

**PENGEMBANGAN MEDIA PEMBELAJARAN ALAT BANTU KETIK
ERGONOMIS (ALBAKIS) UNTUK MENINGKATKAN KEMAMPUAN
MENGETIK PADA SISWA *LOW VISION* DALAM MATA PELAJARAN
TEKNOLOGI, INFORMASI, DAN KOMUNIKASI (TIK) DI SLBN A**

THESIS

Diajukan Untuk Memenuhi Salah Satu Syarat Memperoleh Gelar Magister
Pendidikan Di Departemen Pendidikan Khusus



Oleh:

Muhammad Rafi Wirdan Assyakir Tandu Bela

NIM. 2308970

PROGRAM STUDI PENDIDIKAN KHUSUS

FAKULTAS ILMU PENDIDIKAN

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LEMBAR HAK CIPTA

PENGEMBANGAN MEDIA PEMBELAJARAN ALAT BANTU KETIK ERGONOMIS (ALBAKIS) UNTUK MENINGKATKAN KEMAMPUAN MENGETIK PADA SISWA LOW VISION DALAM MATA PELAJARAN TEKNOLOGI, INFORMASI, DAN KOMUNIKASI (TIK) DI SLBN A

Oleh

Muhammad Rafi Wirdan Assyakir Tandu Bela

S.Pd. Universitas Pendidikan Indonesia, 2022

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**PENGEMBANGAN MEDIA PEMBELAJARAN ALAT BANTU KETIK
ERGONOMIS (ALBAKIS) UNTUK MENINGKATKAN KEMAMPUAN MENGETIK
PADA SISWA LOW VISION DALAM MATA PELAJARAN TEKNOLOGI,
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Muhammad Rafi Wirdan Assyakir Tandu Bela

2308970

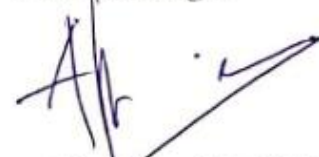
Disetujui dan disahkan oleh pembimbing dan penguji

Pembimbing I



Prof. Dr. H. Endang Rochyadi, M.Pd
NIP. 19560808 198503 1 002

Pembimbing II



Dr. Imas Diana Aprilia, M.Pd
NIP. 19700417 199402 2 001

Penguji I



Prof. Dr. Juhanaeni, M.Ed
NIP. 196005051986032001

Penguji II



Dr. Neni Meiyani, M.Pd
NIP. 195205121988032003

Mengetahui,
Ketua Program Studi Pendidikan Khusus
Fakultas Ilmu Pendidikan
Universitas Pendidikan Indonesia



Dr. dr. Rikhsma Nurahmi Rinalti Akhlan, M.Pd
NIP. 19751118 200501 2 001

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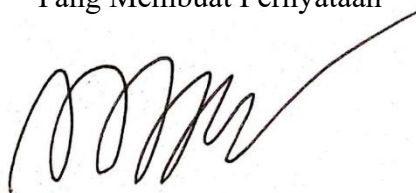
Nama : Muhammad Rafi Wirdan Assyakir Tandu Bela
NIM : 2308970
Program Studi : Pendidikan Khusus
Judul Karya : PENGEMBANGAN MEDIA PEMBELAJARAN ALAT BANTU KETIK ERGONOMIS (ALBAKIS) UNTUK MENINGKATKAN KEMAMPUAN MENGETIK PADA SISWA *LOW VISION* DALAM MATA PELAJARAN TEKNOLOGI, INFORMASI, DAN KOMUNIKASI (TIK) DI SLBN A

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ABSTRAK

PENGEMBANGAN MEDIA PEMBELAJARAN ALAT BANTU KETIK ERGONOMIS (ALBAKIS) UNTUK MENINGKATKAN KEMAMPUAN MENGETIK PADA SISWA *LOW VISION* DALAM MATA PELAJARAN TEKNOLOGI, INFORMASI, DAN KOMUNIKASI (TIK) DI SLBN A

