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# The Impact of Artificial Intelligence on Education: Opportunities and Challenges

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***Abstract***
*The integration of Artificial Intelligence (AI) in education, particularly in learning assessments, presents a notable paradigm shift, promising advancements in learning methodologies. Numerous studies advocate for AI's potential to enhance students' quality by refining evaluations and furnishing precise, measurable feedback. It stands out in mitigating errors, enhancing evaluation accuracy, identifying individual needs, and fostering more effective teaching. Traditional educational approaches, fraught with subjective human judgment and limited forms of assessment like written or oral tests, often fail to capture individual abilities comprehensively. AI's implementation demonstrates the ability to reduce bias, enhance efficiency, and provide tailored assessments, addressing these limitations. Methodologically, this article employs a literature review to synthesize various perspectives on AI's impact on education. It explores AI's potential benefits such as objectivity, efficiency, consistency, analytical capabilities, developmental programs, personalization, flexibility, and anti-cheating measures. Furthermore, it delves into challenges, notably AI's validity, high costs, technological dependency, data security, and the potential influence of behavioral changes on assessment outcomes. The results reveal multifaceted advantages of AI technology, including objectivity in assessments devoid of human bias, efficiency in time and cost, consistent evaluations, enhanced analytical skills, assessment program development, flexibility, and fraud mitigation. However, challenges exist, ranging from ensuring AI's validity and reliability, addressing technological dependency and cost hurdles, securing data, to mitigating biased discrimination. In conclusion, while AI presents a plethora of advantages, its integration into education demands meticulous consideration of associated challenges. The technology's efficacy and reliability, coupled with the cost and security aspects, necessitate thorough scrutiny and rigorous testing before implementation.*
***Keywords:*** *Artificial Intelligence, Opportunities, Challenges*

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## INTRODUCTION

In the world of technology, innovation is one aspect that develops and supports human life. One of them is in the field of education, especially in learning processes and methods. One innovation that is currently attracting public attention is the use of Artificial Intelligence or AI in the field of education based on the thoughts of Gao et al., (2020). Meanwhile, based on the thoughts of Kahng & Cho (2019) AI is a breakthrough and innovation in the field of technology that is able to combine computer algorithms and data processing to form a system that is able to carry out the adaptation process from several experiences gained. previously.

The application of AI in the field of education, such as the learning assessment process itself, is able to attract the attention of many education experts as well as researchers and practitioners. Several studies are able to show that the use of AI in education can provide opportunities to improve the quality of students, especially in terms of evaluation and also providing accurate and measurable feedback for students.

The use of AI technology in education and learning assessment can minimize the occurrence of errors and can also increase the accuracy of evaluations. The use of AI in the world of education can be one way to identify the individual needs of students and teachers so that it is much more effective.

Traditional methods used in the world of education of course have various weaknesses which have been identified. According to the thoughts of Black & Wiliam (1998), traditional methods often rely on

subjective human judgment which can be influenced by the subjective interpretation and bias of each individual. This could be one of the results of an inconsistent educational process and also declining quality.

Another influence according to Bennett (2011) and Harlen (2005) regarding this traditional method is that it has limitations on certain forms. Such as oral exams and also written tests. Practically, this can lead to negligence or neglect of individual abilities which of course cannot be measured or seen in these ways.

The development and implementation process in the world of education, including traditional assessment evaluation, according to Riduwan (2015) and also Arikunto (2013), requires a lot of time and costs. Traditional educational methods, especially in the assessment process, often require time in the assessment and evaluation process so that feedback to the assessment participants is not timely.

Several studies show that AI is able to provide a much better role compared to traditional methods in several aspects. Research from Martin et al. (2019) stated that the use of AI in the world of education, especially in the field of assessment, can provide the ability to increase the accuracy, validity and reliability of assessments. In addition, it can help reduce bias from individual human judgment. AI can also have adaptive assessments that can be tailored to individual needs.

