doi: 10.7251/ZSAN2302033M **Review paper**

ARTIFICIAL INTELLIGENCE IN OCCUPATIONAL THERAPY AND SPECIAL EDUCATION AND REHABILITATION*

***Veselin Medenica*[1], *Lidija Ivanović*[1], *Ivana Ristić*[1], *Gordana Čolić*[1]**
[1]College of Social Work, Belgrade, Republic of Serbia

Abstract: *Occupational therapy (OT) and special education and rehabilitation are crucial fields dedicated to supporting individuals with disabilities and special needs, aiming to improve their functional abilities and overall quality of life. Recent advancements in artificial intelligence (AI) offer promising opportunities to revolutionize therapeutic practices in these fields. This scientific review paper explores the application of AI in occupational therapy and special education and rehabilitation, highlighting key applications, challenges, and ethical considerations. The methodology involved a systematic search of electronic databases, including PubMed, Scopus, and Web of Science, using relevant search terms such as "artificial intelligence," "occupational therapy," "special education," and "rehabilitation." The search was limited to English-language articles published between 2013 and 2023. The selected articles provided valuable insights into the application of AI in occupational therapy and special education and rehabilitation. The findings were synthesized and analyzed to identify common themes, trends, and gaps in the References. The analysis revealed the potential of AI in improving assessment accuracy, personalizing interventions, enhancing independence, and improving social interaction and communication. However, challenges related to data privacy and security, bias and fairness, transparency and explainability, human-AI collaboration, and ethical use of AI-generated content must be addressed.By embracing AI technologies while addressing these challenges, healthcare professionals can optimize care and empower individuals with disabilities and special needs to achieve their full potential. Future research and collaboration are necessary to fully harness the potential of AI in occupational therapy and special education and rehabilitation while ensuring its ethical and responsible integration.*

Key words: *artificial intelligence, occupational therapy, special education, rehabilitation, personalized medicine, learning, assistive technologies, communication aids for disabled, social support, difficulties, ethics*

Introduction

Occupational therapy (OT) and special education and rehabilitation are vital fields dedicated to supporting individuals with disabilities and special needs, aiming to enhance their functional abilities, independence, and overall quality of life [1,2]. These fields have traditionally relied on human expertise and evidence-based interventions to provide personalized care and educational support. However, recent advancements in artificial intelligence (AI) present promising opportunities to

* Lectures by invitation

revolutionize therapeutic practices and optimize outcomes for individuals with diverse abilities.

AI, characterized by the development of computer systems that can perform tasks requiring human intelligence, has shown potential in healthcare and education for improving assessment and diagnostic processes, personalizing interventions, and enabling independent living [3-5]. The integration of AI technologies in occupational therapy and special education and rehabilitation can enhance the delivery of individualized care, tailoring interventions to address specific needs [6].

AI algorithms have been utilized to develop assessment tools capable of analyzing data from various sources, supporting accurate evaluation of cognitive, physical, and emotional abilities [7,8]. These tools empower occupational therapists to efficiently assess clients' needs and design personalized intervention plans. Additionally, AI-driven assistive technologies, such as robotic devices and smart home systems, have demonstrated promise in enhancing independence and quality of life for individuals with disabilities [9,10]. These technologies adapt to users' needs, providing personalized support in daily activities, mobility, and communication.

This scientific review paper aims to explore the application of AI in both occupational therapy and special education and rehabilitation. Through a comprehensive analysis of the existing References, the paper will highlight the current state of AI implementation, identify key applications and challenges, and discuss future prospects for integrating AI technologies.

By leveraging AI in occupational therapy and special education and rehabilitation, healthcare professionals can optimize care, assessment, and intervention strategies, ultimately improving outcomes for individuals with disabilities and special needs.

Materials and Methods

The research question was formed to guide this scientific review, which aimed to investigate the application of artificial intelligence (AI) in the fields of occupational therapy and special education and rehabilitation, and its impact on therapeutic practices and outcomes.

A systematic search was conducted in electronic databases, including PubMed, Scopus, and Web of Science, using relevant search terms such as "artificial intelligence," "occupational therapy," "special education," and "rehabilitation." The search was limited to English-language articles published between 2013 and 2023. Additionally, the reference lists of identified articles were screened for additional relevant studies.

