutions that may be considered technical remedies for specific disabilities. Thanks to that, it is a long time since people with disabilities of the organs of motion have been using motor vehicles in a safe and efficient way, being thus fully socially and economically active. The technologies and techniques are continually improved and developed, to such an extent that even a person with tetraplegia may drive a vehicle if it is provided with a special technically sophisticated system with a joystick. Many functions in a motorcar are automated to a high degree, thanks to which the vehicle may be driven by a disabled person fully on his/her own, without a need of permanent assistance of a third party.

Deaf candidates for drivers

The dysfunction of the hearing and speech organs constitutes a completely different problem. For a driver training course to be organized for people afflicted with a disability of this kind, quite different educational techniques are required, not only from the students involved but also from the instructors who provide theoretical and practical lessons. For the specificity of training such people to be better understood, it is worth describing here the genesis and procedure of solving this problem by the Association for Assistance to Disabled Drivers (in Polish: SPiNKa). The Association is the first and only organization in Poland that has been engaged in a comprehensive and professional way in the training of disabled drivers with various dysfunctions for as long as 10 years.

Basic problems with teaching deaf persons to drive

It happened for the first time at a meeting held in Wodzisław Śląski in 2011 between the circle of deaf candidates for drivers (over 150 people) and the SPiNKa Association that the most important limitations that afflict deaf participants in driver training courses were successfully identified and discussed. Such an approach helped then to develop an appropriate training technology.

Most briefly, the problems faced by such people may be divided into four groups:

- a) communication and imparting the theoretical knowledge during lectures;
- b) communication during practical lessons in a vehicle;
- c) official (state) driving licence exam;
- d) technical aids to compensate the dysfunction of driver's hearing organ during training, examination tests, and driving a vehicle on one's own.

It is worth emphasizing here that deaf persons who safely and efficiently drive their motor vehicles can be met on roads already now. This is because various driver training centres undertook for many years the training of such persons on individual basis. For this purpose, different intuitive techniques were used for the communication between the instructor and the trainee during training drives. Thanks to special instructor's involvement,

it sometimes happened that the trainee was successfully brought to the official driving licence examination. The official exams carried out at Provincial Road Traffic Centres (referred to as WORDs, where the acronym WORD stands in Polish for **W**ojewódzki **O**środek **R**uchu **D**rogowego) constituted one more stage of difficulties and again, as it was during the driver training course, it sometimes happened that the trainee was successfully brought to the happy end and to obtaining the driving licence of his/her dreams. However, any systemic and universally applicable techniques and procedures of training and examining deaf candidates for drivers have never been created and implemented. Nevertheless, now we can safely state that the worst has been left behind. A system of driver training for deaf persons, being developed by the SPiNKa Association with other institutions being its partners, is nearly finished and is to be completely implemented quite soon.

Communication and imparting the theoretical knowledge during lectures

This issue constitutes the relatively smallest problem in the education process. The theoretical lessons within driver training courses are given with participation of sign language interpreters. Thanks to their assistance, deaf students have a real chance to acquire the necessary knowledge within the required scope. In practice, however, some observations have been made that highlight differences in the quality of interpreter's work. Much better effects are achieved by the interpreters who are simultaneously driving instructors. Unfortunately, the interpreters like those are very rare in Poland. Apart from the communication skills, they have practical knowledge, the imparting of which by signing produces the best effects and this is invaluable in such a situation. This task is somewhat more difficult for a standard interpreter. A comparison may be made here to a foreign language interpreter, who knows not only the basic words and phrases in the languages involved but also the specialist terminology used in the specific subject field: his/her interpreting will be much better and more accurate.

Communication during practical lessons in a vehicle

This is the most difficult part of a driver training course. The presence of a sign language interpreter (whether he/she is an instructor or a third party) during practical vehicle driving lessons is not decisive because the trainee when driving a vehicle must be focused on driving actions and must not avert his/her eyes from the road to the signing instructor or interpreter. Alas, the practice in this respect is often contested by specialists in this field. The use of gestures or touches or the showing of charts, drawings, or schematics, the meaning of which has been previously agreed upon with the trainee, is simply dangerous, as this distracts and stresses the trainee. Although a kind of qualified success may thus be achieved, this is not recommended. Conversely, this may be very useful when done during a pause in the drive: everything may be then discussed, explained, and shown in practice.

