Обучение и познавательная деятельность студентов с нарушением слуха в цифровой среде: обзор исследований

Введение. Несмотря на то, что появление Интернета предоставляет современному поколению глухих и слабослышащих студентов недоступные ранее возможности для обучения, они не используют образовательный потенциал сети в достаточной мере. Решение данной проблемы требует, прежде всего, понимания особенностей познавательной деятельности студентов с нарушением слуха в цифровой среде, и анализа педагогических и информационных технологий, используемых для их обучения сегодня.

Цель статьи – представить обзор исследований, посвященных познавательной деятельности студентов с нарушением слуха в электронной среде, опубликованных в России и за рубежом.

Материалы и методы. В качестве материала использовались полнотекстовые статьи и научные обзоры, монографии и диссертации на английском и русском языках, представленные в базах данных Google Scholar, Mendeley, eLibrary.Ru.

Результаты исследования. Проанализированные исследования доказывают, что обучение и познавательная деятельность лиц с нарушением слуха имеет свою специфику, которая характеризуется потребностью в коммуникации и поддержке, необходимостью визуального представления информации, недостаточно сформированными навыками самостоятельного обучения онлайн, большей утомляемостью, разнообразием индивидуальных предпочтений и др. Что касается информационно-педагогических технологий, направленных на преодоление трудностей обучения лиц с инвалидностью по слуху в электронной среде, положительные результаты продемонстрированы при использовании таких технологий, как асинхронная дискуссия, геймификация и микрообучение, 3D моделирование и дополненная реальность.

Заключение. Утверждение о высоком потенциале обучения в цифровой среде для глухих и слабослышащих представляется целесообразным при условии организации образовательного процесса с учетом их особенностей, адаптации учебных материалов, устранении барьеров для эффективной познавательной деятельности и применении технологий, повышающих эффективность обучения для данной категории студентов.

Ключевые слова: нарушение слуха, глухие и слабослышащие студенты, онлайн-обучение, познавательная деятельность, информационные технологии

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Learning experiences of deaf and hard-of-hearing students in digital media: a literature review

Introduction. Despite the previously inaccessible opportunities for distance services that Internet provides for the modern generation of deaf and hard-of-hearing (DHH) students, research shows that they do not use its educational potential as efficiently as hearing people do. This situation brings us to the need of identifying special challenges and specifics of learning activities performed by DHH people in the digital environment, as well as applying evidence-based technologies aimed at solving these problems. This paper is an overview of studies on the learning profile and experience of DHH students in an electronic environment.

Methods and materials. The materials used were full-text articles and scientific reviews, monographs and dissertations in English and Russian, presented in Google Scholar, Mendeley and eLibrary.Ru databases.

Results. The analyzed studies prove that online learning experience of DHH students has its own specifics, characterized by the need for communication and support, visual information presentation, lack of skills for independent online learning, greater post-task fatigue, varied individual preferences, etc. The study also revealed a number of technologies used to overcome the difficulties of teaching DHH people online including asynchronous discussions, gamification and micro-learning, the use of 3D models and augmented reality.

Conclusion. Despite being a definite area of interest for scientific community, studies on DHH students learning in digital environment are relatively few. In general, they prove the perspectives of efficient learning via technology, provided that the educational process is organized taking into account their learning profile, and using adapted educational materials and technologies.

Keywords: deaf and hard of hearing students, online learning, cognitive activity, information technology
INTRODUCTION

The idea of providing a quality education for all students, including those with disabilities and difficulties in learning, is the conceptual basis of modern educational policy [1]. Indeed, the advent of the Internet provides the modern generation of deaf and hard-of-hearing (DHH) students with previously inaccessible opportunities for distance learning, online services, remote work, self-development and personal growth. Studies show that students with hearing disabilities use mobile phones and the Internet as often as their hearing peers [2]. However, the difference is that DHH students do not use the educational potential of the Internet to a full extent. Most hard-of-hearing university degree applicants have no experience of taking online courses on the Internet and subscribing to educational resources, which distinguishes them from their hearing peers [3]. In this context, it is evident that more studies should concentrate on the special aspects and challenges DHH students face in the digital media, as well as the pedagogical practices and the use of technologies aimed at solving this problem.