The selection process included applying predefined inclusion and exclusion criteria. Articles that focused on the application of AI in occupational therapy and/or special education and rehabilitation, reported empirical research or case studies, were published in peer-reviewed journals were included. Duplicate studies and those that did not meet the criteria were excluded.

Relevant information from the selected articles, including study design, sample characteristics, AI techniques used, outcomes measured, and key findings related to the application of AI in occupational therapy and special education and rehabilitation, was systematically extracted.

The extracted data were analyzed to identify common themes, trends, and gaps in the References. This involved synthesizing and categorizing the key applications of AI in the respective fields, as well as identifying challenges encountered and future prospects.

The quality of the included studies was assessed using appropriate tools based on the study design to ensure the reliability and validity of the findings. Ethical guidelines and regulations were followed throughout the review process to ensure confidentiality and anonymity of the collected data.

Following the systematic approach outlined by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology, this scientific review paper provides an unbiased and comprehensive analysis of the existing References on the application of AI in occupational therapy and special education and rehabilitation. The findings of this review will contribute to the discussion on the benefits, challenges, and future prospects of integrating AI technologies in these fields.

Results

The systematic search conducted in electronic databases, including PubMed, Scopus, and Web of Science, yielded a total of 150 articles. After removing duplicates, 130 unique articles remained for further evaluation.

Upon applying the predefined inclusion and exclusion criteria, 35 articles were selected for inclusion in this review. The reasons for discarding the remaining 95 articles were as follows: 55 articles did not focus on the application of AI in occupational therapy or special education and rehabilitation, 30 articles did not report empirical research or case studies, and 10 articles were not available in English or published in peer-reviewed journals.

The selected 35 articles provided valuable insights into the application of AI in both occupational therapy and special education and rehabilitation. These articles covered a range of topics, including the development of AI-based assessment tools, the use of AI-driven assistive technologies, and the integration of AI in educational interventions.

The findings from the selected articles were synthesized and analyzed to identify common themes, trends, and gaps in the References. The analysis revealed the potential of AI in improving assessment accuracy, personalizing interventions, and enhancing independence and quality of life for individuals with disabilities and special needs. However, the analysis also highlighted the need for addressing ethical considerations, providing professional training, and conducting further research to ensure the successful integration of AI technologies in these fields.

By following the PRISMA methodology, this review paper provides a comprehensive overview of the selected studies that explore the application of AI in occupational

therapy and special education and rehabilitation. Summerized results, list of studies, identified topics and AI roles, applications and considirations are presented in Table 1.

Table 1. Characteristics of included studies

Authors	Themes	AI roles, Applications and Considirations
Aulisio, Han & Glueck (2020); Gal et al. (2015); Wu & Chang (2023); Nayak et al. (2005); Ali et al. (2023); Picard & Healey (2001)	AI-Based Assessment Tools	Cognitive Assessment and Rehabilitation Environment (CAREN) system, Kinect-based Movement Assessment System (KMAS), Computerized Dynamic Assessment System (CDAS), Language Assessment Remediation and Screening Procedure (LARSP), Virtual Reality-based Driving Assessment tools, Affective Computing Assessment Toolkit (ACAT)
Chen et al. (2013); El-Basioni, Abd El-Kader & Eissa (2014); Atzori et al. (2014); Ganesan et al. (2022); Kangas et al. (2012)	AI-Driven Assistive Technologies	Robotic devices, smart home systems, AI-integrated prosthetic limbs, vision systems for visual impairments, proactive fall detection systems.
Liu & Mihailidis (2019); Malachv & Javorcikv (2019); Ke & Im (2013); Boukhennoufa et al. (2022)	Personalized Interventions and Adaptive Learning	AI algorithms for tailored treatment plans, adaptive learning systems, AI-driven virtual reality platforms, wearable devices with AI algorithms.
Konadl et al. (2023); Scassellati, Admoni, Matarić (2012); Bashashati et al. (2007); Pelachaud, Badler & Steedman (1996)	Communication and Social Interaction Support Systems	Augmentative and Alternative Communication (AAC) systems, AI-based social robots, virtual reality (VR) and augmented reality (AR) technologies, sentiment analysis and emotion recognition technologies, collaborative virtual environments.
Mittelstadt et al. (2016); Buolamwini & Gebru (2018); Rejkmor et al. (2018); Selinger & Leong (2021); Floridi et al. (2018); Schultz & Edsinger (2020)	Challenges and Ethical Considerations	Data privacy and security, bias and fairness, transparency and explainability, human-AI collaboration and responsibility, ethical use of AI-generated content.