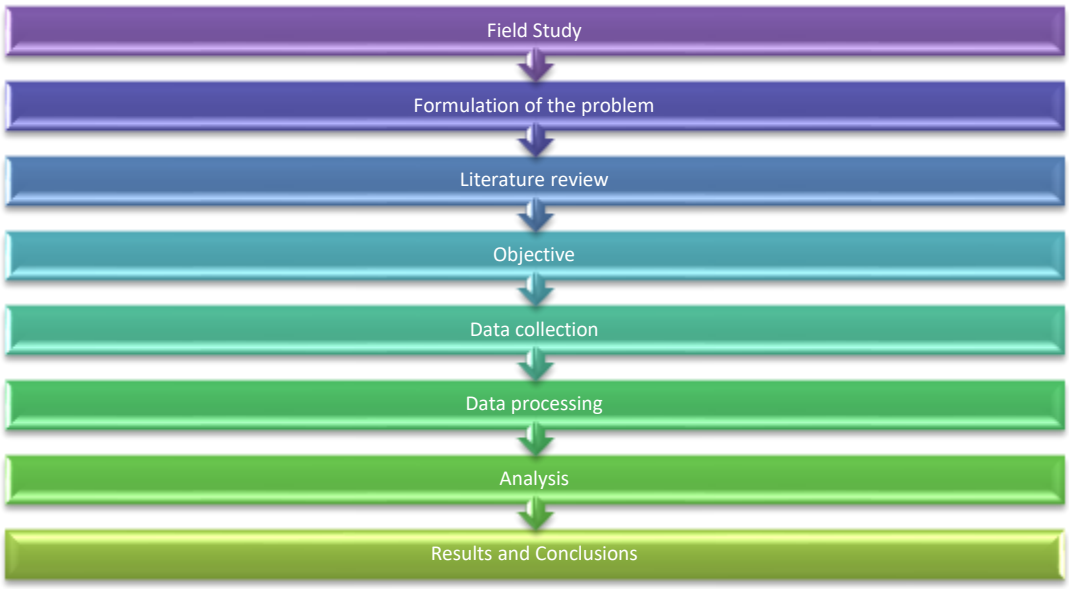
Research from Chen et al (2019) shows that the use of AI can provide time and cost efficiencies which can help in providing feedback quickly and accurately. In this research it is also presented that AI can help in identifying patterns and trends that cannot be done by humans and can help in carrying out the identification process to improve the quality of learning.

The utilization and use of AI technology in the world of education is able to provide potential and benefits, especially in improving the quality of learning. However, AI technology itself is only a tool in the learning process where the final decision is in human hands. Therefore, the use of AI technology in the world of education must be done wisely in order to develop the world of education for the better.

Even though there are several benefits that can be obtained from the application of AI, it is also important to remember that its use must still be considered carefully in order to avoid various kinds of risks. Therefore, systematic literature review research must be carried out and has an important role.

## METHODS

The research method carried out in this article uses the library study method or literature review as a data collection and processing process carried out in making this research. Library study method or *library research* This is a method used in the data collection process in order to understand and also study theories from various types of literature that have a correlation with the research.




Graph 1. Flowchart of Literature Study Methods

## RESULTS AND DISCUSSION

The use of Artificial Intelligence or AI technology in the world of education is able to provide various advantages when compared to traditional methods. There are various advantages and disadvantages in using AI technology in the world of education, especially in the assessment or evaluation process of student performance.

*1. Opportunities In AI Technology*

Objective. One of the advantages and disadvantages of using AI technology in the world of education is objectivity. This is closely related to evaluation or assessment of the final results of students' learning. Usually assessments carried out by humans have a side that is susceptible to bias which can have a big influence on the final results. By using AI technology, of course there is no particular preference or bias in the process of presenting values and scores which can make the assessment more accurate and objective. Assessments using AI technology will be much more objective because decision making in the assessment process does not depend on the subjectivity or interpretation of the individual who carries out the assessment process.

Based on research from Kunnath et al. (2020) is able to present a fairly broad picture of the use of natural language processing technology or NLP which is used in the essay assessment process in an automated way. In this research, it was found that there were various different NLP techniques used in the process. However, the overall use of AI in essay assessment has a much higher level of objectivity compared to human assessment.