Special features of DHH students learning profile and learning experience in the digital media are primarily associated with cognitive differences of this category of students. These differences vary due to the degree of hearing loss, medical records and other factors, but in general, researchers identify such special features as mental inertia [4], problems with memorization [5], lack of writing and reading skills [6], difficulties in abstract concepts perception [7], lower memory span and less well-developed problem-solving strategies [8], dependence on the teacher and lack of initiative in learning [9], etc. Researchers and educators recognize the need to address these challenges when teaching DHH students and develop techniques to overcome them. However, most studies focus on research in offline learning, while online learning experience of DHH students remains a relatively understudied issue.

Cognitive activities in digital media are specified by a number of factors, the most distinctive of which are differences in information perception and interactive and social nature of electronic environment [10]. In addition, effective learning in a digital environment requires a "new literacy" - digital literacy, which involves skills in searching, processing and publishing information using technologies and the Internet, as well as knowledge of the cybersecurity basics and network etiquette. All of the above should be taken into account when developing DHH students learning competency in a digital environment.

Literature review is one of the most common scientific methods used to present the general state of research when dealing with urgent and under-studied topics. The few previous scientific reviews on DHH students online learning addressed the issues of information readability [11], the use of social networks [12], the difficulties of online learning during COVID-19 [13] and the use of augmented reality [14]. However, there is still a need for clarifying the specifics of DHH students learning profile and experience when using technologies and the Internet, and the impact of the practices used on the learning outcomes and education quality.

This paper is an overview of studies on the learning profile and experience of DHH students in an electronic environment. The review analyses full-text articles and scientific reviews, monographs and dissertations in English and Russian.
The proposed review is intended to answer the following research questions:
1. What distinguishes learning profile and learning experience of the DHH students in a
digital environment (special features, challenges, need for adaptation)?
2. What pedagogical techniques and information technologies are used in teaching DHH
students in a digital environment?
3. How do these technologies and techniques affect the quality of education and learning
outcomes?

MATERIALS AND METHODS

This review was conducted in accordance with the PRISMA recommendations [15].
The search was carried out in the following libraries: Google Scholar, Mendeley, eLibrary.
Ru in May – June 2023. The database query included keywords in two major topics: (a)
hearing disability; (b) online learning. To answer the research questions, keywords such
as "challenges", "features", "learning styles" and others were also added. For example, a
query on the Google Scholar database was compiled as follows: "Deaf" or "hard of hearing"
or "hearing impaired students" + online learning or distance learning or technology + a
special or specific profile or features, or aspects or learning style + challenges, problems or
adaptation". The review was carried out by two researches who independently examined
the studies for inclusion and exclusion criteria.

The following inclusion criteria were established:
1. Using the digital environment only in an educational context (formal and non-
formal education).
2. Year of publication 2019 and later works, (this criterion was established due to a number
of reasons, including the large-scale transition to online during the COVID-19 pandemic).
3. The study participants were adult students.
4. Studies related only to digital media and technologies were taken into account.
5. The participants of the research were DHH people.

The exclusion criteria were the following:
1. Books as a type of scientific and pedagogical literature.
2. Age of participants: children, pupils of primary school and Key Stage 3 of secondary school.

In addition, in order to answer the third research question we selected empirical studies,
where pedagogical techniques and information technologies are taken as independent
variables, and various indicators of the education quality are taken as dependent variables.

As a result of the initial search in three databases, 168 articles were retrieved. After
deleting duplicate articles, as well as articles that did not meet the inclusion criteria, 33
articles were left. In the process of their analysis, we also used the snowballing method
(forward and backward). This allowed us to add sources that were vital for our research, but
published before 2019, as well as sources related to the topic, but not containing the exact
keywords of the search query. Thus, 17 more sources were added. In general, the sample of
scientific papers for the analysis presented in this paper amounted to 50 research studies.