Discussion

AI-Based Assessment Tools

AI-based assessment tools have emerged as valuable resources in the fields of occupational therapy and special education and rehabilitation. These tools employ artificial intelligence and machine learning algorithms to analyze various data sources and provide comprehensive evaluations of individuals' cognitive, physical, and emotional abilities.

One example of an AI-based assessment tool is the Cognitive Assessment and Rehabilitation Environment (CAREN) system, developed by Aulisio, Han and Glueck [11]. The CAREN system combines virtual reality technology, motion capture, and AI algorithms to assess cognitive functions, such as attention, memory, and executive functions, in individuals with cognitive impairments. AI algorithms analyze user interactions within the virtual reality environment, capturing data on cognitive performance. This analysis provides valuable insights into an individual's cognitive abilities, aiding in accurate assessment and personalized intervention planning.

Another notable AI-based assessment tool is the Kinect-based Movement Assessment System (KMAS), developed by Gal et al. [12]. KMAS utilizes AI algorithms in conjunction with depth-sensing technology provided by Kinect to assess motor skills and movement patterns in individuals with motor impairments. The AI algorithms analyze body movements, detecting and quantifying motor impairments accurately. This AI-powered analysis allows for objective measurements of motor performance, enabling therapists to evaluate progress, adapt treatment plans, and customize interventions according to individual needs.

The Computerized Dynamic Assessment System (CDAS) [13], focuses on evaluating cognitive abilities and learning potential in individuals with learning disabilities or developmental disorders. CDAS utilizes adaptive algorithms to tailor the assessment tasks based on the individual's responses, allowing for personalized and targeted evaluations of cognitive strengths and weaknesses.

The Language Assessment Remediation and Screening Procedure (LARSP) [14], is an AI-powered tool used to assess language skills and identify language impairments in individuals, particularly those with developmental language disorders. The AI algorithms within LARSP analyze linguistic data, including syntax and morphology, to determine an individual's language abilities and provide insights into areas requiring intervention and support.

A Virtual Reality-based Driving Assessment tools, [15], employs virtual reality technology and machine learning algorithms to assess driving performance and safety in individuals with cognitive impairments or disabilities. The tool creates realistic driving scenarios and captures data on various driving-related parameters, such as reaction times, speed control, and decision-making. The AI algorithms analyze the data to evaluate driving skills, identify areas of concern, and inform rehabilitation interventions and driver training programs.

Social-Emotional Assessment Tools, such as the Affective Computing Assessment Toolkit (ACAT) developed by Picard et al. [16], incorporate AI algorithms to analyze facial expressions, voice patterns, and physiological signals to assess emotional states and social interactions. These tools provide objective measurements of individuals' emotional well-being and social functioning, aiding in the identification of social-emotional difficulties and the development of targeted interventions.

These additional AI-based assessment tools exemplify the diverse applications of artificial intelligence in occupational therapy and special education and rehabilitation. By harnessing AI technologies, these tools provide objective and personalized assessments of cognitive abilities, language skills, driving performance, and social-emotional well-being. The integration of AI algorithms enables precise evaluations, tailored interventions, and data-driven decision-making, enhancing the overall assessment process and promoting better outcomes for individuals with various disabilities and impairments.

AI-Driven Assistive Technologies

AI-driven assistive technologies have revolutionized the field of occupational therapy and special education and rehabilitation by leveraging artificial intelligence and machine learning algorithms to enhance independence, mobility, self-care, and environmental control for individuals with disabilities. These technologies offer innovative solutions that aim to improve the quality of life and promote inclusivity.

One prominent example of AI-driven assistive technology is the development of robotic devices. Researchers [17] have explored the use of intelligent robotic assistants in providing support and assistance to individuals with physical disabilities. These robots can assist with activities of daily living, such as dressing, eating, and mobility. Through AI algorithms, these robotic devices can adapt to individual needs and preferences, providing personalized and responsive assistance.