In the SPiNKa Association, this problem has been solved to a significant degree. In 2012, the first version of the GRASER system was prepared. The acronym GRASER stands for Polish words "**G**raficzny **S**ystem **E**misji **R**ozkazów" ("Graphical Command Emission System"). It defines a technical device that makes it possible to present instructor's commands in

the form of graphical images (pictograms) understandable for the trainee and having the meaning of instructions to do specific things, e.g. "change gear", "turn", "park", "switch on windscreen wipers", etc. The images are displayed on a small screen installed in the vehicle cockpit straight in front of the trainee, in his/her line of vision. This issue and the GRASER system will be described separately, because the system is unique and very modern; moreover, it is most likely the first system of this kind used in Europe.

Official (state) driving licence exam

Only the fact alone that a student is admitted to an official driving licence exam, in result of having gone through all the training procedures, may be deemed a considerable success. Actually, the number of people who passed an official exam is relatively small in comparison with the number of people who started the training. As recently as by 2015, when the old examination system was in use, which was based on answering sets of exam questions (colloquially often described as "based on learning by heart"), a deaf examinee accompanied by an interpreter could receive questions translated into signs. After 2015, when this system was completely changed (to be based on communication with a computer, random generation of questions from a huge database, and limited answering time), the deaf persons were totally eliminated and deprived of any chance to succeed. The legislator, when preparing the new regulations [9], failed to foresee that a deaf person is unable to read and understand a written text because Polish language is alien to him/her. Hence, the passing of the theoretical exam became infeasible for such people. Thus, all the reasons were created for the situation to be considered discrimination of the deaf in terms of equal opportunities compared with those of the fully able persons.

This resulted in numerous protests of the deaf and of the whole community – fully justifiable, to be added. The need of bringing this to conformity with the current laws has forced a requirement to supplement the procedure with an image of a sign language interpreter on the screen, who would translate the sense of the questions into the sign language during the time of the text being displayed. The first educational material to prepare deaf students to such a form of the exam [10] also appeared in the market.

Project named "GŁUSI" ("THE DEAF")

Within as short a time as possible, the SPiNka Association took practical steps to prepare a complete system of education of the deaf people applying for a driving licence. A great help was offered by the "Social Innovations" Programme of the National Centre for Research and Development, of which the SPiNka Association became a beneficiary, as the initiative of the latter to create tools for the education of the deaf candidates for drivers was appreciated in a competition procedure.

The participation in the competition obliged the SPiNka Association to establish a Consortium with other competent partners and to become the project leader, which would manage the project as a whole. Apart from the SPiNka Association, the other Consortium members were:

1. Automotive Industry Institute (PIMOT);
2. Polish Security Printing Works (PWPW);
3. Provincial Road Traffic Centre in Warsaw (WORD Warszawa);
4. Institute for the Deaf in Warsaw.

The project consisted of the following two basic tasks, to be carried out in two phases (trial phase and pilot phase):

1. Working out of a set of exam questions translated into two sign languages (pursuant to the requirements of the Sign Language Law) and preparation of the questions in the version of a film to be loaded into the exam screen.
2. Development of a unique technical device named GRASER, which stands for Polish words "**G**raficzny **S**ystem **E**misji **R**ozkazów" ("Graphical Command Emission System"), to convert spoken instructor's or examiner's commands into pictograms understandable for the deaf trainee/examinee during a training drive or a practical driving test.

The project implementation was started in mid-2015 and the project completion was planned for spring 2018.

Course and outputs of the project

1. *Selection of exam questions from the state exam database and translation of the questions into two sign languages (PJM = Polish sign language and SJM = language-sign system)*