Research conducted by Norris, SP (2019) is more about the use of AI technology in the development process in the world of education, especially in the assessment of various questions and tests. Such as performance tests, construct tests and project tests in the assessment process. The results of this research show that AI can help increase objectivity in the assessment process. Especially for tests that have a complex side and also require subjective assessment. According to research from Foltz (2013), the use of AI in the world of education, especially in terms of assessment and its application, shows that AI can provide much more objective assessment results. And AI can provide efficiency and speed in the process of providing feedback to students. Likewise with Schmidhuber (2015) who discusses the use of deep learning for artificial neural networks and also its application in various aspects including education and assessment. In this research, it is presented that in-depth learning can help increase the objectivity of assessments and also increase the effectiveness and efficiency of the process of presenting results to students.

Efficiency. AI technology used in education has an important role, especially in terms of efficiency. In the world of education, especially in the assessment process, it certainly requires much better efficiency. Assessment of individual humans certainly requires a lot of time and energy. Using AI technology can of course help in automating the assessment process so that time and energy can be much more efficient.

This is stated in research from Adedokun & Adeyemo (2021) which presents several benefits from using AI technology, especially in the assessment or assessment aspect. The use of Artificial Intelligence can help in the process of saving time and money in carrying out assessments. And this can increase the speed of the presentation process to students.

Meanwhile, research from Shieh et al., (2020) in evaluating the use of AI technology can assess the exam results and education of students in a more efficient way. From this research, it was found that AI technology can produce assessments that are much more efficient and also provide *feedback* to students more precisely and quickly.

From several research results, it is presented that the use of AI technology can provide improvements in efficiency in the process of evaluating student test results. It can also be concluded that the use of AI technology provides improvements in terms of efficiency. This AI technology can help in the process of saving time and costs in the educational process, especially assessment and *feedback* to students.

Some of the research presented is able to show that the use of AI technology can reduce the time required for the evaluation process of student assignments and can provide much faster *feedback* . AI

technology can also be a way to help reduce bias errors and can also increase the consistency of assessments. Thus, the use of AI technology can help improve the quality and effectiveness in the world of education.

Consistency. The use of AI technology in the world of education can provide convenience, especially in terms of consistency of assessment results. Assessments carried out individually or traditionally can produce data such as different values. And this is based on the assessor who carries out the evaluation or assessment process. This AI technology can help in the world of education to provide consistency and objectivity.

According to research from Hong et al. (2020) that the use of AI can provide increased consistency in the education sector, especially in the medical education sector. The results presented show that the use of AI can help increase consistency and also reduce the occurrence of errors in the teaching and learning process to assessment and evaluation in the assessment process.

Based on research from Kaul & Lal (2018) that the use of AI can provide increased consistency in the online exam process, especially on the assessment evaluation side. The use of AI technology can help in providing consistency in assessments that occur from different assessors and also reduce assessment errors that usually arise from individual sides.

AI technology can help reduce the time required for the evaluation process of students' educational results and can also provide input or *feedback* much more quickly. Meanwhile, according to Han, S. (2018) in using AI in the language evaluation and assessment process, it is presented that AI can help in increasing consistency in the assessment process. AI can help increase the accuracy of evaluations and assessments by prioritizing algorithms and statistical models.

Analytical capabilities. The use of AI in the educational process, especially assessment, can provide guarantees in improving analytical skills. AI can provide much more detailed analysis capabilities for assessment results and also provide more detailed information about students' strengths and weaknesses in certain areas.

This can help in making the feedback process to students more specific and also in-depth to the participants. According to research from Kovanović et al (2015), the use of AI technology is in carrying out the analysis process and also predicting learning achievement, especially in online courses. The results are presented if the use of AI technology can help identify patterns in data and can also predict the progress of students' learning methods. AI technology can be used to analyze student learning behavior and provide much more effective feedback.