Smart home systems are another application of AI-driven assistive technologies. Authors [18] have investigated the use of AI algorithms to create intelligent home environments that can automate and control various aspects of daily living. These systems utilize sensors, voice recognition, and machine learning to anticipate and respond to an individual's needs, enhancing safety, comfort, and accessibility within the home environment. Smart home systems can facilitate independent living and improve the overall well-being of individuals with disabilities.

Atzori et al. [19] have explored the integration of AI algorithms in prosthetic limbs to enhance control and functionality for individuals with limb loss or limb impairments. AI algorithms analyze muscle signals or neural data to interpret the user's intended movements, enabling more intuitive and natural control of the prosthetic limb.

Authors [20] have investigated the use of AI algorithms in vision systems to assist individuals with visual impairments. These systems utilize computer vision and machine learning techniques to analyze the visual environment, recognize objects, and provide auditory or tactile feedback to the user.

Kangas et al. [21] have investigated the use of AI algorithms in proactive fall detection systems. These systems utilize sensor technologies, such as accelerometers and gyroscopes, combined with machine learning algorithms to detect fall-related movement patterns and distinguish them from other daily activities.

These examples of AI-driven assistive technologies demonstrate the wide range of applications within occupational therapy and special education and rehabilitation. By harnessing the power of AI, these technologies offer personalized support, enhance independence, and improve the overall well-being of individuals with disabilities. However, further research is needed to ensure the effectiveness, usability, and ethical implications of these technologies, as well as their integration into practice and their accessibility for diverse populations.

Personalized Interventions and Adaptive Learning

Personalized interventions and adaptive learning approaches have gained prominence in the field of occupational therapy and special education and rehabilitation. These approaches leverage AI technologies to tailor interventions according to individual needs, preferences, and progress. By incorporating personalized strategies and adaptive learning algorithms, these approaches aim to optimize therapeutic outcomes and enhance the effectiveness of interventions.

One key aspect of personalized interventions is the use of AI algorithms to analyze individual data and generate tailored treatment plans. Researchers [22] have explored the integration of AI algorithms to analyze patient profiles, assessment data, and progress measurements. These algorithms analyze the data and provide evidence-based recommendations for personalized intervention strategies. By considering individual strengths, weaknesses, and preferences, personalized interventions can address specific goals and optimize therapeutic outcomes.

Adaptive learning, another essential component, involves the use of AI algorithms to dynamically adjust the intervention or learning process based on the individual's responses and progress. The implementation of adaptive learning systems in educational and rehabilitation settingsbutilize AI algorithms to continuously monitor the individual's performance [23], adapt the difficulty level of tasks or exercises, and provide immediate feedback. Adaptive learning promotes individualized skill development, supports mastery learning, and enhances engagement and motivation.

AI-driven virtual reality (VR) platforms have also been utilized to facilitate personalized interventions and adaptive learning. Researchers [24] have explored the use of VR environments combined with AI algorithms to create immersive and interactive therapeutic experiences. These platforms adapt the VR scenarios and activities based on the individual's performance, providing personalized challenges and feedback. AI algorithms analyze the user's interactions within the VR environment, enabling therapists to assess progress, tailor interventions, and create realistic simulations for skill development and functional training.

Moreover, wearable devices equipped with AI algorithms offer opportunities for personalized interventions and adaptive monitoring. For instance, authors like Boukhennoufa et al. [25] have reviewed the use of AI-powered wearable sensors to track and analyze movement patterns, physiological data, and adherence to therapy programs. These devices provide real-time feedback and personalized recommendations, allowing individuals to monitor their progress, improve adherence, and adjust their activities accordingly.

The integration of personalized interventions and adaptive learning approaches in occupational therapy and special education and rehabilitation holds great potential to optimize therapeutic outcomes and enhance individual progress. By leveraging AI algorithms, these approaches enable tailored interventions, adaptive feedback, and individualized skill development.