For this task, a sign language interpreter was employed who demonstrated the best experience and ability to present his/her interpreting in the form of a film, which would be then uploaded to the system and added to the questions displayed on the monitor screen during the exam (Fig. 1). In general, over 500 questions were selected and translated from the set of exam questions stored in the database of the Polish Security Printing Works (PWPW). It should be emphasized here that the questions having been translated belong to the subset of "translatable" ones, as not all questions can be translated into a form understandable for a deaf person. This is because the authors of the basic questions often use unconventional and very confusing, at first glance, linguistic structures and expressions, which are untranslatable into the language of gestures of hands and other parts of a human body. The gestures in the sign language are made with using the symbolism of individual moves simplified as much as possible, because this is the essence of the sign language. When preparing the translations of this portion of questions, we were aware of the requirement that the translating of exam questions into the sign language should be in practice a continuous process carried out as the need arises, because the set of basic questions is dynamically changing and the questions are often formulated by casual authors who do not do it on a regular basis. This is dictated by an assumption made that the examinees should not deal with a "closed" and repeating set of questions and should not learn correct answers by heart. Therefore, to ensure similar variability of the questions asked to examinees of this group, the exam questions should be selected again and again and their filmed translations should be continuously uploaded to the system

and added to the basic questions. Such a task, however, is extremely difficult, costly, and time-consuming.



Fig. 1. A shot from a film that illustrates the interpreting into the sign language and is prepared for being uploaded to the computerized system of official driving licence examinations at Provincial Road Traffic Centres (WORD)

- 2. All the questions were recorded in the film version and, in a compressed form, added to the pilot base of exam questions maintained by the Provincial Road Traffic Centre in Warsaw*

The translations of the exam questions into sign languages were recorded in studio conditions. The technical standard of the records had to be high and integrated with the operating system used by the Provincial Road Traffic Centre (WORD) in Warsaw for the examination procedures, as the Centre was our partner in the project implementation (Fig. 2). It turned out, however, that not all the WORDs in Poland were obliged to use similar computer equipment and similar software. Thus, an important conclusion drawn from the project implementation process in this phase has made everybody aware that the integration of the set of exam questions translated into sign languages with the computer systems used by the other WORDs may be a very costly and complicated task.

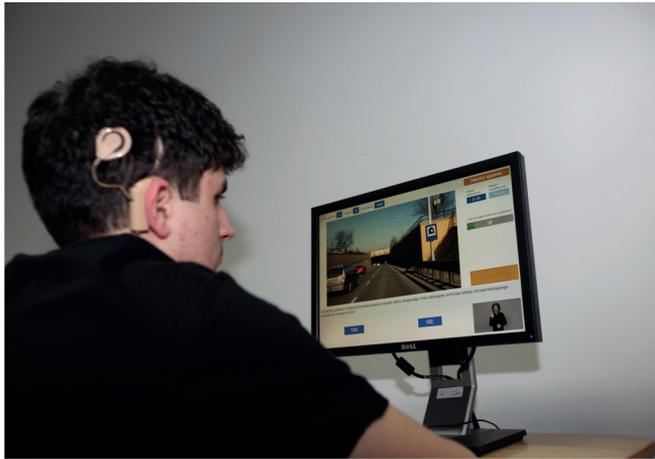


Fig. 2. A pilot theory test with interpreting the exam questions into the sign language at WORD Warszawa

3. *Two copies of the GRASER machine of the second generation, which was technically very advanced, were made*

For a long time, the most severe difficulties in the education of deaf persons were related to the problem of effective communication between the instructor and the trainee during the training drive. The driving instructors who can use the sign language are extremely rare. Anyway, even if an instructor skilled at it accompanies a deaf trainee during a training drive, the communication between them in the sign language is impossible for safety reasons. The instructor is focused on assessing the correctness of the drive while the trainee must be focused on the vehicle driving as such. The activities of hands are absolutely out of the question. The free communication between the instructor and the trainee is only possible when the vehicle is stopped, providing that the instructor can use the sign language. Even the presence of an interpreter as a third party on the rear vehicle seat will not constitute any change. The trainee must be focused on the driving rather than the interpreter.

All this resulted in developing a device named GRASER, which stands for Polish words "**G**raficzny **S**ystem **E**misji **R**ozkazów" ("Graphical Command Emission System"). The device is a miniature electronic unit combined with a small display screen installed in the vehicle cockpit in such a place that it is well visible for the driver. It is so designed that a command uttered by the instructor is decoded into a graphical image simultaneously displayed on the screen. The image is a graphical representation of the command. The deaf person recognizes the image with no problem. The theoretical lessons included training the deaf students in recognizing the catalogued instructor's commands in their graphical form. The GRASER system comprises an appropriate set of commands, which is dynamically changing and can be extended by adding next verbal commands illustrated graphically. As an effect, the student

or examinee can unequivocally understand instructor's or examiner's commands without his/her attention being diverted from driving the vehicle. Simultaneously, the instructor or examiner is not physically absorbed by communication with the driver.

