e-mentor

DWUMIESIĘCZNIK SZKOŁY GŁÓWNEJ HANDLOWEJ W WARSZAWIE
WSPÓŁWYDAWCA: FUNDACJA PROMOCJI I AKREDYTACJI KIERUNKÓW EKONOMICZNYCH

2021, nr 5 (92)

Academic Journal published by **SGH Warsaw School of Economics**
and **Foundation for the Promotion and Accreditation of Economic Education**

e-mentor

Number 5 (92) 2021   ISSN 1731-6758

ICT in education
Lifelong learning
Business and technologies
New trends in management
Teaching methods and programs

Deaf-friendly research – conducting research using an electronic questionnaire

Anna Irasiak

Elżbieta Sroka

Wojciech Górka

Michał Socha

Adam Piasecki

Abstract

A non-exclusive approach in conducting survey-based research which assumes the participation of people with disabilities is one of the important ethical aspects of the research process. The use of the tool, which has been designed in accordance with the universal user-oriented design, makes it possible for people with disabilities to take an active part in surveys. This means that they can present their attitudes and express opinions within the conducted surveys.

The aim of the article is to present the issue of conducting surveys using an electronic questionnaire among deaf people, modelled on the *Avatar PJM* project. People with a hearing impairment, whose first or primary language used for communication is a sign language, should be given a questionnaire in an appropriate form enabling them to complete it easily. The discussed project presents a proposal to construct a questionnaire using the LimeSurvey software. The questionnaire has been adapted to the needs and expectations of the recipient group. The presented solution for designing a user-friendly research tool can be used in other types of research in this group of respondents (e.g. industrial or educational research) or can become an inspiration for further research in this field.

Keywords: electronic questionnaire, Deaf-friendly research, universal user-oriented design, surveys, *Avatar* project

Introduction

Universal Access assumes the right to equal access to Information Technologies for *all* regardless of age, experience, cultural background or disability. It is a perspective that 'recognizes, respects, values, and attempts to accommodate a very wide range of human abilities, skills, requirements, and preferences in the design of computer-based products and operating environments' (Stephanidis & Savidis, 2001, p. 41). In that sense, a well-designed product is usable by anyone, anywhere, at any time, to the greatest extent possible, without the need for *a posteriori* adaptation or specialized design (Connell et al., 1997). It also eliminates the need for additional "special features". The main aim of Universal Access is to undertake systematic efforts to prevent the exclusion of certain users from the information society. On the other hand, it provides a technological substratum for eInclusion in this society, understood as the process of engaging and involving many diverse individuals and cultural or national groups who should help shape and determine technological outcomes (Stephanidis, 2009).

The knowledge and experience derived from such an approach can be applied in the process of equitable inclusion in survey-based research of people who have been excluded so far or who could not be full partners in research, or full-fledged research participants. Therefore, Universal Access can be an approach that supports and provides space for the inclusion in conducting academic research of various minority groups or groups of people with disabilities. We want to present the adoption of the Universal Access approach based on the example of developing a research tool in the form of

Anna Irasiak, Jan Dlugosz University in Czestochowa, Poland, ⓘ https://orcid.org/0000-0003-3046-6365

Elżbieta Sroka, Pedagogical University of Krakow, Poland, ⓘ https://orcid.org/0000-0001-8952-2187

Wojciech Górka, Lukasiewicz Research Network, Poland, ⓘ https://orcid.org/0000-0003-2124-7734

Michał Socha, Lukasiewicz Research Network, Poland, ⓘ https://orcid.org/0000-0002-7439-4001

Adam Piasecki, Lukasiewicz Research Network, Poland, ⓘ https://orcid.org/0000-0001-9323-6159

a survey dedicated to deaf[1] people, i.e. those who are classified as people with disabilities and as a linguistic and cultural minority. In the article we will present the implementation of a computerized video questionnaire accessible in the Polish Sign Language in the *Avatar PJM* project. The solutions used in the project may be implemented and duplicated in small-scale research projects dedicated solely to deaf respondents or in studies of wider populations including such minority groups as the Deaf community.

In this paper, we explore the theoretical assumptions as to how representatives of the Deaf community can participate and get involved in academic research. We discuss types of survey research and the possibility for people who use a sign language as their preferred language for communication to take part in it. These indications correspond to the research project, conducted in 2019–2020, on the possibilities of increasing the readability of statements in the Polish Sign Language using an animated virtual character (avatar), in which we have adapted the survey research tool to make the survey fully accessible to deaf people.

## Universal user-oriented design

Today's information society is based on information which is widely used in everyday social, cultural, business and political, life (Krzysztofek & Szczepański, 2005). In such a society, efficient information flow is indispensable, along with its collection and processing (Babik, 2015). Hence quick information transfer should ensure that the information is available in different forms, so that any person can obtain it in any conditions.

Language is for communication, i.e. transferring information. Here the communication process takes place between the sender conveying a message and the message receiver. Communication should be a two-way process during which information is exchanged, and the message is understandable to both parties and free from information noise (interference) or information barriers (restrictions).

The article is focused on the description of the applied tool intended to provide proper transmission of information during the questionnaire-based survey

Figure 1
Model of communication process in Avatar PJM project
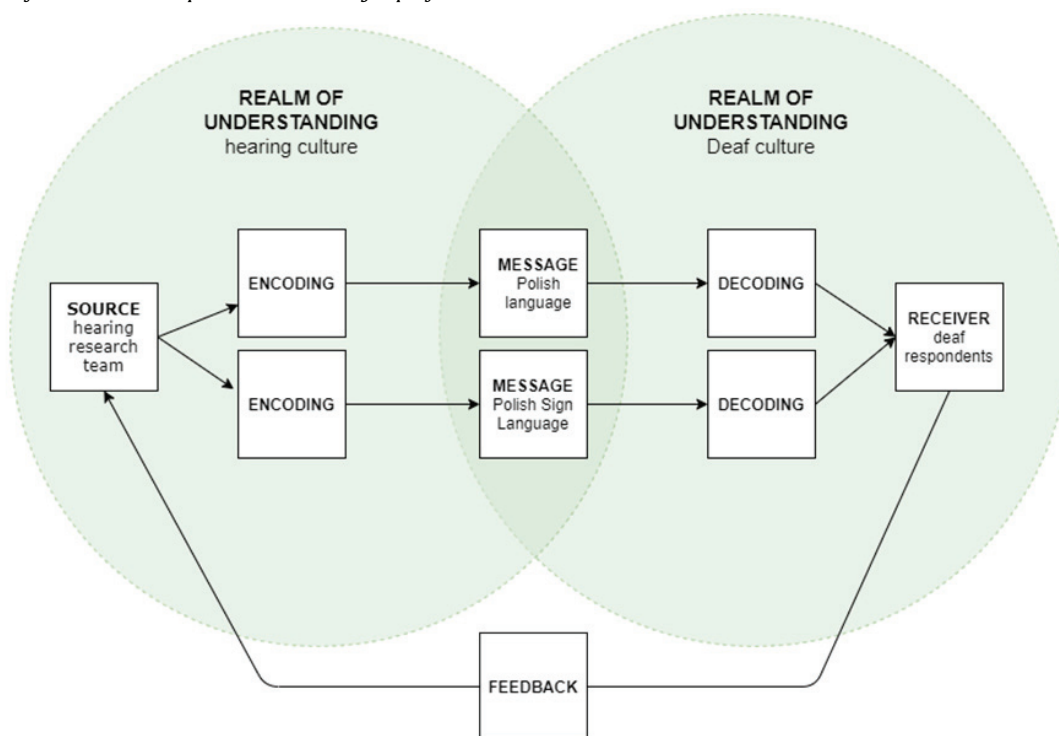
Source: produced by the author based on *Marketing communications: discovery, creation and conversations* (p. 41), C. Fill & S. Turnbull, 2016, Pearson.