Muhammad Rafi Wirdan Assyakir Tandu Bela, 2308970

Program Studi Pendidikan Khusus, Fakultas Ilmu Pendidikan

Universitas Pendidikan Indonesia

rafiwirdan@upi.edu

Penelitian ini bertujuan mengembangkan media pembelajaran ALBAKIS (Alat Bantu Ketik Ergonomis) untuk meningkatkan kemampuan mengetik siswa *low vision* pada mata pelajaran Teknologi Informasi dan Komunikasi (TIK) di SLBN A. Media ini dirancang untuk mengatasi hambatan visual dan postur tubuh yang dialami siswa saat mengetik, dengan mengintegrasikan fitur ergonomis seperti penyesuaian tinggi meja secara elektrik, kaca pembesar untuk monitor dan *keyboard*, pencahayaan yang dapat diatur, serta speaker dengan sistem *talk back*. Penelitian menggunakan metode *Single subject research* (SSR) dengan desain A-B-A (*Baseline 1* – Intervensi – *Baseline 2*). Subjek penelitian adalah satu siswa *low vision* kelas XI berusia 17 tahun dengan visus 20/200. Pengumpulan data dilakukan melalui observasi, tes kemampuan mengetik, wawancara, dan validasi ahli yang melibatkan pakar pendidikan khusus, guru SLB, dan ahli elektro guna memastikan kualitas, keamanan, dan fungsi media. Hasil penelitian menunjukkan adanya peningkatan signifikan dalam kemampuan mengetik setelah penggunaan ALBAKIS. Pada fase *Baseline 1*, skor rata-rata berada pada rentang 73,3%–76,7%. Setelah intervensi, skor meningkat menjadi 87,3%–89,3% dan stabil pada fase *Baseline 2*, yaitu 88,3%–89%. Selain itu, terdapat pengurangan keluhan fisik seperti nyeri leher, punggung, dan kelelahan mata. Peningkatan kemampuan mengetik terlihat pada aspek persiapan mengetik, ketepatan mengetik, penggunaan huruf kapital, tanda baca, serta kemandirian siswa dalam mengoperasikan laptop. Penurunan keluhan fisik menunjukkan bahwa fitur ergonomis ALBAKIS efektif dalam meningkatkan kenyamanan postur tubuh siswa *low vision* selama proses mengetik. Berdasarkan hasil dan analisis, dapat disimpulkan bahwa ALBAKIS efektif digunakan sebagai media pembelajaran adaptif yang meningkatkan kemampuan mengetik, kenyamanan postur, serta kemandirian siswa *low vision*.

Kata kunci: *low vision*, kemampuan mengetik, media pembelajaran adaptif, ALBAKIS, ergonomi, TIK.

ABSTRAK

DEVELOPMENT OF ALBAKIS LEARNING MEDIA TO IMPROVE TYPING ABILITIES OF PEOPLE WITH *LOW VISION* IN ICT SUBJECTS AT SLBN A

Muhammad Rafi Wirdan Assyakir Tandu Bela, 2308970

Program Studi Pendidikan Khusus, Fakultas Ilmu Pendidikan

Universitas Pendidikan Indonesia

rafiwirdan@upi.edu

This study aims to develop ALBAKIS (Ergonomic Typing Aid) learning media to improve the typing skills of *low vision* students in Information and Communication Technology (ICT) subjects at SLBN A. This tool is designed to address visual and postural challenges that students often face when typing, by integrating ergonomic features such as electric height adjustment for the desk, magnifying glass for the monitor and *keyboard*, adjustable lighting, and speakers with a talk-back system. The research method used was *Single subject research* (SSR) with an A-B-A design (*Baseline 1* – Intervention – *Baseline 2*). The research subject was a 17-year-old low-vision student in grade XII. Data collection was conducted through observation, typing ability tests, interviews, and expert validation. Validation involved special education experts, SLB teachers, and electrical engineers to ensure the quality, safety, and functionality of the media. The research results showed a significant improvement in typing skills after using ALBAKIS. In the *Baseline 1* phase, the average score ranged from 73.3% to 76.7%. After the intervention, the scores increased to 87.3%–89.3% and remained stable in the *Baseline 2* phase (88.3%–89%). Improvements were observed in typing preparation, typing accuracy, capital letter usage, punctuation, and independence in operating a laptop. Additionally, physical complaints such as neck pain, back pain, and eye fatigue decreased significantly. From this study, it can be concluded that ALBAKIS is effective as an adaptive learning medium capable of improving typing skills, body posture comfort, and the independence of *low vision* students. The ALBAKIS medium can be adopted in ICT education at special schools to support students' work skills and readiness to enter the computer-based workforce.