A separate solution adopted in the project, corresponding to the needs of the target group of people, is an improvement in the level and culture of communication between examiners and deaf drivers in the vehicle without using the sign language. Thanks to the electronic system, developed within the project, that translates speech into pictograms displayed on a monitor screen, the very awkward gesture of nudging the deaf person to draw his/her attention to a command given by the examiner in the form of a gesture or a written sign will be eliminated. The safety of the exam drive will also be improved, as the additional gestures or necessity to read examiner's command divert examinee's attention from what is happening on the road. Improvement in the manners of physical contact with disabled people is a matter of great concern in developed countries, where a valuable social effect is discerned in such a trend [2].

First of all, a copy of the GRASER system intended for the WORD examiner was made within the project. This mobile device is to be installed by the examiner in the driving test vehicle for the time of a test. The range of the verbal commands and the corresponding graphics are somewhat different, because they have to be consistent with the examination procedure and should not include icons that could be treated as a hint.

The GRASER system in its two versions (training and examination ones) constitutes a great landmark in the practice of teaching deaf persons to drive. It is planned to manufacture a considerable number of such devices so that they become available for all the driver training centres that want to train deaf persons. At the same time, a necessity exists that all the Provincial Road Traffic Centres in Poland should be provided with GRASER devices in the examination version.

The GRASER system is a unique solution in European terms. In this system, the technology used in mobile phones to call numbers or webpages by voice has been employed.

In the GRASER project, the speech recognition function has been defined as conversion of an acoustic signal into a graphic image. This can be done by employing a computer program where advanced algorithms of digital processing of signals, language models, and statistical processes are used. Having been correctly recorded, the speech signal (an example oscillogram has been shown in Fig. 3) is pre-processed so that it can be prepared for further analysis. The recorded curve that represents the signal is difficult for making comparisons. Therefore, efforts are made to describe the signal by a minimum number of parameters with simultaneously maintaining as much information useful in the speech recognition process as possible.

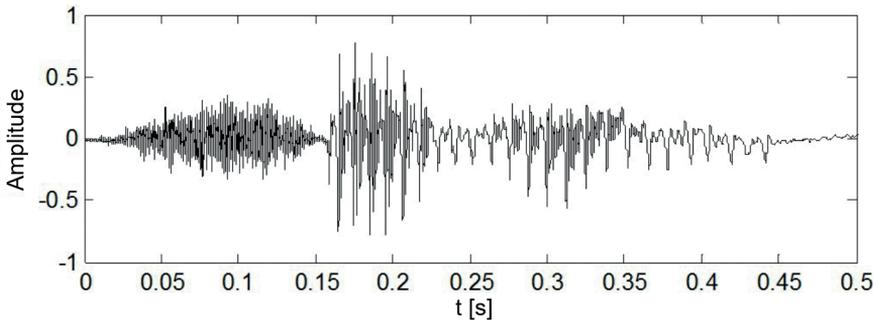


Fig. 3. Oscillogram of the word "siedem" (pronounced in Polish and meaning "seven")

The ASR (Automatic Speech Recognition) system is an extensive multi-block object, whose main purpose is to transform a speech signal into a text or another piece of information. The problem encountered by ASR systems is how to extract useful data from a speech signal and to associate them with e.g. a word that has a specific meaning for a human being. Variation in the speech signal is its natural feature, thanks to which we can recognize the stress or intonation.

A general schematic diagram illustrating the operation of the speech recognition system and showing individual component blocks in the system has been presented in Fig. 4.