[1] We use the capital D to refer to people whose first or preferred language is a visual sign, and who identify themselves with and are actively engaged with the Deaf community. We use the lower-case d to describe all kinds of deaf persons, including those who are hard of hearing. This does not mean "oral/medical" but rather biologically/corporally deaf. We use the term d/Deaf when the distinction between these categories of deaf and Deaf is unclear and is not obvious (Kusters et al., 2017; O'Brien & Emery, 2014).

in the selected group of recipients, i.e. the deaf. The research methodology requires suitable information exchange, in the sense of proper communication throughout the period when the survey is conducted. If the survey makes use of a tool, e.g. a questionnaire, the tool should be adapted to and understandable for the recipients. Deaf people are a group of survey recipients to whom the message has to be conveyed in a language they understand.

In order to provide proper information flow during the survey, the challenge faced by the project team was to prepare it in such a way that the communication and information barriers could be overcome, while the information noise, causing certain restrictions to the survey, could be avoided.

"Technological advances related to multimedia frameworks have transformed the ways in which users interact with and access all types of content" (Fonseca, 2015, p. 307). In order to properly design the tool for conducting surveys in the group of deaf people, the project team focused on elements which are important in communication with and between the deaf. Other points of focus were issues and hints for the development of Human-Computer Interaction (see Kostrubała, 2013) and the User-Centered Design (UCD) (see Garrett, 2011), including the usability and accessibility of the tool for the user. Interactive systems play an important role in today's world. Examples of IT solutions are application software, web applications, Internet portals, games, and educational and entertainment applications. Marek Sikorski (2017) emphasizes that the user's satisfaction from a given solution lies in its usability and handling ease. The quality of a given IT product is also perceived with respect to how the user-system interaction is designed, i.e. the user interface ensuring communication with the computer (p. 22). A badly designed interface may cause errors in the system operations and task completion, prolong the learning process, and result in the user's reluctance to work with the product. Therefore, while developing the product, one has to take into account factors such as understanding the users (learning their limitations, habits and customs) and understanding the requirements the product has to meet (context of use – needs, ergonomic criteria) (Sikorski, 2017).

Information which is conveyed in an easy-to-read form has to improve accessibility through more easily understandable text. It is more appropriate for different target groups (Heumader et al., 2020). Therefore, while preparing the questionnaire tool, the authors paid attention to the use of accessibility principles (WCAG, 2021) i.e. it is required to be Perceivable, Operable, Understandable and Robust (European Parliament, n.d.).

Diversity of the deaf

In terms of language and communication, the deaf constitute a non-homogeneous group. As Monaghan et al. (2003) wrote, 'there are many ways to be deaf'. The spectrum of individual communication styles ex-

tends across a continuum from the deaf who do not sign, and use only a spoken language, to the deaf who are sign language users, with a significantly limited knowledge of the spoken language.

Even so, sign languages are the primary means of communication for a portion of the deaf and hard-of-hearing communities. These groups in particular are at risk of being excluded from participation in scientific research in which data collection methods based on the national language in speech or writing are used. For many deaf people, a sign language is their first (*mother tongue*) or preferred language in communication. Spoken or written languages are often second languages and literacy levels among deaf signers vary in this respect (Lederberg et al., 2013; Napier et al., 2018). Therefore, the deaf as researchers or research participants are frequently underrepresented, because of the issues with different modalities in conducting research (signed, spoken, written) and the need of interpretation, transcription and translation (McKee et al., 2011; Young & Temple, 2014).

Beyond the issues of language knowledge and literacy, there are also additional considerations of *language preference*. It is possible to know two or more languages, but their mere knowledge does not mean the opportunity to participate in each or any of them in academic research. In the case of the Deaf community, it cannot be assumed that someone's knowledge of the spoken language, e.g. English, will be sufficient to participate in the study. Deaf people have various language preferences and the majority of them switch languages and match their chosen communication to the interlocutor, e.g. they sign with friends, sign or speak with their families and speak in official circumstances (public institutions, health care etc.) (National Deaf Center on Postsecondary Outcomes, 2019; Padden, 2000). Also, it is incorrect to assume that if a deaf person participates in the study, he or she will want to communicate in their sign language. In the case of bilingual or multilingual deaf people (who know at least one sign language and one spoken language) it may be inappropriate to conduct research only in a sign language, without giving the possibility to participate on an equal footing to those whose first language is a spoken one. Therefore, it will be necessary to retain the possibility of answering questions and collecting data in both languages (Young & Hunt, 2011).

Another case of possible exclusion of signing deaf participants from academic research is a situation in which it is conducted by hearing researchers who cannot sign and are not aware of the Deaf community's needs. This situation may result in conscious or unconscious marginalization or even systematic exclusion of deaf participants due to communication difficulties of hearing researchers who lack sign language skills, or due to no/insufficient funding to hire sign language interpreters (Napier et al., 2018).

The above-described issues of excluding the deaf from conducting and participating in academic research have their roots in historical isolation of the Deaf community from a variety of public activities

as a result of communication, cultural, social, and language barriers (McKee et al., 2013; see also Ladd, 2003; Lane, 1993). Therefore, being aware of the current changes in this area and the ongoing processes of including and opening up access to various areas of social life, we take the position that it is necessary to undertake conscious and systematic actions of including deaf people in research processes or their individual stages.

Deaf-friendly surveys

The role of deaf people in scientific research can be considered from two perspectives: deaf people as researchers and deaf people as research participants. In the first approach, it is satisfying that the number of deaf researchers in academia is growing. This increase does not concern only the area of research related to *Deaf studies* or sign languages, but also the humanities, social sciences and hard studies (Kusters et al., 2017). Nevertheless, in this article we would like to focus on issues related to the participation of deaf people in research as respondents and the changes in methodological procedures that make this research more *Deaf-friendly*, i.e. more inclusive and culturally appropriate (Singleton et al., 2015). Many ways are described in literature to adapt and adjust the research process to the needs of deaf people and thus increase the correctness of the conducted surveys. Among them are the following:

- interpretation of informed consent documents into a sign language in order to ensure that deaf participants with limited spoken language proficiency will comprehend them (McKee et al., 2013; Singleton et al., 2015; Singleton et al., 2014);
- ensuring confidentiality and anonymity of data recorded on the video while collecting the responses of deaf participants in a sign language (Singleton et al., 2014; Singleton et al., 2015);
- ensuring a proper physical environment in which the data are collected, for example guaranteeing appropriate room acoustics (no reverberation) for hearing aid users or proper lighting conditions for lip readers (avoiding situations where the light is dim or when it is placed behind the speaker) (Young & Hunt, 2011);
- maintaining visual accessibility and avoiding visual disturbances while conducting research with signing deaf participants. The sign language is based on visual modality, therefore it is necessary to ensure good mutual visibility of researchers and study participants for fluent and appropriate communication and smooth information flow (Hill, 2015; Young & Hunt, 2011);
- ensuring the presence of a sign language interpreter during research with signing deaf participants in a situation when the researcher does not sign at all or signs, but not well enough (*SLLS Ethics Statement for Sign Language Research*, 2016; Young & Hunt, 2011).