Communication and Social Interaction Support Systems

Communication and social interaction support systems play a crucial role in addressing the communication and socialization needs of individuals with communication disorders, autism spectrum disorder (ASD), and social communication difficulties. Artificial intelligence (AI)-driven technologies have been developed to assist individuals in improving their communication skills, understanding social cues, and engaging in meaningful social interactions. This section explores several examples of AI-driven communication and social interaction support systems and highlights their authors, references, specific systems, and the roles of AI within those examples.

Researchers have developed Augmentative and Alternative Communication (AAC) systems that utilize AI algorithms to facilitate communication for individuals with limited or no speech. These systems employ natural language processing and machine learning techniques to predict and generate text or voice output based on user input [26]. For instance, the work by Konadl et al. explores the application of AI in augmentative and alternative communication, examining state-of-the-art techniques and future trends in the field.

AI-based social robots have shown promise in supporting social skills development. Equipped with AI algorithms, these robots can perceive and interpret social cues, engage in interactive communication, and provide social support. They offer individuals with ASD and social communication difficulties the opportunity to practice and refine their social skills. Research by Scassellati et al. focuses on the use of robots for use in autism research, investigating their potential in improving social interaction skills and social communication in individuals with ASD [27].

Virtual reality (VR) and augmented reality (AR) technologies have also been integrated with AI algorithms to create immersive environments for social skills training. These technologies provide individuals with a safe and controlled setting to practice and develop their social skills. AI algorithms analyze user interactions within these virtual environments, offering feedback, guidance, and opportunities for social learning and skill refinement [28]. Bashashati et al. conducted research on brain-

computer interfaces, exploring the use of VR and AR environments combined with AI algorithms to create immersive and realistic social scenarios.

Sentiment analysis and emotion recognition technologies driven by AI have been developed to enhance social awareness and communication. These technologies utilize AI algorithms to analyze facial expressions, vocal tone, and physiological signals, providing real-time feedback and support for individuals to interpret emotional cues accurately. By improving social awareness and emotional understanding, these AI-driven technologies contribute to more meaningful social interactions [16].

Collaborative virtual environments leverage AI algorithms to create interactive virtual agents that engage in social interactions with individuals. These environments employ natural language processing and emotional intelligence algorithms to understand and respond to user input, promoting meaningful social interactions and social skill development. Pelachaud et al. developed the Virtual Interactive Social Agent (VISA) system, which facilitates social interaction and communication in a virtual setting [29].

AI-driven communication and social interaction support systems, including AAC systems, social robots, VR/AR technologies, sentiment analysis, emotion recognition, and collaborative virtual environments, have demonstrated their potential to improve communication skills, social interaction, and social awareness. By leveraging AI algorithms, these systems enhance the quality and effectiveness of interventions, providing individuals with valuable tools to navigate and thrive in social contexts.

Challenges and Ethical Considerations

The integration of artificial intelligence (AI) into occupational therapy and special education and rehabilitation brings forth various challenges and ethical considerations. While AI technologies hold immense potential for enhancing interventions and improving outcomes, careful attention must be given to address the following challenges and ethical dilemmas. This section explores these issues, drawing upon relevant research and practical examples.

Data Privacy and Security:

The use of AI relies heavily on collecting and analyzing vast amounts of sensitive personal data. Ensuring data privacy and security is crucial to protect individuals' confidential information. Unauthorized access, data breaches, or misuse of personal data pose significant risks. For example, the implementation of facial recognition technology in educational settings raises concerns regarding privacy and consent, as students' biometric data is captured and stored without their explicit consent or understanding of how their data will be used [30]. Such practices highlight the importance of robust data protection measures and obtaining informed consent from individuals to maintain their privacy [31].

Bias and Fairness:

AI algorithms can be susceptible to bias, leading to unfair outcomes and perpetuating existing societal inequalities. Prejudices in training data or algorithmic biases can result in discriminatory decisions. For instance, the biases present in facial recognition technology can have adverse consequences, such as misidentification or discriminatory actions based on inaccurate algorithmic judgments [32]. Addressing bias and ensuring fairness in AI systems require inclusive and diverse training datasets, regular audits, and ongoing monitoring to mitigate the potential for unfair outcomes [33].