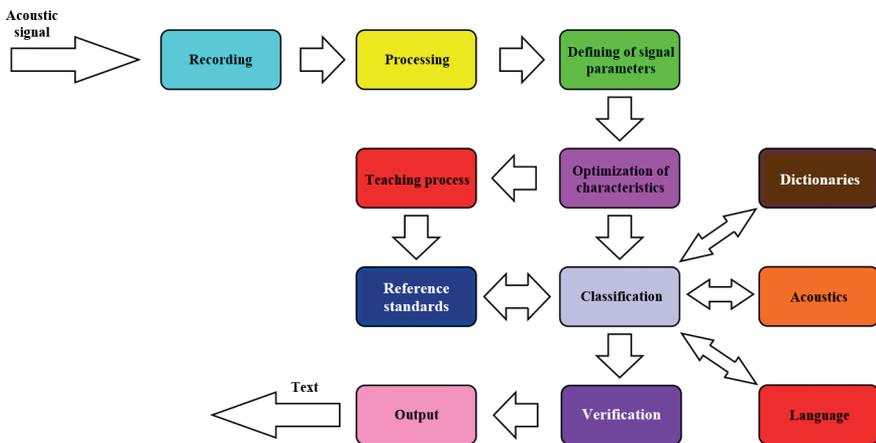


Fig. 4. General structure and principle of operation of the ASR system

Due to the specificity of operation of the GRASER system, a dictionary of clearly grammatically defined reference standards of words (spoken commands) is employed. The speech recognition system should be based on tested and proven solutions that ensure the recognition of commands at a level higher than 90 %. The algorithm and models used in systems of this kind include hidden Markov models (HMM), N-gram language models, artificial neuron networks, etc. The system should support the recognition of speech in Polish.

The speech recognition system analyses a word having been uttered and compares it with the word recorded in the dictionary. Based on the analysis, the word is compared with the reference standard and the word found with the highest confidence threshold is recognized as the command actually issued (Fig. 5).



Fig. 5. Analysis with comparing the phrase having been uttered with the reference standard having been stored

4. 20 deaf students were trained within special driver training courses at a specialized driver training centre at PIMOT, which is one of the partners involved in the project.

During the trial phase of the project, special driver training courses were organized for deaf students. The students were deaf charges of the Institute for the Deaf in Warsaw (Fig. 6). The Institute for the Deaf closely cooperated with the course organizers (PIMOT). Although the rules and regulations of the courses of this type must not differ in any respect from those of the courses for hearing people, the specificity of the students had to be taken into account in the organization of the courses. Therefore, the course of the training lessons was somewhat modified, e.g.:

- a) the time of duration of the theoretical lessons was extended because of the participation of a sign language interpreter;

- b) more training drives were provided;
- c) training drives were intentionally carried out in various road conditions and time of the day;
- d) during the training drives, the training car equipment standard varied depending on the general state of health of a specific trainee (it happens that deafness is accompanied by other disabilities, e.g. dysfunctions of the organ of motion, where additional technical solutions are necessary to remedy the situation).



Fig. 6. Theoretical lessons for young people of the Institute for the Deaf, extended by additionally teaching the students to understand the meaning of pictograms

The course of the training lessons provided the organizers and all the partners involved in the project with a lot of valuable knowledge about people with a dysfunction of this kind who wish to become vehicle drivers. The observations made and experience acquired are priceless from the point of view of the practice of organizing training courses like these as well as the legal recommendations to be conveyed to the legislator, i.e. appropriate commissions of the Sejm and Senate of the Republic of Poland.

5. For the process of education of deaf students to be possible, adequate funds and technical materials were provided, which were necessary for both theoretical lessons and practical training in motor vehicles.

The project implementation, which included the preparation of exam questions, technology of adding them to the base of exam questions, and the GRASER system, would be impossible without active use of training vehicles for driving lessons. A vehicle for teaching people with a dysfunction of the hearing and speech organs to drive must have, and be provided with, a lot of additional devices and tools useful for the training. The presence

and functioning of the GRASER system in the vehicle requires both the instructor and the trainee to behave in a special way. One of the most important elements in the training of deaf persons is the time of response to instructor's commands and the precision of execution of the commands. Hence, the driver's reaction time in many situations must be accurately determined by means of appropriate measuring instruments. A matter of special importance in the deaf person training process is a simulator trial carried out before the student starts the practical training in real road traffic (Fig. 7). The practicing of completely new reactions in virtual reality gives the student a comfort of having gained some experience and minimizes student's stress [4]. Moreover, the training process must be recorded (in audio-video form) with using electronic systems. The records of student's behaviour during test drives are very useful as educational material.

Regardless of the above, everything must be subordinated to traffic safety considerations, during both the training and examination. Many times, the assistance of a third party, i.e. a sign language interpreter, was used during the lessons.