Keywords: *low vision*, typing skills, adaptive learning medium, ALBAKIS, ergonomics, ICT.

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DAFTAR PUSTAKA

- Abu-Yaghi, N., Meqbil, J., Sharif, Z., Helwa, L., Al-Imam, M., & Abumanneh, Z. (2022). Characteristics of visual impairment and the impact of *low vision* assessment in a tertiary academic hospital in Jordan. *Clinical Optometry*, 67-74.
- Ahmad Najmee, N. A., Mohammed, Z., Rahman, M. H. A., Fadzil, N. M., & Ludin, A. F. M. (2024). Optimizing classroom environments for visually impaired school children a scoping review protocol. *PloS one*, 19(10), e0308149.
- Alberta, I. B., Sebastian, D., & Laksono, N. V. (2021). Pendekatan multidimensional computer vision syndrome di era wfh. *Cermin Dunia Kedokteran*, 48(6), 350-354.
- Alsolami, A. S. (2022). Teachers of special education and assistive technology: Teachers' perceptions of knowledge, competencies and professional development. *SAGE Open*, 12(1), 21582440221079900.
- Azahra, L., Nurhayati, Q. M., Parsa, N., Hafidz, A. I., & Fu'adin, A. (2024). Alat bantu baca tunanetra berbasis teknologi text-to-speech dan optical character recognition. *Kohesi: Jurnal Sains dan Teknologi*, 3(2), 1-10.
- Azzahra, A. H., Safitri, D., & Sujarwo, S. (2024). Peran teknologi non-visual desktop access (nvda) untuk siswa tunanetra dalam proses pembelajaran. *Jurnal Teknologi Pendidikan*, 1(4), 7-7
- Bakker, K., Steultjens, E., & Price, L. (2019). The lived experiences of adults with a visual impairment who experience fatigue when performing daily activities. *British Journal of Occupational Therapy*, 82(8), 485-492.
- Barnett, A. L., & Stuart, N. (2024). Understanding Typing Skill in Students With Developmental Disorders. *Current Developmental Disorders Reports*, 11(2), 63-74.
- Bintari, B., & Wicaksono, M. B. (2022). Perancangan prototipe alat bermain belajar braille low cost berbasis mikrokontroler arduino sensor RFID. *Jurnal Teknologi*, 12(2), 55-61.
- Boey, D., Fitzmaurice, K., Tse, T., Chan, M. L., & Carey, L. M. (2022). Classifying types of visual loss linked with function to inform referral to vision rehabilitation for older adults in Singapore. *Gerontology and Geriatric Medicine*, 8, 23337214221130652.
- Brownstein, N. C., Louis, T. A., O'Hagan, A., & Pendergast, J. (2019). The role of expert judgment in statistical inference and evidence-based decision-making. *The American Statistician*, 73(sup1), 56-68.
- Chia, E. M., Wang, J. J., Rochtchina, E., Smith, W., Cumming, R. R., & Mitchell, P. (2004). Impact of bilateral visual impairment on health-related quality of life: the Blue Mountains Eye Study. *Investigative ophthalmology & visual science*, 45(1), 71-76.
- Clements, A. (2006). *Principles of computer hardware*. Oxford University Press.
- Cook, A. M., Polgar, J. M., & Encarnação, P. (2020). Principles of assistive technology. *Assistive technologies*, 1-15.
- Curnow, E., Maclean, F., & McCormack, B. (2024). Assistive technology: Occupational therapy assessment and services for people with dementia. *British Journal of Occupational Therapy*, 03080226241252280.