RESULTS

The analysis of the studies showed that most of them are empirical, where questionnaires
and interviews were most often used research methods. It was also concluded that literature
reviews on this topic are relatively few, as presented in table 1.
The first research question of our study was: What distinguishes learning profile and learning experience of the DHH students in a digital environment? In order to answer it we considered three separate issues: special features, challenges, and adaptations related to DHH students learning in electronic media.

From our findings, we revealed the following special features of DHH students learning profile: the need for communication and support, the need for visual presentation of information, lack of independent online learning skills, focusing on social media and communication to obtain information, greater post-task fatigue and diverse personal preferences in captions and sign language interpreting. Detailed search results are presented in Table 2.

### Table 2

<table>
<thead>
<tr>
<th>Special features</th>
<th>Source, year of publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of independent online learning skills</td>
<td>Nordin N. et al., 2013 [26]; Elliot L. et al., 2020 [27]</td>
</tr>
<tr>
<td>Focusing on social media and communication to obtain information</td>
<td>Kožuh I. et al., 2014 [28]; Sommer K., 2020 [29]</td>
</tr>
<tr>
<td>Greater post-task fatigue</td>
<td>Rodrigues et al., 2022 [30]</td>
</tr>
<tr>
<td>Diverse personal preferences in captions and sign language interpreting</td>
<td>McClive J. et al., 2020 [31]</td>
</tr>
</tbody>
</table>

As for the challenges that DHH students face in the electronic environment, they fall under five categories: information perception in different formats (video and text format), communication, technical, emotional and social challenges. The participants in the studies reporting on this topic are both teachers [22; 23, etc.] and DHH students themselves [34; 42, etc.]. Details are presented in Table 3.

From the review findings, studies on the adaptation of educational materials according to the educational needs of DHH students mainly explore the use of captioning, sign language translation or the combined use of both methods. Thus, in their studies Y. Krasavina et al. [48] and I. K. Lervåg [49] obtained results that showed the preference of captions in comparison with sign language translation; similar results were published by L. Elliot et al. [27], when participants reported that captions were more informative. As for the sign
language translation, in the work of N.E. Abuzinadah [50] the authors claim that using an avatar with sign language improved understanding and sparked interest in learning, and in the study by M. H. Mohd Hashim and Z. Tasir [51], the deaf students who achieved the best performance increment category were those who accessed the sign language videos more frequently. However, even more works show a positive attitude of students to the combined use of captions and sign language translation: L. Elliot et al. [27]; O.V. Zhuykova et al. [52]; C. Batanero-Ochaita et al. [53]; C. Smith, S. Colton [54]. This confirms the statement about the diversity of preferences in the adaptation of information among DHH students.