Fig. 7. Exercises with optimizing the engine speed when moving off in a driving simulator and measurements of the time of response of deaf candidates for drivers

6. Series of practical, training and testing drives were conducted with deaf students in various road conditions (time of the day, configuration of the land, traffic intensity)

For the training drives to be carried out, all the Consortium members had to show deep commitment and to undertake and carry out various works that had not been known or encountered by them until then. The most important criterion of the reasonability of such works was the degree of their usefulness for the deaf people who aspired to the role of a vehicle driver. For this reason, much educational effort was focused on correct functioning of such people within the space available in the training vehicles. It must be understood that prior to taking

a driving licence exam where the sign language is to be used, the candidate must be additionally prepared for that during the basic driver training course. The communication with the trainee during the lessons must be adapted to the examination requirements (Figs 8 and 9). The content, selection, and nature of exam questions translated into the sign languages must coincide and be consistent with the training process. The training and examination must be coherent with each other in terms of their substance. With this objective in view, the cycle of training drives was carried out in various road conditions, both in an urban agglomeration and on a motorway, in various weather and temperature conditions, in very intensive traffic and in circumstances where intensive manoeuvring of the vehicle was required. The basic issue to which particular attention was paid was the "acoustics" of stimuli and external signals that should be alternatively perceived by a deaf driver and to which the deaf driver should correctly respond. This is of critical importance for a deaf driver, especially in consideration of the fact that many exam questions – formulated with using video records.



Fig. 8. Example of an exam task to be represented by a pictogram in the GRASER system



Fig. 9. Example of a command to carry out an exam task in the GRASER system. The examiner utters a command in the car: "Turn back with using the reverse gear" [1]

7. A group of instructors were trained who became specialists in teaching deaf persons

The teaching of deaf people requires the driving instructor to show many special qualities and behaviours. The communication barrier must be overcome not only by using technical means but also mentally. Patience, inquiring mind, powers of concentration, precision, and time offered become factors of absolutely different value in the case of teaching deaf people. All of them must be significantly enhanced. This requires appropriate psychological attitude. It has been proven beyond doubt that not every instructor may effectively work with a deaf trainee. The project works have resulted in a very important discovery: it has been found that if the instructor has an opportunity to spend several hours with his/her future trainee in circumstances completely disconnected from the driver training course (at trainee's home, during other everyday activities, etc.), then his/her knowledge about the trainee becomes more comprehensive. Knowing more, he/she easier, just intuitively and naturally, adapts himself/herself to deaf person's needs. The body and gesture language gets so enriched that becomes an additional communication asset during driving lessons.

8. Wide circles of the deaf were familiarized with the project objectives and the progress in organizing the training courses was continually presented.

The project implementation process required close contacts with the circles of deaf persons, including those among which there are no, and there will never be, vehicle drivers. The ability of driving a vehicle by oneself has a great value in the self-evaluation process. The fact that something considered impossible actually can come true influences the whole set of motivational characteristics of an individual. Even the deaf people who know the above although they are not drivers consider this fact very positive in the context of awareness of growth in the value of the whole community of the deaf in the social dimension [3].

9. Grassroots initiatives and appeals were directed to the Sejm of the Republic of Poland for the preparation of legal solutions aimed at enabling deaf persons to apply for a C category driving licence.

During the project implementation time, numerous contacts took place between project participants and many different milieus, not only consisting of deaf people. This subject matter has been arousing interest among driver training centres, non-governmental organizations (NGOs), as well as firms and institutions where the possibility of employing deaf people is considered, especially in the situation that a revision to the Act of vehicle drivers, admitting deaf persons to the driver's profession at the present scarce availability of such workers, is coming into effect [8]. Therefore, questions begin to be asked as regards the possibility that a C category driving licence could be formally obtained by deaf persons, as it has turned out that it is already now that motor trucks are driven by deaf persons on Polish roads: such drivers are employed by carriers of West-European countries and it was there that they have obtained their driving licences. The facts like this are the best example of departure from the stereotypes, which are in Poland an effect of years of abandonments and neglect, resulting in social exclusion of the deaf in terms of their economic activity.

Another "added value" of the project having been completed is the revealing of impossibility of carrying out a practical A category driving licence test with a deaf person because of the lack of communication between the examiner in a motor car and the examinee riding a motorcycle. A team of specialists working on the GŁUSI (THE DEAF) project has offered the developing of a radio system for training and examining a deaf motorcyclist with using vibrating command points installed on a special harness worn by him/her (Fig. 10).