Another example of activities to increase the possibility of participation in the Deaf community-based research is modification of research tools and adjusting them to the language preferences of the respondents. In the past, surveys have mainly been conducted in writing, using sheets of paper, and were made during direct contact, the so-called PAPI System – Paper over Pencil Interview. Currently, some surveys still use this form. Since the 1980s, technological advances have transformed the way research data are collected and processed. New, more effective and less time-consuming techniques have been developed, such as: Computer-Assisted Telephone Interviewing (CATI, telephone version of PAPI); Computer-Assisted Personal Interviewing (CAPI, interviewers read the questions and enter the answers into laptops from which they are directly sent to the measurement center); Audio Computer-Assisted Self-Interviewing (ACASI, respondents read or listen to the computer questions and then enter the answers to it on their own. There is also a telephone version of this technique – T-ACASI); Computerized Self-Administered Questionnaires (CSAQ, where questionnaires are submitted as computer files). The latter has been almost completely replaced by Computer-Assisted Web Interviewing (CAWI) (Couper & Bosnjak, 2010; Wright & Marsden, 2010).

All these techniques have at least one thing in common – they exclude people with lower levels of literacy from taking part in them, therefore in certain types of research the representativeness of the research sample may be questioned. In such a situation, the level of understanding of the questions in the written-form questionnaire may be incomplete or inappropriate, especially in relation to the sublime scientific language (Napier et al., 2018). It is a mistake to assume that collecting data in written surveys is not an exclusion because it is independent of hearing ability (Young & Hunt, 2011). In fact, the lack of hearing has a negative effect on the level of literacy (Lederberg et al., 2013)

Modern technologies in the service of the deaf

Due to the rapid development of the Internet and the World Wide Web, the popularity of Internet research has grown significantly and is now widely used in various sectors of the research industry. Internet-based research may be the basic research method or be part of research that uses the triangulation of research methods. The attractiveness of Internet-based research is supported by the speed of data collection, even with a large number of respondents, and the relatively low costs of its implementation. In the context of the Deaf community, a definite advantage of Internet research is the possibility of using complex instruments with rich visual functions and dynamic elements (Bosch-Baliarda et al., 2019).

The advancement of information technology is conducive to the development of solutions that can

enable this group of respondents to participate in surveys and thus give them the opportunity to express their own opinions or share their experiences. Thanks to broadband Internet, web cameras, and modern software, it is possible to develop questionnaires with a sign language version in addition to a text version. It is also possible to save and collect responses provided only in a sign language (European Parliament, n.d.; National Deaf Center on Postsecondary Outcomes, 2019). Of course, many rules still have to be followed and many aspects of using the technology have to be observed, such as: proper lighting, appropriate positioning of respondents in relation to the recording device, or the use of appropriate recording techniques. This is essential in order to ensure that research material is properly managed for further use and processing (Kushalnagar et al., 2017; Kusters et al., 2017).

Visual presentation of the questionnaire content and video recording enable research to be conducted in a sign language, taking into account its specificity and the cultural context in which it functions. It is a system of visual-gestural communication. It is articulated with the whole body of a signer, with the most important role played by hands. In sign language communication, non-manual signals, such as facial expressions, eye gaze, body leaning, head tilting, shoulder raising, mouthing, etc. and interpretation, are also very important as they are used as grammatical markers. Therefore, the ability to transmit and register these visual and motor nuances of expression is extremely important for the subsequent proper interpretation of the collected data in scientific research. Moreover, the sign language syntax possesses a unique characteristic: unlike the linear syntax of spoken languages, it allows for three-dimensionality. That means, as opposed to words of a spoken language, that sign language words can be articulated at different spatial positions (Lachner et al., 2015). This feature, along for example with the presence of metaphors in the sign language, which work a bit differently than they do in spoken languages (Ladd, 2003), causes that the utterances of the sign language users can be recorded, processed and transmitted only in the form of video recordings.

There is no doubt that the language of science and scientific communication is the spoken language, especially English, but modern technology allows us to open up to a completely new area of research conducted from the beginning to the end in a sign language.

There are different topic areas in which questionnaire-based surveys in the Deaf community are conducted. Some of them are dedicated exclusively to the Deaf because their topics are related to *Deaf studies* or to a sign language (see Kotowicz et al., 2020; Leeson et al., 2018). The remaining are about universal human issues when the researchers, due to various reasons, want to collect data from people with hearing disabilities too (see Kushalnagar et al., 2017).

The approaches to creating questionnaires with the use of sign languages are different too. Some are based on already existing questionnaires which are adapted accordingly in order to include the underrepresented group of deaf respondents in the survey (see Cornes & Brown, 2012; Graybill et al., 2010). Others are more innovative. Here the questionnaires are built from scratch and include the authors' original solutions as to how to implement a sign language into a survey tool (see Kushalnagar et al., 2017). There are also questionnaire-based surveys in which, similarly to our survey, questionnaires adapted to a sign language serve to evaluate signing avatars (see Ebling & Glauert, 2016; Kipp et al., 2011).

Avatar PJM project

The project "Research on Increasing the Readability of Expressions in Polish Sign Language by an Avatar" (Avatar PJM) (http://www.migowisko.pl/sztukamigania), was conducted by the EMAG Institute of Poland's Łukasiewicz Research Network (Ł-EMAG) (https://ibemag.pl/en). The project was financed by the State Fund for Rehabilitation of Disabled People in the open competition "Social and technological innovations in the process of disabled people activation". The survey was carried out in the voivodeship of Silesia, Poland, in the period 01.01.2019 – 29.02.2020 and involved 111 deaf participants.

The goal of the survey was to assess the efficiency of the Polish Sign Language (PSL) communication by an avatar and to identify features which, to the greatest extent, contribute to satisfactory reception and suitable comprehension of the communicated message. In addition, the survey allowed diagnosis and description of the preferences of the deaf as far as signing avatars are concerned. The reason to undertake the research was the need to develop a solution which would increase the readability of a signed message provided by an avatar and would contribute to the liquidation of social barriers towards the deaf by providing them with a tool supporting communication in their natural language. Looking further ahead, this research is meant to verify the possibilities of using avatars in information systems (in offices, railway/bus stations, public institutions websites) and to assess the possibilities of efficient integration of the signing avatar application with other IT systems.

The survey was conducted in three stages. In the first, preliminary, stage, we compared how the participants receive sign-language messages provided by a human interpreter as opposed to an avatar. During the second stage, a 3D model of the avatar was made, along with animation considering additional, diagnosed elements which improve the sign-language reception. In the third stage, we verified the reception of the animation which was equipped with extra elements improving sign-language comprehension. The results of the conducted survey were intended to address the issues about the efficiency of avatar-signed presentations.

One of the tasks of the Ł-EMAG team was to prepare tools for the survey that focused on (1) comparing the

readability of the message in the Polish Sign Language provided by an avatar and by a human interpreter, and (2) comparing the readability of the message signed by the avatar before and after introducing the modifications that resulted from the implementation of readability-diagnosed features. This paper presents the survey tool – the questionnaire developed for research purposes.