According to research from Tanes & Martin (2020), the use of AI technology in the process of improving and evaluating students' critical thinking skills. From the results of this research, it is shown that AI technology can help with the process of identifying and evaluating students' critical thinking abilities through data and text analysis. AI can provide input with certain specifications and also in a personalized manner so that it can help students improve critical thinking skills. Meanwhile, according to research from Sanchez & Huang (2017) in evaluating the use of AI technology in the adaptive learning process, it was presented that AI technology can be helpful and also useful in identifying students' learning needs and can also provide recommendations. that suits their needs. AI can carry out the process of analyzing students' learning behavior which can provide effective and personalized feedback.

The research shows that AI technology can help in improving the analytical capabilities of assessments. AI technology can be used as a way to analyze data and behavior from the teaching and learning process of students to provide much more effective feedback. AI technology can be used to predict the progress of students' learning and also provide recommendations that suit their needs. Thus, the use of AI technology can help improve the quality and effectiveness of the teaching and learning process.

Development of assessment programs. The use of AI technology in education, especially assessment, can help develop assessment programs. AI can help in designing assessment questions that are both efficient and effective. Apart from that, it can develop automatic scores to evaluate participant answers very quickly and accurately. The use of AI in the assessment process provides advantages compared to traditional assessments. In this case, AI can help in increasing objectivity, efficiency and also consistency and analytical

capabilities. Therefore, the use of AI in the assessment process can be a very appropriate solution to meet the assessment needs in the complex and continuously developing field of education.

Based on research from Jiao et al. (2020) in the evaluation process in the use of AI technology in developing English writing assessment programs, the results showed that AI can help increase the validity and reliability of English writing assessments. AI technology can help in analyzing text and also providing more specific *feedback to students*. AI technology can be used to predict student learning progress and also provide recommendations according to their needs. Meanwhile, according to Davis et al. (2019) in evaluating the use of AI technology in developing a family medicine competency assessment program. The results obtained show that AI technology can help increase the validity and reliability of competency assessments. AI technology can be used to analyze assessment data and provide much more specific input. AI technology can be used to predict student learning progress and also provide appropriate recommendations.

Flexibility. The use of AI in the assessment side of education can provide much greater flexibility. In traditional assessments, participants must of course follow a predetermined schedule. And the assessment process is carried out simultaneously with other participants. However, by using AI, participants can carry out the assessment process anytime and anywhere according to their needs.

Research by Mancheno-Smoak et al. (2021) states that the use of AI technology in the assessment process provides the ability to present various types of questions. The study also shows that AI technology can facilitate the process of collecting and analyzing large amounts of data. This can help increase accuracy and consistency in assessment results. AI technology can help expand the range of assessments that students can access. Research conducted by Stowe et al. (2020) presented that the use of AI technology in the assessment process can provide students with the possibility of carrying out assessments online and independently which can reduce geographical and time limitations.

Minimize fraud. The use of AI in the assessment process can help reduce fraud in the assessment process. In traditional assessments, cheating can occur if participants use the same material or it is not even allowed. However, by using AI, assessments can be done online and can also automatically reduce the possibility of fraud. Research conducted by Hendry et al., (2019) shows that learning has the ability to detect acts of fraud or cheating. And this must be developed further to achieve higher accuracy and validity.

Personalization. The use of AI in education can help provide more personalized assessments for each student. AI can carry out the process of identifying participants' strengths and weaknesses and provide feedback that is more specific and appropriate to each participant's needs. According to research from Rauh, C., et al., (2018) in evaluating the use of AI technology in the assessment program development process, it was found that AI technology could help provide more personalized assessments for students. AI technology can be used to analyze learning data and also provide feedback according to the learning needs of each student. AI technology can also be used to predict student learning progress and provide recommendations according to needs.

*2. Challenges in AI Technology*

Apart from the opportunities and benefits that can be obtained from using AI, there are several challenges that you must be aware of when using this technology. Based on the results of the literature review of the research conducted, of course there are several challenges in AI technology.

AI validity and reliability. The use of AI in education requires high validity and reliability. AI technology must be able to provide consistent and objective results. In this case, of course, it is still a challenge because AI is still unable to fully imitate and adapt human intelligence. The quality of data used in AI must also be controlled and regulated to ensure accurate results.