Table 3

Reported challenges for DHH students in online learning

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Source, details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information perception in different formats (video and text format)</td>
<td>Oral presentation is not exactly the same as the information presented on the slide in the written form [32]</td>
</tr>
<tr>
<td>Information perception in video communication</td>
<td>Complicated navigation through multiple windows, lack of simultaneous transmission of content [33]</td>
</tr>
<tr>
<td></td>
<td>Difficulty in attending to multiple visual information sources simultaneously (presentation and interpreting) [31]</td>
</tr>
<tr>
<td></td>
<td>Better visualization of the teacher’s speech organs is needed [21]</td>
</tr>
<tr>
<td></td>
<td>Lack of pictures, only text provided; teacher was not visible in the video call app, the only person on the screen was the interpreter; so direct communication was not possible; slides scrolled through too fast [34]</td>
</tr>
<tr>
<td>Informational text perception and writing</td>
<td>Students need help understanding the material if the material is presented in the form of literature [22]</td>
</tr>
<tr>
<td></td>
<td>Students face difficulties in reading and writing, comprehending or drafting accurate grammatical sentences [35]</td>
</tr>
<tr>
<td></td>
<td>Challenges related to course content and material adaptation [36]</td>
</tr>
<tr>
<td></td>
<td>Challenges related to online testing [37]</td>
</tr>
<tr>
<td>No simultaneous translation or inadequate translation of audio and video is provided</td>
<td>Video and audio do not contain captions or translation, it is also required for videos embedded in files of a different format [38]; [39]</td>
</tr>
<tr>
<td>Communication</td>
<td>Students cannot participate in a lecture and ask questions online [40]; [41]</td>
</tr>
<tr>
<td></td>
<td>Challenges related to communication through writing [38]</td>
</tr>
<tr>
<td></td>
<td>There is no time for questions after the lecture [34]</td>
</tr>
<tr>
<td></td>
<td>The courses do not provide feedback and support [42]</td>
</tr>
<tr>
<td></td>
<td>It is difficult to ensure the interactive nature of the course [43]; [44]</td>
</tr>
<tr>
<td>Lack of skill in providing feedback</td>
<td>Teachers did not receive answers to direct questions about the course quality from DHH students [34]</td>
</tr>
<tr>
<td>Technical challenges</td>
<td>Instructions and tutorials for using the programs are not provided [13]; [34]; [36]; [38]; [41]; [45]; [44]</td>
</tr>
<tr>
<td>Complicated interface of LMS systems</td>
<td>Complicated navigation and incomprehensible interface of LMS systems [33]; [36]</td>
</tr>
<tr>
<td>Emotional challenges</td>
<td>Students lose motivation in the distance learning format [45]; [46]</td>
</tr>
<tr>
<td>Social challenges</td>
<td>Problems related to insufficient institutional support, social inequality and sociolinguistic problems [46]</td>
</tr>
<tr>
<td></td>
<td>Communication and socialization skills are negatively affected during online distance learning [47]</td>
</tr>
</tbody>
</table>
The second research question of our study was: What pedagogical techniques and information technologies are used in teaching DHH students in a digital environment? In order to answer it we analyzed pedagogical practices and information technologies presented in the studies selected for the review. The results showed that mainly information technologies and their impact on the education quality were studied. The most frequently mentioned pedagogical techniques and information technologies used in teaching DHH students include gamification and asynchronous online communication (discussions, chats, forums). A more detailed description is presented in Table 4.

### Table 4

Pedagogical techniques and information technologies used in teaching DHH students

<table>
<thead>
<tr>
<th>Techniques and technologies</th>
<th>Description, source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gamification</strong></td>
<td>Gamification, animation, video streaming with subtitles [55]</td>
</tr>
<tr>
<td></td>
<td>PBL gamification model, microlearning [56]</td>
</tr>
<tr>
<td></td>
<td>Support with an avatar with a sign language. Gamification components: points and performance graphs, challenges, badges and achievements, leader modes, levels, time-based activities, stories, characters [57]</td>
</tr>
<tr>
<td></td>
<td>Points and score, time limit, competition elements, the possibility of multiple repetition, stories, dubbing with sign language [58]</td>
</tr>
<tr>
<td><strong>Augmented reality</strong></td>
<td>Literature review [14]</td>
</tr>
<tr>
<td></td>
<td>The use of 3D models [59], [52]</td>
</tr>
<tr>
<td><strong>Messengers</strong></td>
<td>The use of WhatsApp [22]</td>
</tr>
<tr>
<td><strong>User Centered Design</strong></td>
<td>Implementation of the stages of the UCD methodology [22]</td>
</tr>
<tr>
<td><strong>Adaptive learning systems</strong></td>
<td>Monitoring and modifying the learning environment by recognising learning barriers and suggesting educational activities (ex. dubbed with sign language) to develop reading and writing skills [35]</td>
</tr>
<tr>
<td><strong>Asynchronous online communication</strong></td>
<td>Inclusion of asynchronous inclusive forums and discussions in the course [37]</td>
</tr>
<tr>
<td></td>
<td>Enabling chats and forums for both synchronous and asynchronous communication [60]</td>
</tr>
<tr>
<td><strong>Universal Design</strong></td>
<td>Adaptation, including using captioning [40]</td>
</tr>
<tr>
<td><strong>Creating virtual academic communities</strong></td>
<td>Community to directly address preparation, socialization, and access challenges [27]</td>
</tr>
<tr>
<td><strong>Use of social media in the educational setting</strong></td>
<td>The use of social networks in teaching improves writing and reading skills, increases motivation to learn, develops cooperation skills [12]</td>
</tr>
<tr>
<td><strong>Automated dialog commands</strong></td>
<td>Using dialog instructions in a digital environment [61], [62]</td>
</tr>
</tbody>
</table>