Fig. 10. Radio system for training and examining a deaf motorcyclist with using vibrating command points installed on a special harness worn by him/her [5]

10. The project participants became experts for the related Sejm commissions and sub-commissions within the scope of the bills introducing important amendments to the "Road Traffic Law" Act with respect to disabled persons as traffic participants

An important effect of the work on the project was the fact that a group of people was selected from the Consortium community and the Sejm commissions involved took them as consultants and experts in this field. They permanently participate in, and considerably contribute to, the commissions' works on the new laws. The work of this group of experts is invaluable, which is emphasized by the parliament members themselves. The said experts are a source of the knowledge that was previously completely unavailable to the legislator. Even representatives of the health service previously presented very conservative and anxious opinions about such aspirations of deaf persons. Such an attitude arises from the lack of practical knowledge about technical evolutions and applications of specific devices and systems that can compensate the effects of deafness [5].

The issue of official driving licence examination adapted for people with various disabilities, including the deaf, has become one more aspect of the parliamentary works. In practice, the costs of such exams for the disabled are higher than they are in the case of fully able people. This provides grounds for another statement, concerning the discrimination

of some people, including the disabled students of driver training courses. The higher costs are caused by the fact that the driving test vehicle for disabled examinees must be specially provided with additional technical systems and equipment. The Provincial Road Traffic Centres in Poland have not such vehicles at their disposal. This causes a necessity that the specialized vehicles must be rented, against extra payment, from the driver training centres where the examinees were trained. The Sejm commissions' works resulted in the preparation of a commonly awaited and, finally, passed law that exempted disabled persons from payments for the official driving licence examination [7].

11. A vision to establish a National Centre for the Mobility of the Disabled (KOMON)

The implementation of the GŁUSI (THE DEAF) project significantly contributed to the intensification of work on establishing a National Centre for the Mobility of the Disabled (KOMON) in Poland.

In its essence, KOMON is to be the Poland's first institution where special procedures will be professionally applied, primarily to verify, in medical terms, the ability of a disabled person to drive a motor vehicle on his/her own. Having passed such a verification procedure, the disabled person will be entrusted to care of appropriate specialists in engineering and biomechanics, who will determine in detail the type and scope of the technical adaptation of a vehicle to individual needs of the specific person. Then, a wide range of financial and trade steps will be offered to the disabled person in order to arrange for him/her the purchase and subsequent servicing of an appropriate vehicle.

In the recent years, various important steps have been taken in Poland, which began to improve the situation of disabled people as regards their social and economic activity. This included actions aimed at removal of architectural barriers, improvements in public transport (e.g. introduction of low-floor vehicles), arranging of special parking spaces, subsidies offered by the State Fund for Rehabilitation of Disabled Persons (PFRON) for arranging jobs for such people, etc. However, all these measures, although improving the situation, are insufficient to state that the progress in the works on the activation of people with disabilities may be considered satisfactory in comparison with expectations and with the everyday situation in this field in the West-European countries.

When this problem is closely examined, which can only be done by somebody who permanently stays among such people and is continuously in touch with their suggestions, expectations, and demands, a general conclusion as presented below may be drawn.

A necessity is arising to establish a specialized institution that would address comprehensively and professionally the motorization-related mobility of disabled people as the most important factor determining their social and economic activity. The role of such an institution may be played by KOMON, for which the basic concept and lines of activity have already been prepared and are waiting for implementation. The arguments for putting such a solution into practice are self-evident, because:

- the number of problems that arise in connection with the mobility of the disabled is continuously increasing and the problems come from many different sources, such as milieus, firms, institutions, authorities and administration offices, etc.;

- there is an objective necessity to channelize such issues and to direct them to a specialized institution, which not only would have highly specialized personnel but also would be permanently in contact with various circles of people with disabilities who are capable to assess objectively and continually the quality of the solutions proposed.