According to research from Schneider et al. (2019), the use of AI in the standard medical assessment process is discussed. They explained that AI technology is very important in the process of using assessments. Especially in cases involving the patient's life. Therefore, the reliability of AI must be carefully tested and validated by practitioners and experts. Meanwhile, according to Bostrom & Yudkowsky (2014), the validity and reliability of AI is an important aspect of its use. Therefore, AI must be tested rigorously and also developed to strict standards in order to ensure accuracy when providing results. In line with research from

Walker et al. (2019) that the reliability of AI in the assessment process must be carefully tested and must also be validated by experts to be reliable.

This research shows that the validity and reliability of AI is an important challenge in the use of AI technology in education. The reliability of AI must be rigorously tested and developed according to strict standards to ensure its accuracy in delivering results. Validation by relevant experts is also very important to ensure that the results provided are accurate and reliable.

Dependence on technology and large costs. The use of AI in education requires large costs and adequate technological infrastructure. This is an obstacle and challenge for institutions or organizations that want to apply this technology, especially in developing countries. Research from Mishra & Pandey (2021) states that cost and technology dependence are challenges in using AI in education, especially assessment in the learning process. Therefore, the use of AI in education must be considered carefully, especially in the cost sector and also the availability of technological infrastructure. This is in accordance with research from Walker et al., (2019), that cost and technology dependency is one of the obstacles and challenges in using an automated assessment system, especially if the required technological infrastructure is not available and is also too expensive.

Based on research from Hoque et al. (2021), it is stated that cost and technology dependence are challenges in the process of using AI in education. Especially in developing countries. Therefore, careful and perfect thought is needed before deciding to apply this technology in an assessment.

Data Security. The use of AI in education can cause problems, especially related to data privacy and security. Student data and other data collected and analyzed by AI can be targeted by hackers or irresponsible users. Therefore, there needs to be strict regulations and an adequate security system to protect the privacy and security of this data. Based on research from Khaled et al. (2021), it is stated that data privacy and security is one of the problems when using AI technology in the assessment process. Student data that is collected and analyzed by AI can become a target for hackers. Therefore, strict regulations and an adequate security system can be one way to protect this data. Meanwhile, according to research from Spataro & Ciminello (2021), data privacy and security is one of the ethical issues in the use of AI technology used in education. Student data must be kept confidential and also protected from unethical use. Therefore, clear regulations and policies must be created to protect data privacy and security when using AI technology. Meanwhile, according to Shabani & Borry (2018) regarding data privacy and security, this is indeed a major and important problem in the use of digital data. In this case, it is student data that uses AI technology. Therefore, there is a need for regulations and policies to protect this data.

Biased discrimination. AI can provide biased or discriminatory results if the data used is contaminated by various irrelevant factors. Such as aspects of gender or race. This can influence the results of the assessment and also reduce the fairness of the assessment. Therefore, efforts need to be made to eliminate irrelevant factors in the data aspects and also reduce bias. According to research from Bolukbasi et al. (2016), it is stated that gender bias in natural language processing technology or NLP can be used to eliminate this bias. One example of gender bias in NLP is that algorithms often associate the word "programmer" with men and the word "housewife" with women. This study shows that debiasing techniques can reduce this association and provide appropriate results. Meanwhile, based on Buolamwini & Gebru (2018) in research on gender bias in facial recognition technology and also how to overcome this bias, it shows that facial recognition algorithms in several technology companies provide worse results for people with skin complexions. dark and female. This research shows that by getting more diverse data and the right techniques, appropriate algorithms can be produced. Meanwhile, according to research from Kim (2021) it also provides algorithmic bias in educational assessments and also the factors that cause this bias. One of these studies shows that algorithms in educational assessment often provide inappropriate results, especially for minority groups. For example, people with disabilities and also students from ethnic minorities. This research also discusses efforts to eliminate bias in educational assessments and also apply appropriate principles of justice.