- Dainoff, M., Maynard, W., Robertson, M., & Andersen, J. H. (2012). Office ergonomics. *Handbook of human factors and ergonomics*, 1550-1573.
- Dandona, R., Dandona, L., Srinivas, M., Giridhar, P., Nutheti, R., & Rao, G. N. (2002). Planning *low vision* services in India: a population-based perspective. *Ophthalmology*, 109(10), 1871-1878.
- Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2020). Implications for educational practice of the science of learning and development. *Applied developmental science*, 24(2), 97-140
- Demmin, D. L., & Silverstein, S. M. (2020). Visual impairment and mental health: unmet needs and treatment options. *Clinical Ophthalmology*, 4229-4251.
- Dianat, I., Molenbroek, J., & Castellucci, H. I. (2018). A review of the methodology and applications of anthropometry in ergonomics and product design. *Ergonomics*, 61(12), 1696-1720.
- Emerson, S., Emerson, K., & Fedorczyk, J. (2021). Computer workstation ergonomics: Current evidence for evaluation, corrections, and recommendations for remote evaluation. *Journal of Hand Therapy*, 34(2), 166-178.
- Fernández-Batanero, J. M., Montenegro-Rueda, M., Fernández-Cerero, J., & García-Martínez, I. (2022). Assistive technology for the inclusion of students with disabilities: a systematic review. *Educational technology research and development*, 70(5), 1911-1930.
- Gagnon-Roy, M., Bourget, A., Stocco, S., Courchesne, A. C. L., Kuhne, N., & Provencher, V. (2017). Assistive technology addressing safety issues in dementia: a scoping review. *The American Journal of Occupational Therapy*, 71(5), 7105190020p1-7105190020p10.
- Ghaoui, C. (Ed.). (2005). *Encyclopedia of human computer interaction*. IGI global.
- Gibson, R. F. (2010). A review of recent research on mechanics of multifunctional composite materials and structures. *Composite structures*, 92(12), 2793-2810.
- Gissara, D. (2022). Classroom adaptations for students with *low vision*.
- Gøranson, I. E., Ochoa, T. A., & Zoeller, K. A. (2021). Strengths, pitfalls, and potential in Norway's approach to special education. *Intervention in School and Clinic*, 56(5), 273-279.
- Hamilton, B. (2022). *Integrating technology in the classroom: Tools to meet the needs of every student*. International Society for Technology in Education.
- Han, L., Zhang, H., Xiang, Z., Shang, J., Anjani, S., Song, Y., & Vink, P. (2021). Desktop lighting for comfortable use of a computer screen. *Work*, 68(s1), S209-S221.
- Hoogerwerf, E. J., Mavrou, K., & Traina, I. (2021). The role of assistive technology in fostering inclusive education. *Strategies and tools to support change*. London & New York: Routledge.
- Hoque, M. E. (2016). Three domains of learning: Cognitive, affective and psychomotor. *The Journal of EFL Education and Research*, 2(2), 45-52.

