The Effect of Artificial Intelligence in Improving Student Achievement in High Schools

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Abstract. Artificial Intelligence (AI) is a process for shaping human thinking styles so that they can design machines to behave like humans or also known as Cognitive Tasks, namely from information data that has been programmed to make machines able to do work like what humans are doing automatically. The research objective is to see how influential Artificial Intelligence is in increasing student achievement, especially in senior high schools. This problem utilizes a quantitative approach with survey models and in-depth interviews. The research survey used by researchers is online based using the Google Form Platform. The results of this study explain that Artificial Intelligence can assist teachers in creating students who excel in learning, especially at the high school level. The conclusion of the research is the Effect of Artificial Intelligence at the Senior High School level in Improving Student Achievement, that is, with the help of Artificial Intelligence Technology, it helps teachers achieve student competency in the teaching and learning process and students can also improve achievement in the learning process. The limitations of this study are that researchers only conduct research on the influence of Artificial Intelligence in improving student learning achievement at the upper secondary level only, the researcher hopes that the next researcher will be able to conduct the same research but at a higher level.

Keywords: Artificial Intelligence, Achievement, Influence

1   Introduction

Information Technology, which is becoming increasingly widespread, has become a necessary part in all sectors and aspects of life, both in the economic, business and even educational spheres [1], [2]. This occurs due to adjustments to people's needs in seeking information which can be helped by Information Technology. In everyday life, whether we realize it or not, we have applied artificial intelligence technology [3]. There are already many applications around us that are often used based on artificial intelligence such as video/music streaming, search engines, selfie features on smartphones, Global Positioning System (GPS), Video Games, and Social Media [4]. Educational institutions, especially high schools, are a place where a teaching and

learning process takes place. There are several important roles that teachers must play in providing education in the Industrial Revolution Era 4.0, firstly students are able to create jobs that do not currently exist, secondly prepare students to be able to solve problems that previously did not exist, and thirdly prepare students to be able to use technology .

Preparing students to be able to face changes from the Era of Social Revolution 4.0 to the Era of Social Revolution 5.0 is not an easy thing. Teachers must be able to rack their brains to find learning strategies that can facilitate students to progress and develop [5]. Currently, technological developments are used to make work easier and meet human needs. Apart from providing benefits in the field of information and communication, this technological development also provides benefits in the educational aspect [6], [7]. Educational Technology is a derivative of the abstract elements of humans, ideas, machines and management [8]. So in that case, this educational technology can be understood as a solid and unified process that includes people, methods, ideas, tools and bodies to analyze cases, find ways to solve a problem, carry out solutions to cases that are currently happening, test and work on which includes all aspects of human learning. So this can help educators and students to create effective and efficient learning.

Today the use of ICT has become an inseparable part of human life [9], [10]. Various forms of human life have been affected by the existence of ICT developments ranging from individuals to government agencies. In addition, ICT can advance the transition of human civilization from the industrial era to the information age [11], [12]. Information and Communication Technology or commonly abbreviated as ICT is technology that is commonly used in the process of obtaining, compiling, storing and managing data or information in order to produce accurate, relevant and timely data for individuals and community groups [13], [14]. As human intelligence increases, ICT also continues to develop with the creation of the latest technology to solve problems that occur. The more this information technology develops, the more innovation will be obtained [15], [16]. So that the role of IT is often used as a form of support for learning, both for lessons at school or for self-learning.

Artificial Intelligence is a part of Information Technology that exists as a form or way to improve student achievement [17], [18]. Artificial Intelligence or commonly abbreviated as AI is an application and instructions that are connected to computer programming to be able to do something that in the human view is intelligent or can be understood as a lesson on how to make computers able to do things that are currently done better than humans, who did it [19], [20]. The foundation and installation of Artificial Intelligence is very broad, including in the field of education. Learning using this AI system is learning that has been modified so that it can improve learning achievement and student focus. This is because AI has the advantage of teaching students individually and marking the desired problem to find the correct and appropriate way of teaching students using artificial intelligence technology.

Learning by utilizing the function of AI is personalized learning (learning that adapts to student needs) so that it can improve student learning experiences and make students better understand a subject matter [21], [22]. Increasing student focus in learning is one form of the role of AI in individual systems. This is because the ability possessed by AI is that it can teach students to learn individually and be able to recognize the surrounding environment needed to find the right way of learning for stu-

dents through this artificial intelligence. So, it can improve student achievement during the teaching and learning process in the classroom, especially at the senior high school level. For example, if this technology knows what makes us interested in an object, then that object will be used as an example to make it easier to understand the subject matter.