## CONCLUSION

The use of AI technology in the world of education, especially in assessment and assessment and evaluation, can provide several benefits such as objectivity, efficiency, consistency, analytical capabilities, development of assessment programs, personalization, flexibility, and being able to prevent cheating. However, there are several challenges such as the validity and reliability of AI, cost, technology dependency, data privacy and security, and changes in participant behavior that can affect the assessment results. The application of AI technology must be done carefully and also pay attention to existing challenges. This needs to be tested before applying AI to assessments and also paying attention to the quality of the data used in the use of AI technology.

## REFERENCES

Adedokun, A.O., & Adeyemo, O.I. (2021). Enhancing Assessment and Evaluation with Artificial Intelligence. *International Journal of Emerging Technologies in Learning*, 16(4), 134-148. http://dx.doi.org/10.30734/jpe.v10i2.3199

Aggarwal, A., Singla, S., & Kaur, S. (2019). Machine learning based automatic assessment systems: A review. *International Journal of Computer Applications*, 181(47), 15-22. https://doi.org/10.1016/j.iswa.2021.200056

Akgun, S., & Greenhow, C. (2022). Artificial intelligence in education: Addressing ethical challenges in K-12 settings. *AI and ethics* , *2* (3), 431–440. https://doi.org/10.1007/s43681-021-00096-7 .

Alshehri, S., Drew, S., Alghamdi, R., Alsolami, R., & Aljohani, N. (2019). The impact of using artificial intelligence in assessments. *Education and Information Technologies*, 24(2), 1619-1638. https://link.springer.com/journal/10639/volumes-and-issues/24-2

Arikunto, S. (2013). *The research procedure is a practice approach (revision VIII)*. Jakarta: Rineka Cipta. https://opac.perpusnas.go.id/DetailOpac.aspx?id=801361

Beede, P., Julian, J., Langdon, G., McKittrick, G., Khan, B., & Doms, M. (2011). *Women in STEM: A gender gap to innovation*. US Department of Commerce. DOI:10.2139/ssrn.1964782

Bennett, R.E. (2011). Formative assessment: A critical review. *Assessment in Education: Principles, Policy & Practice*, 18(1), 5-25. https://doi.org/10.1080/0969594X.2010.513678

Black, P., & William, D. (1998). Inside the black box: Raising standards through classroom assessment. *Phi Delta Kappan*, 80(2), 139-148. DOI:10.1177/003172171009200119

Bolukbasi, T., Chang, K. W., Zou, J. Y., Saligrama, V., & Kalai, A. T. (2016). Man is to computer programmer as woman is to homemaker? Debiasing word embeddings. *In Advances in neural information processing systems* (pp. 4349-4357). https://doi.org/10.48550/arXiv.1607.06520

Bostrom, N., & Yudkowsky, E. (2014). The ethics of artificial intelligence. *The Cambridge Handbook of Artificial Intelligence*, 316-334. https://doi.org/10.1017/CBO9781139046855.020

Brookhart, S. M. (2013). *How to create and use rubrics for formative assessment and grading*. ASCD. DOI: 10.12691/education-5-5-12

Buolamwini, J., & Gebru, T. (2018). Gender shades: Intersectional accuracy disparities in commercial gender classification. *Proceedings of the 1st Conference on Fairness, Accountability and Transparency*, PMLR 81:77-91. https://proceedings.mlr.press/v81/buolamwini18a/buolamwini18a.pdf

Chen, G., Gao, Y., Chen, X., & Yang, Y. (2020). Adaptive learning and assessment based on learning styles using deep learning. *Journal of Educational Computing Research*, 57(6), 1447-1466. DOI:10.1186/s41239-021-00289-4

Chen, L.C., Chen, Y.H., & Huang, Y.M. (2019). The effects of web-based formative assessment on self-regulated learning and learning performance in a mathematics course. *Computers & Education*, 133, 43-55. DOI:10.1007/s11423-021-10071-y

Chan, C. (2023). *Is AI Changing the Rules of Academic Misconduct? An In-depth Look at Students' Perceptions* of 'AI-giarism'.

https://www.researchgate.net/publication/371347082_Is_AI_Changing_the_Rules_of_Academic_Misconduct_An_In-depth_Look_at_Students'_Perceptions_of_'AI-giarism'