- Horowitz, P., Hill, W., & Robinson, I. (2015). *The art of electronics* (Vol. 2, p. 658). Cambridge: Cambridge university press.
- Izzah, F. N., & Supriyadi, U. (2023). Aplikasi baca buku untuk tunanetra *low vision* menggunakan optical character recognition dan text to speech. *Journal of Mandalika Literature*, 4(1), 250-261.
- Jalil, A., Rosa, F., Affandi, R., Aziz, A., Saputra, W. N. H., & Ridho, A. A. (2024). Literature Review: Exploration of Features Microsoft Word. *International Applied Science*, 3(1), 28-32.
- Jonsson, C. (2012). Visual ergonomics and computer work—is it all about computer glasses?. *Work*, 41(Supplement 1), 3577-3579.
- Kalava, A., Ravindranath, S., Bronshteyn, I., Munjal, R. S., SchianodiCola, J., & Yarmush, J. M. (2014). Typing skills of physicians in training. *Journal of graduate medical education*, 6(1), 155-157.
- Karwowski, W., & Zhang, W. (2021). The discipline of human factors and ergonomics. *Handbook of human factors and ergonomics*, 1-37.
- Kelts, G. I., McMains, K. C., Chen, P. G., & Weitzel, E. K. (2015). Monitor height ergonomics: A comparison of operating room video display terminals. *Allergy & Rhinology*, 6(1), ar-2015.
- Khan, R., Surti, A., Rehman, R., & Ali, U. (2012). Knowledge and practices of ergonomics in computer users. *JPMA-Journal of the Pakistan Medical Association*, 62(3), 213.
- Krahl, K. M. (2017). *Using Microsoft Word to Hide Data* (Master's thesis, Utica College).
- Kuo, Y. L., Huang, K. Y., Kao, C. Y., & Tsai, Y. J. (2021). Sitting posture during prolonged computer typing with and without a wearable biofeedback sensor. *International journal of environmental research and public health*, 18(10), 5430.
- Lee, S. Y., Gurnani, B., & Mesfin, F. B. (2024). Blindness. In *StatPearls [Internet]*. StatPearls Publishing.
- Lema, A. K., & Anbesu, E. W. (2022). Computer vision syndrome and its determinants: A systematic review and meta-analysis. *SAGE Open Medicine*, 10, 20503121221142402.
- Lenker, J. A., & Paquet, V. L. (2003). A review of conceptual models for assistive technology outcomes research and practice. *Assistive Technology*, 15(1), 1-15.
- Liang, I., Spencer, B., Scheller, M., Proulx, M. J., & Petrini, K. (2024). Assessing people with visual impairments' access to information, awareness and satisfaction with high-tech assistive technology. *British Journal of Visual Impairment*, 42(1), 149-163.
- Liang, I., Spencer, B., Scheller, M., Proulx, M. J., & Petrini, K. (2024). Assessing people with visual impairments' access to information, awareness and satisfaction with high-tech assistive technology. *British Journal of Visual Impairment*, 42(1), 149-163.
- Lim, S. M., Nyoman, L., Tan, Y. J., & Yin, Y. Y. (2021). Transition practice before entering primary school: A longitudinal study of children with and without special needs across a year. *Hong Kong Journal of Occupational Therapy*, 34(2), 63-72.

- Loh, L., Prem-Senthil, M., & Constable, P. A. (2024). A systematic review of the impact of childhood vision impairment on reading and literacy in education. *Journal of Optometry*, 17(2), 100495.
- Ma, Y. L., Tan, J. R., Wang, D. L., & Liu, Z. Z. (2018). Light-weight design method for force-performance-structure of complex structural part based co-operative optimization. *Chinese Journal of Mechanical Engineering*, 31(1), 42.
- Majszak, M., & Jebeile, J. (2023). Expert judgment in climate science: How it is used and how it can be justified. *Studies in history and philosophy of science*, 100, 32-38.
- Mallare, J. C. T., Pineda, D. F. G., Trinidad, G. M., Serafica, R. D., Villanueva, J. B. K., Cruz, A. R. D., ... & Roxas, E. A. (2017, December). Sitting posture assessment using computer vision. In *2017IEEE 9th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment and Management (HNICEM)* (pp. 1-5). IEEE.
- Mani, K., Provident, I., & Eckel, E. (2016). Evidence-based ergonomics education: Promoting risk factor awareness among office computer workers. *Work*, 55(4), 913-922.
- Mardiyanti, F. (2021). Pengukuran risiko kerja dan keluhan muskuloskeletal pada pekerja pengguna komputer. *Journal of Innovation Research and Knowledge*, 1(3), 333-346.
- Martiningsih, D. (2023). E-Pub Sebagai Teknologi Pendukung Pembelajaran Bagi Penyandang Disabilitas Netra. *Optimalisasi Pemanfaatan Teknologi Pembelajaran*, 31.
- McGlashan, H. L., Blanchard, C. C., Sycamore, N. J., Lee, R., French, B., & Holmes, N. P. (2017). Improvement in children's fine motor skills following a computerized typing intervention. *Human movement science*, 56, 29-36.
- McNicholl, A., Casey, H., Desmond, D., & Gallagher, P. (2021). The impact of assistive technology use for students with disabilities in higher education: a systematic review. *Disability and rehabilitation: assistive Technology*, 16(2), 130-143.
- Mogk, L. (2011). Eye conditions that cause *low vision* in adults. In M. Warren & B. A. Barstow (Eds.), *Occupational therapy interventions for adults with low vision* (pp. 27-73). American Occupational Therapy Association.
- Nabilah, A., Luthfiya, A., Nitit, P. P., & Amaliyah, A. (2025). Analisis Pengaruh Lingkungan Kerja Fisik terhadap Produktivitas Karyawan Pada Perusahaan Di Jawa Timur. *Journal of Exploratory Dynamic Problems*, 2(2), 34-55.
- Pandya, N., Gupta, N., & Nagpal, D. (2023). *Low vision*: Knowledge, attitude, and practice among optometrists in India. *British Journal of Visual Impairment*, 41(1), 56-65.
- Peteri, V. (2017). Bad enough ergonomics: A case study of an office chair. *Sage Open*, 7(1), 2158244016685135.
- Prahmana, R. C. I (2021) *Singel Subject Research: Teori dan Implementasinya; Suatu Pengantara*. UAD Press
- Pranowo, T. A. (2021). Pengembangan aplikasi pembelajaran tunanetra (aptun) berbasis teknologi asistif untuk pencarian konten pembelajaran mahasiswa tunanetra (Peer Review).