Questionnaire structure

The challenge faced by the research team was to develop a tool that would make it possible to answer the questions and share opinions within the focus group composed of deaf people. The development concerned both the substantive scope of the questionnaire, i.e. adaptation of the contents, and technical issues, i.e. the usability and accessibility of the contents carrier. As far as the contents adaptation is concerned, the questions were formulated in a way making them easy to read (E2R) (Hartley, 2012) and easy to understand (Kools, 2012). From the technical point of view, the presented tool was unique on the Polish market, as the developed software, containing solutions for the deaf, made it possible to fill in questionnaires in two languages: the Polish language and the Polish Sign Language.

The first step and the scientific basis of the research was a literature survey on the possibility to develop IT systems for sign-language interpretation all over the world. Additionally, the team analyzed different publications to assess the state of the art in the field of avatar construction, and possibilities of presenting the sign language both in the form of avatars and in the form of video-recorded human interpreters. The key issue was to identify, based on the analyzed literature, the language and communication abilities and needs of the deaf with respect to scientific research.

Based on the literature survey, some factors were identified which impact the accessibility of electronic questionnaires available on the Internet and dedicated to people with hearing disabilities. These are factors aimed at increasing the efficiency and methodological accuracy of data collection. In terms of the tool availability through a web page, two concepts were applied: User Experience Design (Brejcha, 2015; Lachner et al., 2015; Marcus, 2006) and Usage-Centered Design (Windl & Heimgärtner, 2013). These concepts were analyzed in terms of differences and similarities which occur, or may occur, between the users from the Deaf community culture and those from the hearing majority. What proved to be useful while preparing a personalized deaf-oriented questionnaire was practical hints on the usability of web pages. These hints were followed to make the proposed tool useful and to ensure positive experience on the user's side (Krug, 2014; Nielsen & Loranger, 2006).

Based on the literature survey and the experience gained during previous projects, a number of aspects were recognized as indispensable in the developed tool. One of the key decisions which affected further work on the tool design and development was to guarantee physical and sensual accessibility of the questionnaire for deaf people (see: deafness medical model) and to consider cultural differences (see: deafness culture-linguistic model, Ladd, 2003). Thus it was decided to provide the contents both in Polish and in the Polish Sign Language in order to increase accessibility and avoid linguistic and cultural biases. Moreover, it was necessary to offer an interface which met the varied needs of users. Here the focus was on the applied colors and fonts.

As far as the Polish language content is concerned, it was stressed that the questions and answers should be formulated in plain language which, on one hand, rendered the text legible and understandable and on the other hand did not raise difficulties during interpretation into sign language. Such an approach ensured that language equivalents in PSL could be found. It also lowered the risk of misrepresentation of the questionnaire contents, depending on the language in which it was conducted. Hence, this approach increased the credibility of the collected data. In addition, regarding the sign-language text, a native signer was employed to interpret the text and sign it in the questionnaire video recordings. A native signer has an ability to place the interpreted and signed contents in the cultural context of the Deaf. This way, the signed message does not become devoid of linguistic and cultural nuances which may be crucial for the research results. Both in the Polish language and the Polish Sign Language, it was necessary to guarantee proper visibility and readability of questions and answers and to prepare precise instructions on how to fill in the questionnaire or submit particular answers (detailed solutions in this regard will be discussed further in the paper).

Another group of factors impacting questionnaire accessibility were the issues related to videos with sign-language content, content structure, and navigation of the questionnaire elements. The key task in this respect was the implementation of the questionnaire signed version into the software tool in a way that would ensure its accessibility and readability.

Bearing in mind the above issues, the LimeSurvey system was chosen as the basic tool for drawing up the questionnaire. LimeSurvey (https://www.limesurvey.org/en/) is a web-based questionnaire system, distributed as open-source software, written in the PHP language. The decision to use the already existing software, which can be adapted, was made based on the fact that LimeSurvey has many useful functionalities, such as the possibility to create questionnaires according to different layouts and with different types of questions, to choose from different templates for the most convenient interface adaptations, to edit the contents using the WYSIWYG HTML editor, and to take advantage of easy import and export of questions. This system had been already used by the Ł-EMAG team in previous research projects, including those concerning increasing the accessibility of persons with disabilities to different services. The work

with the system began with analysis of the original template code available in the administration panel and development tools of LimeSurvey (see Figure 2). A detailed analysis and greater familiarity with the original template code structure made it possible to define a group of questions which would have to be modified for the purposes of the developed question-naire. The size of the window (according to the se-lected template), in which the questions and answers were presented, limited the volume of displayable text. Another factor limiting the text volume was the necessity to place extra components related to sign language. This in turn meant that the contents of the questions and the number of possible answers had to be limited. Some questions were split into two (or more) or rephrased.

Therefore, providing a tool accessible to deaf signers required, on one hand, selection of a proper interface style with already implemented accessibility solutions. On the other hand, this interface had to be equipped with certain specific elements that met the needs of the deaf and was compatible with the questionnaire-based survey employed in the *Avatar PJM* project.

The selected and applied solutions were divided into several areas. As far as navigation is concerned, we pointed out easy-to-use and intuitive elements that should be available regardless of the user's experience or language abilities. Such elements were one question per page of the questionnaire, and easy navigation between the questionnaire pages/questions by means of clearly visible buttons "next" and "return". A function displaying progress as a percentage of questions answered helped with

orientation in the questionnaire. The crucial issue was to provide precise and short instructions in the form of short messages about the necessity to answer a question in order to proceed to the next one, or about the number of answers possible (one or multiple). These messages minimized the risk of unintentional action and improved the questionnaire completion process.

While working on video material, it was important to ensure perceptibility of information, meaning that the information could be conveyed regardless of the ambient conditions or sensory abilities of the user. It was assumed that the group of respondents might include older people with sight dysfunctions or low concentration levels. In this respect, solutions were provided such as the possibility to zoom in/out from the multimedia window, or to pause and replay the video. In order to increase the "readability" of videos with signed contents, proper contrasts were ensured, i.e. dark clothes of the interpreter improving the visibility of moving hands, and a neutral one-color background.