Transparency and Explainability:

AI systems often operate as black boxes, making it challenging to understand the underlying decision-making processes. Lack of transparency and explainability can hinder trust, accountability, and the ability to address errors or biases. This lack of transparency is particularly concerning in the context of facial recognition technology, where individuals may not have a clear understanding of how their facial data is being processed and interpreted [34]. Striving for transparency in AI systems is crucial, enabling clear explanations of how decisions are reached and providing individuals with the necessary information to make informed choices [35].

Human-AI Collaboration and Responsibility:

As AI technologies become more pervasive in occupational therapy and special education and rehabilitation, clarifying the roles and responsibilities of human practitioners and AI systems becomes crucial. Blindly relying on AI systems without critical evaluation may lead to errors, misinterpretations, or inappropriate interventions. It is important to strike a balance between the capabilities of AI and the expertise and judgment of human professionals. For example, in the case of facial recognition technology in educational settings, human oversight is essential to ensure the responsible use of the technology and avoid undue reliance on algorithmic decisions [36].

Ethical Use of AI-Generated Content:

The use of AI-generated content raises ethical concerns, particularly when it comes to issues of intellectual property, authenticity, and misinformation. Deepfake technology, for instance, poses significant ethical dilemmas, as it can create highly realistic yet fabricated media. The misuse of deepfakes can lead to misinformation, privacy violations, and reputational damage [37]. Ethical guidelines and regulations are necessary to ensure responsible and accountable use of AI-generated content, preventing its malicious or deceptive use.

Addressing these challenges and ethical considerations is essential for the responsible and beneficial integration of AI in occupational therapy and special education and rehabilitation. By proactively identifying and mitigating these concerns, practitioners, researchers, policymakers, and technology developers can foster the development and

deployment of AI technologies that align with ethical principles and promote positive outcomes for individuals with disabilities.

Conclusion

The integration of artificial intelligence (AI) in occupational therapy and special education and rehabilitation holds significant potential to enhance therapeutic practices and optimize outcomes for individuals with disabilities and special needs. This scientific review paper has provided a comprehensive analysis of the application of AI in these fields, highlighting key applications, challenges, and ethical considerations.

Through the review of References, it is evident that AI-based assessment tools play a crucial role in accurately evaluating cognitive, physical, and emotional abilities. Examples such as the Cognitive Assessment and Rehabilitation Environment (CAREN), Kinect-based Movement Assessment System (KMAS), and Computerized Dynamic Assessment System (CDAS) demonstrate the power of AI algorithms in providing objective and personalized assessments.

AI-driven assistive technologies, including robotic devices, smart home systems, and prosthetic limbs, have shown promise in enhancing independence, mobility, and quality of life for individuals with disabilities. These technologies adapt to users' needs, provide personalized support, and enable individuals to engage in daily activities more effectively.

Personalized interventions and adaptive learning approaches leverage AI algorithms to tailor interventions according to individual needs and progress. By analyzing individual data and dynamically adjusting the intervention, these approaches optimize therapeutic outcomes and promote individualized skill development.

Communication and social interaction support systems powered by AI have the potential to address the needs of individuals with communication disorders, autism spectrum disorder, and social communication difficulties. Augmentative and alternative communication systems, social robots, virtual reality environments, and sentiment analysis technologies enhance communication skills, social interaction, and social awareness.

However, the integration of AI in occupational therapy and special education and rehabilitation also presents challenges and ethical considerations. Data privacy and security, bias and fairness, transparency and explainability, human-AI collaboration and responsibility, and the ethical use of AI-generated content are among the key concerns that need to be addressed to ensure responsible and ethical use of AI technologies.

In conclusion, AI has the potential to transform occupational therapy and special education and rehabilitation by enhancing assessment accuracy, personalizing interventions, promoting independence, and improving social interaction and communication. By embracing AI technologies while addressing the associated challenges and ethical considerations, healthcare professionals can optimize care and

empower individuals with disabilities and special needs to achieve their full potential. Future research and collaboration between professionals, researchers, policymakers, and technology developers are essential to harness the full potential of AI in these fields and ensure its ethical and responsible integration.

Acknowledgment

We would like to express my sincere gratitude to ChatGBT for its invaluable assistance in the development of this article. ChatGBT, powered by OpenAI's GPT-3.5 architecture, served as a remarkable language model, providing insightful suggestions, generating creative ideas, and offering reliable information throughout the writing process.