- Rahma, S. A., & Astuti, S. B. (2025). Pengaruh ergonomi pada kantor teknik terhadap produktivitas kerja karyawan. *Lintas Ruang: Jurnal Pengetahuan dan Perancangan Desain Interior*, 13(1), 27-35.
- Reisel, L., Nadim, M., & Brekke, I. (2021). The impact of having a child with special needs: Labour market adaptations of immigrant and majority mothers. *Acta Sociologica*, 64(4), 403-419.
- Roesdiono, E. (2004). Mengetik manual: sistem 10 jari. *Jakarta: Bagian Proyek Pengembangan Kurikulum Direktorat Pendidikan Menengah Kejuruan Direktorat Jendelar Pendidikan Dasar dan Menengah*.
- Roesdiono. (2004). Mengetik Manual Sistem 10 Jari, Jakarta : Departemen. Pendidikan Nasional.
- Saputra, H., Siregar, R. B., Purwana, R., & Butar, M. H. B. (2024). Pengaruh postur kerja duduk didepan komputer terhadap penderita neck pain pada dosen institut kesehatan helvetia. *Journal Healthy Purpose*, 3(2), 163-169.
- Sarsoh, J. T., Hashem, K. M., & Hendi, H. I. (2012). An effective method for hiding data in Microsoft Word documents. *Global Journal of Computer Science and Technology Network, Web & Security*, 12(12), 39-42.
- Senjam, S. S., Foster, A., Bascaran, C., Vashist, P., & Gupta, V. (2020). Assistive technology for students with visual disability in schools for the blind in Delhi. *Disability and Rehabilitation: Assistive Technology*, 15(6), 663-669.
- Setiawardani, M., & Suhaeni, T. (2016). Penggunaan musik daerah untuk meningkatkan kompetensi kecepatan dan ketepatan mengetik mahasiswa. *Jurnal Riset Bisnis Dan Investasi*, 2(3), 12-28.
- Shah, P., Schwartz, S. G., Gartner, S., Scott, I. U., & Flynn Jr, H. W. (2018). *Low vision services: a practical guide for the clinician. Therapeutic advances in ophthalmology*, 10, 2515841418776264.
- Shan, G. (2023). Exploring the intersection of equipment design and human physical ability: Leveraging biomechanics, ergonomics/anthropometry, and wearable technology for enhancing human physical performance. *Advanced Design Research*, 1(1), 7-11.
- Sharma, P. P., Mehta, R. K., Pickens, A., Han, G., & Benden, M. (2019). Sit-stand desk software can now monitor and prompt office workers to change health behaviors. *Human factors*, 61(5), 816-824.
- Shikdar, A. A., & Al-Kindi, M. A. (2007). Office ergonomics: deficiencies in computer workstation design. *International Journal of Occupational Safety and Ergonomics*, 13(2), 215-223.
- Shute, V. J., & Zapata-Rivera, D. (2007). Adaptive technologies. *ETS Research Report Series*, 2007(1), i-34.
- Špakov, O., & Majaranta, P. (2009). Scrollable Keyboards for Casual Eye Typing. *PsychNology Journal*, 7(2).
- Steinfeld, E., Lenker, K., Paquet, V. (2002). The Anthropometrics of Disability. *Center for Inclusive Design and Environmental Access*
- Stopa, M. (2024). Assessment of navigators' ergonomic awareness and working conditions on navigation bridges. *International Shipbuilding Progress*, 71(1), 29-47.