Regarding the content layout on the screen, some solutions were provided to enable comfortable and efficient use of the questionnaire with minimum men-tal effort. A new function was developed to move the video forward and backward, making the video infor-mation accompanying questions with multiple-choice answers readable and comprehensible. In questions with a long cafeteria of possible answers that required scrolling, the video window with the sign-language interpreter was relocated in such a way that the re-spondent could see each answer without missing the provided video information (see Figure 3).
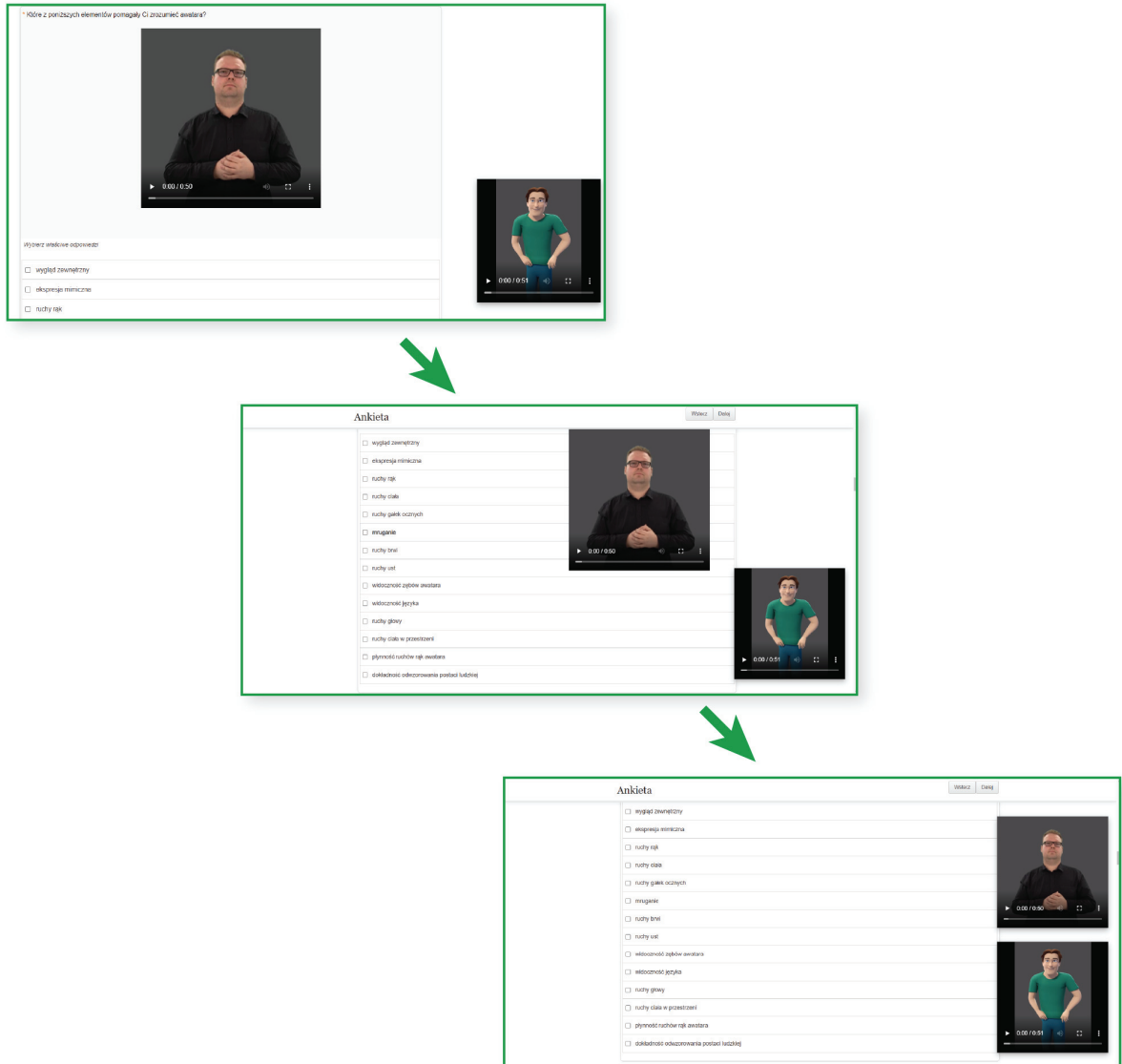
Figure 2
Development tool
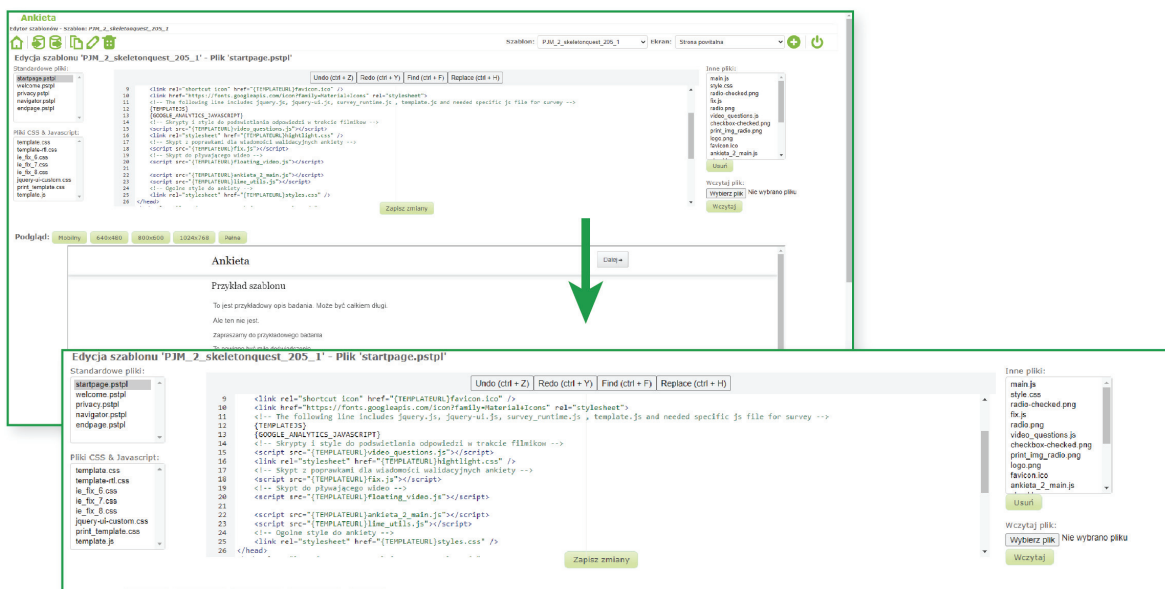
Source: authors' own work.

Figure 3

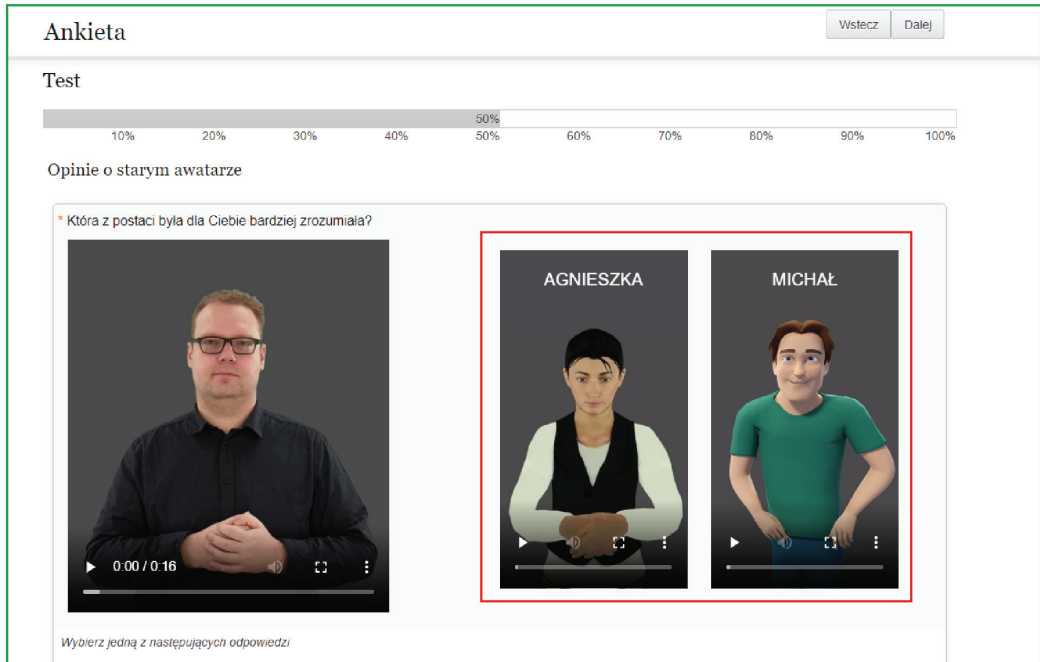*Relocated video with a sign-language interpreter*

Source: authors' own work.