References

[1] Chao, S. O. N. G., Sha, G. E., Yao, W., & Linhai, Y. A. N. G. (2022). The Influence of Occupational Therapy on College Students' Home Physical Exercise Behavior and Mental Health Status under the Artificial Intelligence Technology. Occupational Therapy International, 2022.

[2] Drigas, A. S., & Ioannidou, R. E. (2013). A review on artificial intelligence in special education. Information Systems, E-learning, and Knowledge Management Research: 4th World Summit on the Knowledge Society, WSKS 2011, Mykonos, Greece, September 21-23, 2011. Revised Selected Papers 4, 385-391.

[3] Liu, L. (2018). Occupational therapy in the fourth industrial revolution. Canadian Journal of Occupational Therapy, 85(4), 272-283.

[4] Sardari, S., Sharifzadeh, S., Daneshkhah, A., Nakisa, B., Loke, S. W., Palade, V., & Duncan, M. J. (2023). Artificial Intelligence for skeleton-based physical rehabilitation action evaluation: A systematic review. Computers in Biology and Medicine, 106835.

[5] Han, E. R., Yeo, S., Kim, M. J., Lee, Y. H., Park, K. H., & Roh, H. (2019). Medical education trends for future physicians in the era of advanced technology and artificial intelligence: an integrative review. BMC medical education, 19(1), 1-15.

[6] Pozzi, C., Cavalli, S., Leorin, C., Cauli, O., & Morandi, A. (2020). The present and the future of occupational therapy. Occupational Therapy for Older People, 145-167.

[7] Seo, W., Jun, J., Chun, M., Jeong, H., Na, S., Cho, W., & Jung, H. (2022). Toward an AI-assisted Assessment Tool to Support Online Art Therapy Practices: A Pilot Study. In Proceedings of 20th European Conference on Computer-Supported Cooperative Work. European Society for Socially Embedded Technologies (EUSSET).

[8] Villamil, V., Deloria, R., & Wolbring, G. (2019, September). Artificial intelligence and machine learning: what is the role of social workers, occupational therapists, audiologists, nurses and speech language pathologists according to academic References and canadian newspaper coverage?. In Proceedings of the 5th Workshop on ICTs for improving Patients Rehabilitation Research Techniques (pp. 83-87).

[9] Inoue, K., Wada, K., & Ito, Y. (2008). Effective application of Paro: Seal type robots for disabled people in according to ideas of occupational therapists. In Computers Helping People with Special Needs: 11th International Conference, ICCHP 2008, Linz, Austria, July 9-11, 2008. Proceedings 11 (pp. 1321-1324). Springer Berlin Heidelberg.

[10] Liu, L., & Mihailidis, A. (2019). The changing landscape of occupational therapy intervention and research in an age of ubiquitous technologies. OTJR: Occupation, Participation and Health, 39(2), 79-80.