- Sunanto, J. (2005). Mengembangkan potensi anak berkelainan penglihatan. *Jakarta: Departemen Pendidikan Nasional*.
- Susanto, A., Hasibuan, T. K., Sandrika, T., Putri, A. S., Maulana, S. Z., & Jahro, S. A. (2025). Inovasi Penataan Ruang Kelas untuk Meningkatkan Keterlibatan Siswa dalam Proses Pembelajaran. *AT-TAKLIM: Jurnal Pendidikan Multidisiplin*, 2(6), 39-53.
- Taylor, R. (2014). *Exceptional students: Preparing teachers for the 21st century*. McGraw-Hill Higher Education.
- Tittelbach, D., Fields, L., & Alvero, A. M. (2008). Effects of performance feedback on typing speed and accuracy. *Journal of Organizational Behavior Management*, 27(4), 29-52.
- Trewin, S., & Keates, S. (2006). Computer access for motor-impaired users. In *Encyclopedia of Human Computer Interaction* (pp. 92-99). IGI Global.
- Turbert, D., gudgel, D. (2024). *Low vision Assistive Devices*. *American Acadamy of Ophthalmology-sep*
- Van Weerdenburg, M., Tesselhof, M., & van der Meijden, H. (2019). Touch-typing for better spelling and narrative-writing skills on the computer. *Journal of Computer Assisted Learning*, 35(1), 143-152.
- Wahid, S. H. (2024). Exploring the intersection of Islam and digital technology: A bibliometric analysis. *Social Sciences & Humanities Open*, 10, 101085.
- Wahlström, J. (2005). Ergonomics, musculoskeletal disorders and computer work. *Occupational medicine*, 55(3), 168-176.
- Wahyuni, L., Umi, S., & Mardiyah, K. (2017). Pengaruh Motivasi Belajar dan Penggunaan Media Pembelajaran Typing Master terhadap Keterampilan Mengetik Sistem 10 Jari Buta Siswa Kompetensi Keahlian Administrasi Perkantoran. *Jurnal Administrasi Perkantoran*, 8(1), 5-6.
- Ward, J., Rogers, N., Brown, R., Jeffries, G., & Wright, D. (1995). Techniques in anthropometry applied to disabled and elderly populations. *Biomedical Sciences Instrumentation*, 31, 281-285.
- Weiss, J., Girard, L., Gimbert, F., Amitrano, D., & Vandembroucq, D. (2014). (Finite) statistical size effects on compressive strength. *Proceedings of the National Academy of Sciences*, 111(17), 6231-6236.
- West, S. K., Rubin, G. S., Broman, A. T., Munoz, B., Bandeen-Roche, K., Turano, K., & SEE Project Team. (2002). How does visual impairment affect performance on tasks of everyday life?: The SEE Project. *Archives of Ophthalmology*, 120(6), 774-780.
- Wijayanto, A. (2021). *Dinamika Perkembangan dan Pembelajaran Geraka Anak*.
- Wittich, W., Jarry, J., Morrice, E., & Johnson, A. (2018). Effectiveness of the Apple iPad as a spot-reading magnifier. *Optometry and Vision Science*, 95(9), 704-710.
- Yassierli, Y., Hardiningtyas, D., Dianita, O., Muslim, K., & Kusmasari, W. (2020). Panduan Ergonomi "Working From Home.". *Perhimpunan Ergonomi Indonesia*, 1-19.
- Zapf, S. A., Scherer, M. J., Baxter, M. F., & H. Rintala, D. (2016). Validating a measure to assess factors that affect assistive technology use by students with disabilities in

elementary and secondary education. *Disability and Rehabilitation: Assistive Technology*, 11(1), 38-49.

Zhang, C., Mao, X., Pang, L., & Wang, H. (2025). Effects of lighting on visual ergonomics, visual perception and psychological responses in windowless offices. *Lighting Research & Technology*, 57(3), 229-249.