Due to a specific feature of the project, i.e. the evaluation of readability of the signing avatar, it was decided that the evaluated item (video with the signing avatar) should be visible to the respondent at the beginning of the questionnaire and throughout its duration, as a hint. Where three videos were provided (one explaining the questionnaire contents and the other two being the items to be compared and evaluated), they were laid out in such a way that the user could see each of them in a readable form, in one line, and the videos to be evaluated were separated from the one with the sign-language interpreter (see Figure 4).

The questionnaire prepared by the Ł-EMAG team could be classified as a one-clip layout for a cross-modal bilingual VSL questionnaire, i.e. the category described by Bosch-Baliarda, Vilageliu and Orero in (Bosch-Baliarda et al., 2019), with separate sign-language videos for each question and only one question displayed per page. However, an extra functionality was developed and implemented regarding the content compatibility between the Polish Sign Language and the Polish language. This was the function highlighting the answer in Polish at the time it was conveyed in PSL in the video clip (see Figure 5). The synchronization of the video and the text was provided on the basis of an additional file with subtitles of the questionnaire contents. The file contained time markers in the video which corresponded to the relevant items of the questionnaire. Thus the questionnaire item which was presented in the sign language at that time was highlighted precisely. Implementing such an original proprietary modification into the already existing LimeSurvey tool meant that two languages could be integrated. It also helped to

Figure 4

The videos to be evaluated and the videos with the sign-language interpreter

Source: authors' own work.

Figure 5

Video with a sign language interpreter combined with highlighted Polish language answers
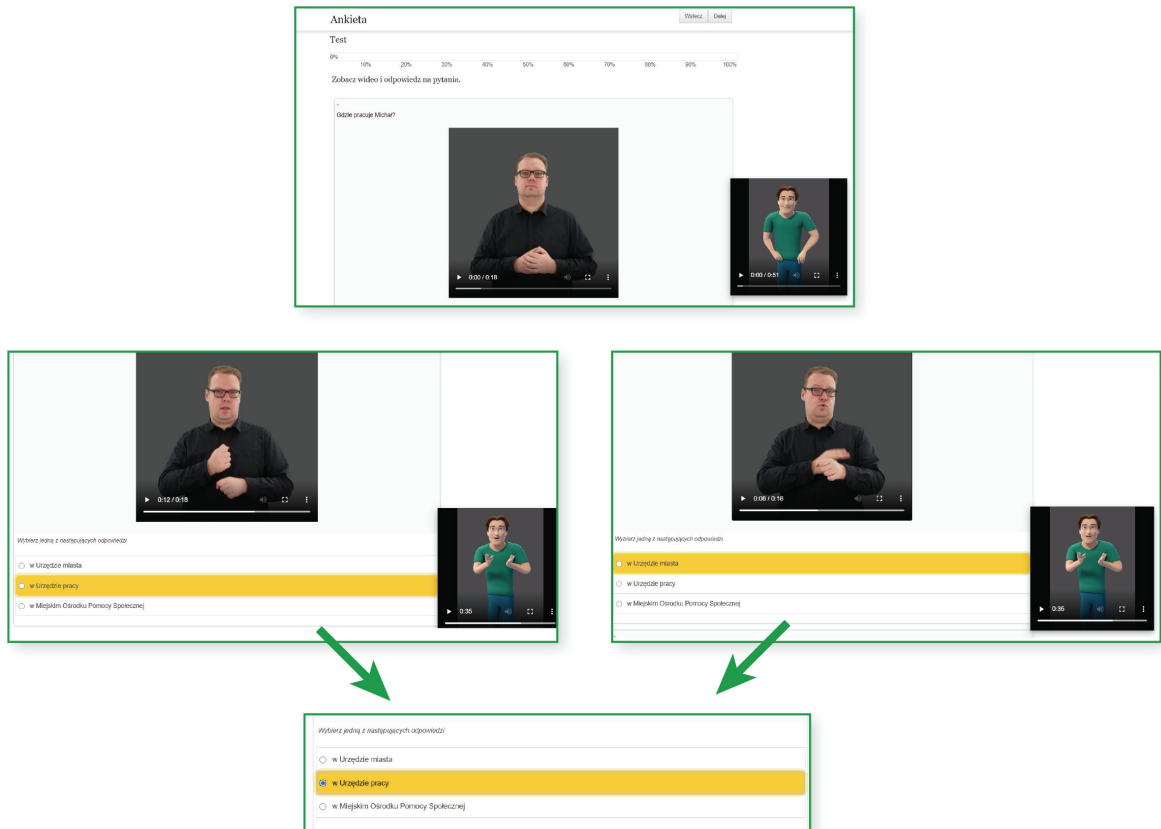
Source: authors' own work.

prevent any group of users, either using the Polish language or the Polish Sign Language, from being embarrassed or branded.

In-depth interviews with the deaf concerning the researched problem were also an integral part of the survey. Therefore, the discussed questionnaire featured closed questions and the authors decided not to implement the functionality of adding sign language answers by means of a video registration tool. The questionnaire-based survey was the starting point for interviews, making it possible to collect various data that could better exemplify the issue of the readability of a message in PSL presented by the avatar.

Conclusions

Thanks to the use of equitable access and active participation rules, derived from the concept of Universal Access in research tool development, the constructed questionnaire enabled the respondents, i.e. the deaf using a sign language, to provide unassisted and autonomous answers to the questions. One of the elements that distinguish the questionnaire created by Ł-EMAG, at least in the Polish conditions, is the use of videos in a language comprehensible to the respondents (Polish Sign Language), where each text translated into sign language on the video was time-matched with the highlighted text in the Polish language. This enabled deaf bi-lingual people, or the deaf with a very good command of Polish, to switch between languages while filling in the questionnaire. This advantage is remarkable due to the fact that it is difficult to achieve full equivalence in translation between two languages (Dotter, 2000; Janzen, 2005) and any mistakes or false interpretations in this respect may undermine the quality of the collected data and research results.

In the tests presented in this paper, the questionnaire tool was used to verify how accurately deaf people who use sign language every day understood the Polish Sign Language avatar. By answering more detailed questions, the deaf respondents could also give their opinions on the avatar's features, i.e. which of them were designed properly and which required some improvement. The respondents answered properly over 80% of questions intended to verify the understanding of the message conveyed by the avatar in the sign language. This is a good result as to the respondents' understanding of the contents of both the questions and possible answers to these questions. Some preliminary conclusions about the efficiency of using the tool for research purposes can be drawn. It seems justifiable to continue monitoring the level of satisfaction of deaf respondents using the Deaf-friendly tool. Therefore evaluation tests concerning the tool itself need to be developed in order to check such features as easy operation of the tool, its usability, or weak points that require improvement.