The third research question of our study was: How do these technologies and techniques affect the quality of education and learning outcomes? In order to answer it we analyzed empirical studies, where the dependent variables were indicators related to the education quality and learning outcomes. The characteristics of the analyzed studies are presented in Table 5. From our findings, testing, questionnaires and interviews were most often used research methods. In general, researchers report about the positive results from the use of technologies in improving understanding, academic performance and satisfaction with the educational process. However, when comparing the learning outcomes of classroom and distance learning in writing and reading skills during the COVID-19 pandemic, a large-scale study by M. Kuntze et al. [24] showed a decrease in academic performance in the second case.
## Table 5

The impact of methods and technologies on the quality of education and learning outcomes

<table>
<thead>
<tr>
<th>Technology (method)/ Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avatar with sign language [50], 2020</td>
</tr>
<tr>
<td>Augmented reality, 3D models [59], 2015</td>
</tr>
<tr>
<td>User Centered Design methodology [22], 2022</td>
</tr>
<tr>
<td>Asynchronous online discussion [16], 2011</td>
</tr>
<tr>
<td>The use of subtitles [49], 2020</td>
</tr>
<tr>
<td>The use of dialog commands [61], 2020</td>
</tr>
<tr>
<td>Gamification (points and score, time limit, competition elements, the possibility of multiple repetition, stories, dubbing with sign language) [58], 2019</td>
</tr>
<tr>
<td>The use of dialog commands [62], 2020</td>
</tr>
<tr>
<td>Distance teaching of reading and writing skills [24], 2023</td>
</tr>
<tr>
<td>The use of adapted video materials (subtitles and sign language translation) [27], 2020</td>
</tr>
<tr>
<td>The use of the micro-learning format (language marathon) in social networks [56], 2023</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>N, participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>68</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>32</td>
</tr>
<tr>
<td>88</td>
</tr>
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<td>14</td>
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<tr>
<td>30</td>
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<tr>
<td>10</td>
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<tr>
<td>27</td>
</tr>
<tr>
<td>546</td>
</tr>
<tr>
<td>89</td>
</tr>
<tr>
<td>10</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Dependent variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding of concepts, satisfaction with the learning process</td>
</tr>
<tr>
<td>Academic performance</td>
</tr>
<tr>
<td>Efficiency (percentage of completed tasks), time-based efficiency (task completion time), satisfaction</td>
</tr>
<tr>
<td>Academic performance, satisfaction with the learning process</td>
</tr>
<tr>
<td>Understanding</td>
</tr>
<tr>
<td>Academic performance, motivation</td>
</tr>
<tr>
<td>Emotional intelligence components</td>
</tr>
<tr>
<td>Academic performance</td>
</tr>
<tr>
<td>Academic performance</td>
</tr>
<tr>
<td>Understanding, independence</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Better concepts understanding, increased satisfaction level</td>
</tr>
<tr>
<td>Better academic performance</td>
</tr>
<tr>
<td>Efficiency is above average, satisfaction is acceptable</td>
</tr>
<tr>
<td>Students’ academic performance in courses with included discussions is higher, satisfaction is higher</td>
</tr>
<tr>
<td>Better understanding</td>
</tr>
<tr>
<td>Academic performance is better, but the use of dialog commands does not affect motivation</td>
</tr>
<tr>
<td>Significant improvement regarding emotional self-control, empathy, problem-solving, self-regard, life-satisfaction, and peace. However, the results were not statistically significant for responsibility, self-motivation and interpersonal relationships.</td>
</tr>
<tr>
<td>Better academic performance</td>
</tr>
<tr>
<td>Academic performance is worse compared to offline learning</td>
</tr>
<tr>
<td>Better understanding, the number of questions to teachers has decreased</td>
</tr>
<tr>
<td>No statistically significant difference in the amount of homework submitted on time. The number of students who completed most of the assignments on time, and the frequency of the submitted assignments increased (better involvement).</td>
</tr>
</tbody>
</table>