Chaudhry, Muhammad & Kazim, Emre. (2021). Artificial Intelligence in Education (AIEd): a high-level academic and industry note 2021. *AI and Ethics*, 2. 1-9. DOI:10.1007/s43681-021-00074-z

Darling-Hammond, L., & Adamson, F. (2010). Beyond basic skills: The role of performance assessment in achieving 21st century standards of learning. *Stanford Center for Opportunity Policy in Education*. DOI: 10.12691/education-5-5-12

Davis, R.E., Nichols, R.L., & Grant, J.F. (2019). Using artificial intelligence to develop and evaluate a competency-based assessment program in family medicine. *Academic Medicine*, 94(4), 557-563. doi: 10.1370/afm.2887

Foltz, P. W. (2013). Automated essay scoring: applications to educational technology. *Handbook of Research on Educational Communications and Technology*, 2, 169-181. https://www.researchgate.net/publication/239061100_Automated_Essay_Scoring_Applications_to_Educational_Technology

Gao, T., et al. (2020). A review of artificial intelligence applications in educational assessment. *Journal of Educational Evaluation for Health Professions*, 17: 27. DOI:10.36941/ajis-2021-0077

George, B., & Wooden, O. (2023). Managing the Strategic Transformation of Higher Education through Artificial Intelligence. *Administrative Sciences* , *13* (9), 196. MDPI AG. Retrieved fromhttps://doi.org/10.3390/admsci13090196

Han, S. (2018). Exploring the role of artificial intelligence in language assessment. *Language Testing*, 35(1), 37-55. https://doi.org/10.3390/languages8040247

Harlen, W. (2005). Teachers' summative practices and assessment for learning— tensions and synergies. *The Curriculum Journal*, 16(2), 207-223. https://doi.org/10.1080/09585170500136093

Hattie, J. (2009). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. Routledge. https://apprendre.auf.org/wp-content/opera/13-BF-References-et-biblio-RPT-2014/Visible%20Learning_A%20synthesis%20or%20over%20800%20Meta-analyses%20Relating%20to% 20Achievement_Hattie%20J%202009%20...pdf

Hendry, GD, Harper, BD, & Rahman, FM (2019). Using machine learning to detect cheating in online assessments. *Assessment & Evaluation in Higher Education*, 44(3), 360-372. DOI: 10.1371/journal.pone.0254340

Hoque, R., Sorwar, G., & Alzoubi, M. (2021). A Comprehensive Review of the Use of Artificial Intelligence in Education: Opportunities and Challenges. *Journal of Educational Technology & Society*, 24(2), 110-123. DOI: 10.3390/diagnostics13010100

Kahng, J., & Cho, K. (2019). The applications of artificial intelligence in educational assessment. *Journal of Educational Evaluation for Health Professions*, 16: 31. DOI:10.29322/IJSRP.13.03.2023.p13536

Kordzadeh, Nima & Ghasemaghaei, Maryam. (2021). Algorithmic bias: review, synthesis, and future research directions. European *Journal of Information Systems*. 31. 1-22. DOI:10.1080/0960085X.2021.1927212

Kovanović, V., Joksimović, S., Gašević, D., & Hatala, M. (2015). Analyzing and predicting learning achievements in online courses with symbolic and subsymbolic methods. *Journal of Computer Assisted Learning*, 31(3), 268-286. https://doi.org/10.1016/j.iheduc.2015.06.002

Kumar, V., & Boulanger, D. (2020, October). Explainable automated essay scoring: Deep learning really has pedagogical value. In *Frontiers in education* (Vol. 5, p. 572367). Frontiers Media SA. Retrieved from osf.io/fxvru .

Kunnath, S.R., Gupta, S., & Srivastava, S. (2020). *Automated essay scoring using natural language processing techniques: A systematic review*. IEEE Access, 8, 200322-200335. doi: 10.1007/s10462-021-10068-2

Lee, A.S., Babenko, O., George, M., & Daniels, V. (2023). The promises and perils of remote proctoring using artificial intelligence. *Canadian medical education journal* , *14* (2), 173–174. https://doi.org/10.36834/cmej.74229

Muthmainnah & Seraj, Prodhan & Oteir, Ibrahim. (2022). Playing with AI to Investigate Human-Computer Interaction Technology and Improving Critical Thinking Skills to Pursue the 21st Century Age. *Education Research International*. 2022. 17. 10.1155/2022/6468995.