Based on the conducted survey, it is possible to draw some conclusions that can serve as know-how while carrying out similar questionnaire-based re-search. Surveys based on Deaf-friendly questionnaires can easily be distributed in the Deaf community and, thanks to technological facilitators, can be filled in quickly. However, the main work load is assigned to the preparatory stage, which is much more time-consuming than only preparing a monolingual, written version of the tool. What is more, it is necessary to have proper technological assets, i.e. hardware and software, and human assets, i.e. interpreters or native signers.

The survey was addressed to the Deaf community as respondents. Still, we believe that the tool developed for research purposes can be used in other, mainstream studies, in which the deaf are only a part of the focus group, or studies conducted at a point of convergence of the hearing and the Deaf worlds, for example when examining sign-speech bilingualism. Surveys conducted on the basis of an analogical tool address the requirements of ethical standards, which stipulate that collecting data from respondents should be done in their preferred language and suitable linguistic modality. We are positive about the fact that they contribute to building an inclusive approach in scientific research practice and indicate specific methodological solutions for the development of the scientific theory in this field.

References

Babik, W. (2015). Ekologia informacji w bibliotecznej społeczności informacyjnej. In T. Piestrzyński, & J. Jerzyk-Wojtecka (Eds.), *Biblioteka w społeczeństwie wiedzy. Informacja, edukacja, profesjonalizm. Konferencja naukowa Biblioteki Uniwersytetu Łódzkiego. Materiały konferencyjne* (pp. 59–69). Wydawnictwo Uniwersytetu Łódzkiego. https://doi.org/10.18778/8088-191-4.05

Bosch-Baliarda, M., Vilageliu, O. S., & Orero, P. (2019). Toward a sign language-friendly questionnaire design. *The Journal of Deaf Studies and Deaf Education*, *24*(4), 333–345. https://doi.org/10.1093/deafed/enz021

Brejcha, J. (2015). *Cross-cultural human-computer interaction and User Experience Design: A semiotic perspective*. CRC Press. https://doi.org/10.1201/b18059

Connell, B. R., Jones, M., Mace, R., Mueller, J., Mullick, A., Ostroff, E., Sanford, J., Steinfeld, E., Story, M., & Vanderheiden, G. (1997). *The principles of universal design*. NC State University, The Center for Universal Design. https://projects.ncsu.edu/ncsu/design/cud/about_ud/udprinciplestext.htm.

Cornes, A. J., & Brown, P. M. (2012). Mental health of Australian deaf adolescents: An investigation using an

Auslan Version of the strengths and difficulties questionnaire. *Deafness & Education International*, *14*(3), 161–175. https://doi.org/10.1179/1557069X12Y.0000000009

Couper, M. P., & Bosnjak, M. (2010). Internet surveys. In P. V. Marsden, & J. D. Wright (Eds.), *Handbook of survey research* (pp. 527–550). Emerald Group Publishing Limited.

Dotter, F. (2000). On the adequacy of phonological solutions for sign languages. In *Angemessene Strukturen: Systemorganisation in Phonologie, Morphologie und Syntax* (pp. 47–62). Olms.

Ebling, S., & Glauert, J. (2016). Building a Swiss German Sign Language avatar with JASigning and evaluating it among the Deaf community. *Universal Access in the Information Society*, *15*, 577–587. https://doi.org/10.1007/s10209-015-0408-1

European Parliament. (n.d.). *Accessibility of the Europarl website*. Retrieved July 30, 2021, from https://www.europarl.europa.eu/portal/en/accessibility

Fill, C., & Turnbull, S. (2016). *Marketing communications: discovery, creation and conversations*. Pearson.

Fonseca, D. (2015). User experience and access using augmented and multimedia technologies: special issue of UXeLATE (2012). Workshop and HCI International Conference (2013) special sessions. *Universal Access in the Information Society*, *14*, 307–310. https://doi.org/10.1007/s10209-014-0360-5

Garrett, J. J. (2011). *The elements of user experience. User-Centered Design for the web and beyond* (2nd ed.). New Riders.

Graybill, P., Aggas, J., Dean, R. K., Demers, S., Finigan, E. G., & Pollard, R. Q. (2010). A community-participatory approach to adapting survey items for deaf individuals and American sign language. *Field Methods*, *22*(4), 429–448. https://doi.org/10.1177/1525822X10379201

Hartley, J. (2012). Designing easy-to-read text. In Ch. Abraham, & M. Kools (Eds.), *Writing health communication: An evidence-based guide* (pp. 7–22). Sage Publications Ltd. http://dx.doi.org/10.4135/9781446288054.n2

Heumader, P., Koutny, R., Pühretmair, F., Matausch-Mahr, K., & Miesenberger, K. (2020). Personal access to documents using different literacy levels. *Universal Access in the Information Society*, *19*, 527–539. https://doi.org/10.1007/s10209-019-00662-1

Hill, J. C. (2015). Data collection in sociolinguistics. In E. Orfanidou, B. Woll, & G. Morgan (Eds.), *Research methods in sign language studies: A practical guide* (pp. 7–20). John Wiley & Sons, Inc. https://doi.org/10.1002/9781118346013.ch12

Janzen, T. (2005). Interpretation and language use: ASL and English. In T. Janzen (Ed.), *Topics in signed language interpreting. Theory and practice* (pp. 69–105). John Benjamins Publishing Company. https://benjamins.com/catalog/btl.63

Jones, M. C., Churchill, E. F., & Twidale, M. B. (2008). Mashing up visual languages and web mash-ups. In P. Bottoni, M. B. Rosson, M. Minas (Eds.), *IEEE Symposium on Visual Languages and Human-Centric Computing* (pp. 143––146). https://doi.org/10.1109/VLHCC.2008.4639075

Kipp, M., Nguyen, Q., Heloir, A., & Matthes, S. (2011). Assessing the deaf user perspective on sign language avatars. In *The Proceedings of the 13th International ACM SIGACCESS conference on Computers and Accessibility (ASSETS '11)* (pp. 107–114). Association for Computing Machinery. https://doi.org/10.1145/2049536.2049557

Kools, M. (2012). Making written materials easy to understand. In Ch. Abraham, & M. Kools (Eds.), *Writing health communication: An evidence-based guide* (pp. 23–42). Sage Publications Ltd.

Kostrubała, S. (2013). Komunikacja człowiek–komputer. *Studia Ekonomiczne, 128*, 23–40. https://bibliotekanauki.pl/articles/590214

Kotowicz, J., Woll, B., & Herman, R. (2020). Adaptation of the British Sign Language Receptive Skills Test into Polish Sign Language. *Language Testing, 38*(1), 132–153. https://doi.org/10.1177/0265532220924598

Krug, S. (2014). *Don't make me think, revisited: A common sense approach to web usability* (3rd ed.). New Riders.

Krzysztofek, K., & Szczepański, M. S. (2005*). Zrozumieć rozwój. Od społeczeństw tradycyjnych do informacyjnych*. Wydawnictwo Uniwersytetu Śląskiego.

Kushalnagar, P., Harris, R., Paludneviciene, R., & Hoglind, T. (2017). Health Information National Trends Survey in American Sign Language (HINTS-ASL): Protocol for the cultural adaptation and linguistic validation of a national survey. *JMIR Research Protocols*, *6*(9), e172. https://doi.org/10.2196/resprot.8067

Kusters, A., De Meulder, M., & O'Brien, D. (2017). Innovations in deaf studies: Critically mapping the field. In A. Kusters, M. De Meulder, & D. O'Brien (Eds.), *Innovations in deaf studies: The role of deaf scholars* (pp. 1–56). Oxford University Press.