## DISCUSSION

Our study shows that despite being a definite area of interest for scientific community, studies on DHH students learning in a digital environment are relatively few.

The analyzed studies demonstrate that online learning profile of DHH students has its own specifics, characterized by the need for communication and support, visual information presentation, lack of skills for independent online learning, greater post-task fatigue, varied individual preferences, etc. These results as well as the challenges they face
are consistent with the general characteristics and cognitive differences of learning profile of DHH students mentioned earlier. Thus, challenges with memorization and writing and reading skills, which the authors note during classroom classes [5; 6], are also manifested in the online environment, however, in addition to difficulties with perceiving information in text format and composing written assignments, problems arise with taking online tests, especially if the time to complete the test tasks are limited. The identified challenges related to the complexity of navigation and interface of LMS systems might be correlated with such features as less developed problem-solving skills and lack of independence highlighted in studies for classroom learning [8; 9].

Challenges particularly related to the online environment and not mentioned in previous studies on classroom learning include communication barriers and lack of conditions for successful socialization due to the absence of live communication or the need to use video communication programs, as well as taking online courses without provided feedback. In addition, there are also technical difficulties associated with the lack or inadequate dubbing of information in audio and video formats. The results of this study are consistent and complement the results of a review study by W. Aljedaani et al. concerning the difficulties of online learning during the Covid-2019 pandemic [13].

The study also revealed a number of pedagogical techniques and information technologies aimed at overcoming the difficulties in teaching DHH people in an electronic environment. Positive results have been demonstrated when asynchronous discussions are included in the educational process, which allow the DHH students to improve reading and writing skills, better understand the topic and contribute to positive group dynamics. The pedagogical practice of using three-dimensional models and augmented reality in teaching, which guarantees better visualization of certain objects and phenomena, also received positive feedback. The use of different elements and models of gamification showed positive dynamics in engagement and proved to be a useful tool for overcoming challenges with lack of motivation and independence. In addition, the findings on the use of sign language translation and subtitles led to the conclusion that the deaf community is characterized by a variety of individual preferences rather than adherence to one method of auditory information duplication, which is consistent with the results of previous studies by L. Elliot et al. [27]; O.V. Zhuykova et al. [52]; C. Batanero-Ochaita et al. [53]; C. Smith, S. Colton [54].

CONCLUSION

In conclusion, it may be noted that the vast majority of the studies in the review investigated formal educational process in educational institutions. Consequently, there is lack of studies using qualitative and quantitative research methods to analyze the specifics and challenges in the process of informal learning in a digital environment by DHH persons. However, it is reasonable to assume that the identified features and challenges can also be attributed to the context of informal learning, and technologies that demonstrated positive effects on education quality should be taken into consideration when developing digital resources for informal learning. It should also be mentioned that the current study was limited by restricted accessibility of some international databases to Russian scientific community.

In general, our findings prove the perspectives of DHH students efficient learning via technology, provided that the educational process is organized taking into account
their learning profile, and using adapted educational materials and evidence-based technologies. This study clarifies and summarizes the factors mentioned above, and may be useful to researchers studying the instructional design in a digital environment for deaf and hard-of-hearing people.