Nitko, A. J. (2001). *Educational assessment of students (2nd ed.)*. Upper Saddle River, NJ: Merrill. https://www.scirp.org/(S(351jmbntvnsjt1aadkposzje))/reference/referencespapers.aspx?referenceid=2411143

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic Analysis: Striving to Meet the Trustworthiness Criteria. *International Journal of Qualitative Methods* , *16* (1). https://doi.org/10.1177/1609406917733847

Owoc, M. L., Sawicka, A., & Weichbroth, P. (2019, August). Artificial intelligence technologies in education: benefits, challenges and strategies of implementation. In *IFIP International Workshop on Artificial Intelligence for Knowledge Management* (pp. 37-58). Cham: Springer International Publishing. DOI:10.1007/978-3-030-85001-2_4

Rauh, C., Heyder, A., & Maier, R. (2018). The potential of adaptive educational technologies: An empirical study of personalized e-learning. *Journal of Educational Technology & Society*, 21(3), 1-13. https://www.jstor.org/stable/e26458500

Riduwan. (2015). *The scale of measurement of research variables. Alphabet*. https://opac.perpusnas.go.id/DetailOpac.aspx?id=716954

Salvia, J., & Ysseldyke, J. (2007). *Assessment in special education: A practical approach*. Boston, MA: Houghton Mifflin. https://www.researchgate.net/publication/230853249_Assessment_in_Special_and_Inclusive_Education

Schmidhuber, J. (2015). Deep learning in neural networks: An overview. *Neural networks*, 61, 85-117. https://doi.org/10.1016/j.neunet.2014.09.003

Schneider, E.F., Lang, A., Shin, M., & Bradley, S.D. (2019). Investigating the use of artificial intelligence in standardized medical assessments. *Academic Medicine*, 94(11S), S74-S81. http://repo.darmajaya.ac.id/4143/1/Artificial%20Intelligence%20in%20Medical%20Imaging_%20Opportunities%2C%20Applications%20and%20Risks%20%28%20PDFDrive%20%29.pdf

Shabani, M., & Borry, P. (2018). Rules for the ethical use of digital data in human research. *In Ethical Aspects of Research with Human Subjects*, (pp. 113-129). DOI: 10.1038/s41431-017-0045-7

Rios-Campos, Carlos & Cánova, Elva & Zaquinaula, Irma & Zaquinaula, Hilda & Castro Vargas, Daniel & Peña, Willam & Idrogo, Carlos & Arteaga, Rayber. (2023). Artificial Intelligence and Education. *South Florida Journal of Development*. 4. 641-655. 10.46932/sfjdv4n2-001.

Stiggins, R. (2005). From formative assessment to assessment for learning: A path to success in standards-based schools. *Phi Delta Kappan*, 87(4), 324- 328. http://68.77.48.18/RandD/Phi%20Delta%20Kappan/Assessment%20FOR%20Learning%20-%20Stiggins.pdf

Stiggins, R. (2007). Assessment through the student's eyes. *Educational Leadership*, 64(8), 22-26. https://www.researchgate.net/publication/237491140_Assessment_Through_the_Student's_Eyes

Stowe, R., Sammons, M., Sibert, J. L., & Vincent, R. (2020). Remote Proctoring: An Examination of Utilizing Artificial Intelligence and Assessment Literacy to Ensure Academic Integrity in Online Assessments. *Journal of Educators Online*, 17(2), n2. https://www.thejeo.com/archive/2020_17_2

Zawacki-Richter, Olaf & Marín, Victoria & Bond, Melissa & Gouverneur, Franziska. (2019). Systematic review of research on artificial intelligence applications in higher education - where are the educators?. *International Journal of Educational Technology in Higher Education*. 16. 1-27. 10.1186/s41239-019-0171-0.