Lachner, F., von Saucken, C., 'Floyd' Mueller, F., & Lindemann, U. (2015). Cross-cultural User Experience Design helping product designers to consider cultural differences. In P. Rau (Ed.), *Cross-cultural design. Methods, practice and impact. CCD 2015* (pp. 58–70). Springer. https://doi.org/10.1007/978-3-319-20907-4_6

Ladd, P. (2003). *Understanding deaf culture: In search of deafhood*. Multilngual Matters.

Lane, H. (1993). *The mask of benevolence: Disabling the Deaf community*. Random House.

Lederberg, A. R., Schick, B., & Spencer, P. E. (2013). Language and literacy development of deaf and hard-of-hearing children: Successes and challenges. *Developmental Psychology, 49*(1), 15–30. https://doi.org/10.1037/a0029558

Leeson, L., Haug, T., Rathmann, C., Sheneman, N., & van den Bogaerde, B. (2018). *Survey Report from the ECML project ProSign: Sign Languages for Professional Purposes (2012–2015). The implementation of the CEFR for Sign Languages in Higher Education: Results of an International Survey*. European Center for Modern Languages (ECML). https://hdl.handle.net/11245.1/a391e645-a53e-48fd-a5a2-28e37af39f6b

Marcus, A. (2006). Cross-cultural user-experience design. In D. Barker-Plummer, R. Cox, & N. Swoboda (Eds.), *Diagrammatic representation and inference. Diagrams 2006* (pp. 16–24). Springer. https://doi.org/10.1007/11783183_4

McKee, M., Schlehofer, D., Cuculick, J., Starr, M., Smith, S., & Chin, N. P. (2011). Perceptions of cardiovascular health in an underserved community of deaf adults using American Sign Language. *Disability and Health Journal*, *4*(3), 192–197. https://doi.org/10.1016/j.dhjo.2011.04.001

McKee, M., Schlehofer, D., & Thew, D. (2013). Ethical issues in conducting research with deaf populations. *American Journal of Public Health*, *103*(12), 2174–2178. https://doi.org/10.2105/AJPH.2013.301343

Monaghan, L., Schmaling, C., Nakamura, K., & Turner, G. H. (2003). *Many ways to be deaf: International variation in deaf communities*. Gallaudet University Press.

Napier, J., Lloyd, K., Skinner, R., Turner, G. H., & Wheatley, M. (2018). Using video technology to engage deaf sign language users in survey research: An example from the Insign project. *Translation and Interpreting*, *10*(2), 101–121. https://doi.org/10.12807/ti.110202.2018.a08

National Deaf Center on Postsecondary Outcomes. (2019). *Communicating with deaf individuals*. https://www.nationaldeafcenter.org/sites/default/files/Communicating%20with%20Deaf%20Individuals.pdf

Nielsen, J., & Loranger, L. (2006). *Prioritizing web usability*. New Riders.

O'Brien, D., & Emery, S. D. (2014). The role of the intellectual in minority group studies: Reflections on deaf studies in social and political contexts. *Qualitative Inquiry*, *20*(1), 27–36. https://doi.org/10.1177/1077800413508533

Padden, C. (2000). The Deaf community and the culture of deaf people. In M. Adams, W. J. Blumenfeld, H. W. Hackman, M. L. Peters, X. Zuniga (Eds.) (3rd ed.), *Readings for diversity and social justice* (pp. 343–352). Routledge.

Sikorski, M. (2017). *Interakcja człowiek–komputer*. Polsko-Japońska Wyższa Szkoła Technik Komputerowych.

Singleton, J. L., Jones, G., & Hanumantha, S. (2014). Toward ethical research practice with deaf participants. *Journal of Empirical Research on Human Research Ethics*, *9*(3), 59–66. https://doi.org/10.1177/1556264614540589

Singleton, J. L., Martin, A. J., & Morgan, G. (2015). Ethics, Deaf-friendly research, and good practice when studying sign languages. In E. Orfanidou, B. Woll, & G. Morgan (Eds.), *Research methods in sign language studies: A practical guide* (pp. 7–20). John Wiley & Sons, Inc. https://doi.org/10.1002/9781118346013.ch1

SLLS Ethics Statement for Sign Language Research. (2016). https://slls.eu/slls-ethics-statement/

Stephanidis, C. (2009). *The universal access handbook*. CRC Press Taylor & Francis Group. https://doi.org/10.1201/9781420064995

Stephanidis, C., & Savidis, A. (2001). A universal access in the information society: Methods, tools, and interaction technologies. *Universal Access in the Information Society*, *1*(1), 40–55. https://doi.org/10.1007/s102090100008

WCAG. (2021). *Web Content Accessibility Guidelines (WCAG) Overview*. https://www.w3.org/WAI/standards-guidelines/wcag/

Windl, H., & Heimgärtner, R. (2013). Intercultural design for use – extending Usage-Centered Design by cultural aspects. In A. Marcus (Ed.), *Design, User Experience, and Usability. Health, Learning, Playing, Cultural, and Cross-Cultural User Experience. DUXU 2013* (pp. 139–148). Springer. https://doi.org/10.1007/978-3-642-39241-2_17

Wright, J. D., & Marsden, P. V. (2010). Survey research and social science: history, current practice, and future prospects. In P. V. Marsden, & J. D. Wright (Eds.), *Handbook of survey research* (pp. 3–25). Emerald Group Publishing Limited.

Young, A., & Hunt, R. (2011). *Research with d/Deaf people.* School for Social Care Research. http://eprints.lse.ac.uk/41800/1/SSCR_Methods_Review_9_web.pdf

Young, A., & Temple, B. (2014). *Approaches to social research: The case of deaf studies*. Oxford University Press. https://doi.org/10.1093/acprof:osobl/9780199929535.001.0001

Anna Irasiak, PhD is an assistant professor at Jan Długosz University in Częstochowa. She has been involved in scientific and didactic projects related to the education of future teachers, sign language and the university's accessibility to persons with disabilities. She is a proficient translator of the Polish Sign Language.

Elżbieta Sroka, PhD is an assistant professor at the Institute of Information Sciences of Pedagogical University of Krakow a Senior Specialist at Łukasiewicz-EMAG, and certified UX designer. She specializes in testing information users, designing user-friendly websites and mobile applications, and digitalization and application of new technologies with respect to their accessibility to persons with disabilities. She has taken part in projects focused on fighting social exclusion and developing new technologies in society.

Wojciech Górka, MSc is a senior specialist at Łukasiewicz-EMAG. He is a systems analyst and software engineer and specializes in computer system design. He is a co-author of solutions related to the application of ICT in fighting social exclusion.

Michał Socha, MSc is a senior specialist at Łukasiewicz-EMAG. He is a doctoral student at the Faculty of Automatic Control, Electronics and Computer Science of the Silesian University of Technology. He specializes in computer system design using artificial intelligence and is a co-author of solutions related to the application of ICT in fighting social exclusion.

Adam Piasecki, MSc is a leader of the Accessibility and Communication Competence Center at Łukasiewicz-EMAG. He is a graduate of the Silesian University of Technology and doctoral student at the Faculty of Informatics and Communication of the University of Economics in Katowice. For many years he has been manager of projects related to fighting social exclusion and implementing IT solutions in industry and administration.