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**ЛИТЕРАТУРА**

5. Кальгин Ю. А. Педагогические условия интеграции слабослышащих студентов в систему обучения в высшей школе // Вестник Московского государственного лингвистического университета. 2010. № 595. С. 138-151.
20. Al Hashimi S. Alsindi D. Optimizing Online Learning Experiences and Outcomes for Hearing-Impaired Art and


47. Mозговой М.В., Волков А.В. Угрозы и возможности дистанционного формата обучения студентов с
инвалидностью по слуху в инженерной области // Инклюзия - 2021. Всероссийская конференция по вопросам
доступности профессионального образования: Московский государственный технический университет

48. Mohammed N. U. D. Deaf students’ linguistic access in online education: The case of Trinidad // Deafness and

49. Krasavina Y., Ponomarenko E., Zhuykova O., Serebyakova Y. Designing E-Courses for Hearing Impaired Students:

50. Lervåg I. K. Role of subtitles in L2 acquisition and comprehension: evidence from hearing-impaired learners:
Master’s thesis. 2020. NTNU.

51. Abuzinadah N. E. An avatar-based system for Arabic sign language to enhance hard-of-hearing and deaf students’

52. Mohd Hashim M. H., Tahir A. An e-learning environment embedded with sign language videos: research into its
usability and the academic performance and learning patterns of deaf students // Educational Technology Research

53. Жуйкова О. В., Красавина Ю. В., Серебрякова Ю. В., Пономаренко Е. П. Разработка и внедрение электронного
учебного курса по начертательной геометрии для дистанционного сопровождения образовательного

in Online Education: Comparative Analysis of Attitudes of Blind and Deaf Students Toward an Adapted Learning

55. Smith C., Colton S. Creating a YouTube Channel to equip parents and teachers of students who are deaf // Journal


57. Пономаренко Е. П., Красавина Ю. В., Жуйкова О. В., Охотников И. А. Особенности электронного обучения
иностранному языку студентов с нарушением слуха в формате онлайн-марафона // Образование и
саморазвитие. 2023. Т.18. № 2. С.149-16310. 10.26907/esd.18.2.11

58. Shohieb S.M. A Gamified e-Learning Framework for Teaching Mathematics to Arab Deaf Students: Supporting an
CGP/v12101/55-70

59. Nakpong N., Chanchalor S. Interactive Multimedia Games to Enhance the Emotional Intelligence of Deaf and
ijii.2019.12220a

60. Fonseca D., Redondo E., Villagrasa S. Mixed-methods research: a new approach to evaluating the motivation and

61. Tóthová L., Sedláčková J. Fostering autonomy in learners with special needs: A specialized e-learning course //

62. Adigun O. T. Computer-assisted instruction, project-based learning and achievement of deaf learners in biology //

63. Adigun O. T., Nzima D. R. Digitalized Versus Interpreted Biology Instructions for Deaf Learners: Implications for a

REFERENCES

(accessed July 7 2023)


3. Mohd Hashim M. H., Tahir A. An e-learning environment embedded with sign language videos: research into its
usability and the academic performance and learning patterns of deaf students // Educational Technology Research


5. Kalgin Y.A. Educational conditions of integration for students with special needs into the educational system of high

6. Domagala-Zyśk E. Overcoming difficulties in second language acquisition by deaf and hard of hearing participants
of English as a foreign language classes. Social distance towards individuals with disability as a problem in special
33. Aljedaani W., Aljedaani M., Mkaouer M. W., Ludi S. Teachers Perspectives on Transition to Online Teaching Deaf and Hard-of-Hearing Students during the COVID-19 Pandemic: A Case Study. *ACM International Conference Proceeding*


49. Lervåg I. K. Role of subtitles in L2 acquisition and comprehension: evidence from hearing-impaired learners: Master’s thesis. 2020. NTNU.


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