The tasks of the institution of this type should include:

- a) prompt preparation of professional actions and procedures that should result in practical enabling of disabled persons to aspire to becoming a vehicle driver;
- b) establishing of contacts with various specialized institutions such as universities and the like schools, institutes, and firms in order to search for reasonable techniques and technologies that would enable practical implementation of the EU standard of general accessibility;
- c) wide range of training for the firms and institutions whose activities are related to disabled people and their needs;
- d) establishing of international contacts and cooperation with the firms of all over the world that are leaders in this field.

Recapitulation

The Consortium members who were involved in the GŁUSI (THE DEAF) project express their satisfaction with having the opportunity to participate in such an undertaking. Absolutely all of them are convinced that the project outputs include not only the accomplishment of the practical project tasks (i.e. making of the translations and of the GRASER system) but also, or maybe above all, the "echoes" that were produced in various milieus and contributed to making many institutions and individuals "discover" completely new issues and facts, previously absent not only from their everyday activities but also from the general social consciousness.

There is no doubt that the product worked out within the project should be implemented without unnecessary delay in the examination practice at all the Provincial Road Traffic Centres (WORDS) throughout Poland. It should be developed in terms of both the quantity of the exam questions and the range of the driving licence categories, inclusive of professional driver's licences. For the range of project objectives to be widened so that it would cover the driver training within the scope of preliminary and temporary confirmation of qualifications as well as other training courses, the budget required must be large enough. Anyway, we fully appreciate the fact that in spite of limited budget of the project, a sort of "added value" was luckily generated, which should be a spur to more courageous and ample, in financial terms, investing in projects aimed at improving the activity of people with disabilities. Even without detailed analyses, the effectiveness of this project may be classified as the highest possible. This practically manifests itself in the fact that disabled persons do enter the open labour market and actively participate in the generation of the gross national product.

The society of disabled people aspires to reach a position where their everyday existence would not generate too much costs in the state budget. Quite the opposite, they want and can noticeably contribute to the national income.

Thanks to the "Social Innovations" Programme of the National Centre for Research and Development, the expectations of many people with hearing disability may come true. The Programme has highlighted the research area that still has not been sufficiently explored and described in the literature and this undoubtedly will have an impact on the development of further studies and research in this field.

References

- [1] Folwarczny M, Paczkowski A, Wysopal G, Zawada Z. Piktogramy – prawo jazdy kategorii B (Pictograms – the C category driving licence). PIMOT 2017.
- [2] Hunter J, de Vries J, Brown Y, Hekstra A. Handbook of Disabled Driver Assessment. Portare Working Group, Ljubljana 2009 – (translated by A Paczkowska).
- [3] Paczkowski A. Nauka jazdy osób niepełnosprawnych (Driving lessons for disabled people). Chapter V in: Marciniak K [ed]. Poradnik niepełnosprawnego kierowcy i pasażera (Handbook for a disabled driver and passenger). Motor Transport Institute and the SPiNKa Association, Warszawa 2013.
- [4] Paczkowski A, Więckowski D. Symulatory jazdy samochodem w szkoleniu osób niepełnosprawnych (Car driving simulators in training of disabled persons). Logistyka. 2014; 4.
- [5] Paczkowski A, Więckowski D. Potrzeba obiektywnej oceny zdolności do prowadzenia pojazdów przez osoby niepełnosprawne (The need of objective assessment of the vehicle driving ability of disabled persons). Niepełnosprawność – zagadnienia, problemy, rozwiązania. 2017; II(23)
- [6] Ekspertyza doradcza dla Przemysłowego Instytutu Motoryzacji, dotycząca innowacyjnego systemu emisji rozkazów dla niesłyszących kandydatów na kierowców (Advisory expert's opinion for the Automotive Industry Institute on an innovative command emission system for deaf candidates for drivers). NOWERK EDYTA NOWAG, 30 Nov. 2015.
- [7] Act of 28 February 2018 on changing the Vehicle Drivers Act (Dz. U. of 2018, item 728).
- [8] Act of 12 April 2018 on changing the Vehicle Drivers Act (Dz. U. of 2018, item 1098).
- [9] Regulation of the Minister of Infrastructure and Construction of 24 February 2016 on examining applicants for vehicle driving licences, on training, examining, and licensing of examiners, and on the standard forms to be used in the related cases (Dz. U. of 2016, item 232).
- [10] Pakiet Innowacyjny MIGACZ (Innovative Package SIGNER). www.emigacz.pl (cited: 20 May 2015)