[11] Aulisio, M. C., Han, D. Y., & Glueck, A. C. (2020). Virtual reality gaming as a neurorehabilitation tool for brain injuries in adults: A systematic review. Brain injury, 34(10), 1322-1330.
[12] Gal, N., Andrei, D., Nemeş, D. I., Nădăşan, E., & Stoicu-Tivadar, V. (2015). A Kinect based intelligent e-rehabilitation system in physical therapy. In Digital Healthcare Empowering Europeans (pp. 489-493). IOS Press.
[13] Wu, L. J., & Chang, K. E. (2023). Effect of embedding a cognitive diagnosis into the adaptive dynamic assessment of spatial geometry learning. Interactive Learning Environments, 31(2), 890-907.
[14] Nayak, J., Bhat, P. S., Acharya, R., & Aithal, U. V. (2005). Classification and analysis of speech abnormalities. ITBM-RBM, 26(5-6), 319-327.
[15] Ali, S. G., Wang, X., Li, P., Jung, Y., Bi, L., Kim, J., & Sheng, B. (2023). A systematic review: Virtual-reality-based techniques for human exercises and health improvement. Frontiers in Public Health, 11.
[16] Picard RW, Vyzas E, Healey J. Toward Machine Emotional Intelligence: Analysis of Affective Physiological State. IEEE Trans Pattern Anal Mach Intell. 2001;23(10):1175-1191.
[17] Chen, T. L., Ciocarlie, M., Cousins, S., Grice, P. M., Hawkins, K., Hsiao, K.,& Takayama, L. (2013). Robots for humanity: using assistive robotics to empower people with disabilities. IEEE Robotics & Automation Magazine, 20(1), 30-39.
[18] El-Basioni, B. M. M., Abd El-Kader, S. M., & Eissa, H. S. (2014). Independent living for persons with disabilities and elderly people using smart home technology. International Journal of Application or Innovation in Engineering & Management (IJAIEM), 3(4), 11-28..
[19] Atzori M, Gijsberts A, Castellini C, et al. Electromyography Data for Non-invasive Naturally-Controlled Robotic Hand Prostheses. Sci Data. 2014;1:140053
[20] Ganesan, J., Azar, A. T., Alsenan, S., Kamal, N. A., Qureshi, B., & Hassanien, A. E. (2022). Deep Learning Reader for Visually Impaired. Electronics, 11(20), 3335.
[21] Kangas M, Vikman I, Nyberg L, et al. Comparison of Real-life Falls of Older People Detected by a Wearable Accelerometer and a Videotape Protocol. Aging Clin Exp Res. 2012;24(6):647-654.
[22] Liu, L., & Mihailidis, A. (2019). The changing landscape of occupational therapy intervention and research in an age of ubiquitous technologies. OTJR: Occupation, Participation and Health, 39(2), 79-80.
[23]Malach J, Javorcik T, Conditions and Bases of Incorporation of Artificial Intelligence into Czech School Environment, 2019
[24] Ke, F., & Im, T. (2013). Virtual-reality-based social interaction training for children with high-functioning autism. The Journal of Educational Research, 106(6), 441-461.
[25] Boukhennoufa, I., Zhai, X., Utti, V., Jackson, J., & McDonald-Maier, K. D. (2022). Wearable sensors and machine learning in post-stroke rehabilitation assessment: A systematic review. Biomedical Signal Processing and Control, 71, 103197.
[26] Konadl, D., Wörner, J., Luttner, L., & Leist, S. (2023). Artificial intelligence in augmentative and alternative communication systems–a References-based assessment and implications of different conversation phases and contexts.
[27] Scassellati B, Admoni H, Matarić MJ. Robots for Use in Autism Research. Annu Rev Biomed Eng. 2012;14:275-294.
[28] Bashashati A, Fatourechi M, Ward RK, Birch GE. A Survey of Signal Processing Algorithms in Brain-Computer Interfaces Based on Electrical Brain Signals. J Neural Eng. 2007;4(4):R32-R57.

[29] Pelachaud, C., Badler, N. I., & Steedman, M. (1996). Generating facial expressions for speech. Cognitive science, 20(1), 1-46.
[30] Mittelstadt BD, Allo P, Taddeo M, Wachter S, Floridi L. The Ethics of Algorithms: Mapping the Debate. Big Data Soc. 2016;3(2):2053951716679679.
[31] Buolamwini J, Gebru T. Gender Shades: Intersectional Accuracy Disparities in Commercial Gender Classification. In: Proceedings of the 1st Conference on Fairness, Accountability and Transparency. 2018:77-91.
[32] Rajkomar A, Hardt M, Howell MD, Corrado G, Chin MH. Ensuring Fairness in Machine Learning to Advance Health Equity. Ann Intern Med. 2018;169(12):866-872.
[33] Selinger, E., & Leong, B. (2021). The ethics of facial recognition technology. Forthcoming in The Oxford Handbook of Digital Ethics ed. Carissa Véliz.
[34] Mittelstadt BD, Allo P, Taddeo M, Wachter S, Floridi L. The Ethics of Algorithms: Mapping the Debate. Big Data Soc. 2016;3(2):2053951716679679.
[35] Floridi L, Cowls J, Beltrametti M, et al. AI4People - An Ethical Framework for a Good AI Society: Opportunities, Risks, Principles, and Recommendations. Minds Mach. 2018;28(4):689-707.
[36] Schultz J, Edsinger A. Ethical Considerations of Artificial Intelligence in Mental Health Care. Curr Treat Options Psychiatry. 2020;7(4):409-41