Artificial Intelligence can identify what methods make it difficult for students to understand the lesson in progress [23]. So that later AI can get used to finding new ways to help teachers in student learning to more easily understand the lesson material given by the teacher and students will become more enthusiastic during the learning process, because if students don't understand the lesson it will make the students bored. was in class [24]–[26]. Blackboard, which is one of the tools in the educational sector which is usually used in schools and universities. Professors use this online platform to publish the notes they make, apart from that there are quizzes and several tests, because it is hoped that this will enable students to raise problems and assignments to complete the assessment. This can make it easier for students to access lesson materials and assignments given by the teacher. AI can also find out the reasons behind students' lack of understanding in understanding the subject matter taught by educators.

Based on the results of relevant research related to this study conducted by Luh Putu Ary Tjahyanti, Putu Satya Saputra, Made Santo Gitakarma in their article entitled The Role of Artificial Intelligence to Support Learning during the Covid-19 Pandemic, they said that Artificial Intelligence does not always have a negative impact that can replace human role. Even though there are human jobs that will be replaced by AI, Artificial Intelligence will also have a positive impact on humans, such as increasing human abilities and making what we are doing get better results. Meanwhile, in the article entitled The Important Role of Artificial Intelligence in Developing Learning Methods for Students in Indonesia, written by Raihana Astagisa et al (2022), they conclude that the role of Artificial Intelligence really supports the process of developing educational technology and is useful in developing learning methods.

The reason researchers took research with this title was because many students did not know where their interests and talents were in a lesson, students did not understand the learning methods provided by educators, and students had no interest in their lessons. Therefore, researchers here try to review the importance of the role of Artificial Intelligence in the field of education. Can using AI at the high school level improve student learning achievement? So that students know where their interests are directed (such as in terms of choosing a college and what major they will study after graduating from high school), students can also easily understand the lessons and be interested in these lessons. That is why researchers want to show the influence of Artificial Intelligence in improving student learning achievement at the high school level.

2 Methods

The research method used is a quantitative survey model research method, which uses online-based Google forms and in-depth interviews with teachers and students. Research using this quantitative method is a process of discovering knowledge by using data in the form of numbers as a tool to find out information about what is being researched [27], [28]. Researchers try to understand and describe the understanding that can be obtained from the survey process between researchers and the subjects who will be interviewed. Researchers use analysis from sources so that researchers can understand what actually happened. By utilizing the basic theoretical basis that is owned, researchers can focus more on the truth that occurs in the target field. In this study, we did not ask detailed questions, but the questions given to the subjects were general questions first, after that they were done, then the subjects were provoked to talk as a whole.

This method has a deductive thinking pattern, by knowing a phenomenon and using general concepts to explain a special phenomenon [29], [30]. By using this quantitative method, it is hoped that researchers can find clues to the problem being researched in depth and comprehensively. The aim of conducting research is to obtain results from the research process carried out by means of interviews so that researchers can obtain clear information in their observations. In this method, researchers use data analysis techniques using numbers and quantities in their research. Researchers used the online method directly with Google Form and WhatsApp. This technique was chosen because researchers can get more accurate and concrete information about subjects who directly experience the process.

In this research, there needs to be an observation carried out by the researcher, namely in order to get a realistic picture of the influence of Artificial Intelligence in improving student learning achievement. Capturing the truth cannot only be done by researching one subject, but it is also necessary to approach many people, because each person has a different view. This makes researchers unable to capture the truth in a broad and detailed manner. Therefore, in research the data received is data analysis, this is what causes the research results obtained from research results using quantitative methods to have the possibility of experiencing changes. Thus, in this study researchers conducted a survey by giving online questionnaires to teachers and students for data collection, by asking questions related to the influence of AI in improving student learning achievement at the high school level.

3 Results And Discussion

3.1 Results

The results obtained after conducting observations in Senior High Schools concluded that Artificial Intelligence is very influential in Senior High Schools in improving student learning achievement. Effective learning will be created with the right methods provided by teaching staff to students with the support of the right media, with a good relationship between the two, it will certainly be possible to produce students

who excel. Therefore, the aim of Artificial Intelligence is to help students and teachers during the learning process. Apart from that, it is to find out errors in a learning method given by the teacher to students so that students do not understand the lessons explained by the teacher. Therefore, the researcher here asked several questions to respondents, both teachers and students, in order to strengthen the research being researched by the researcher. Researchers distributed questions online, namely by using Google forms. This is proven by the percentage obtained at 67.9 which shows that the criteria for agreeing is that many respondents agree with the existence of Artificial Intelligence at the Senior High School level. Details can be seen in the following image.

Table 1. Table of respondent answers.

No	Assessment Aspects	Strongly agree	agree	Don't agree	Disagree	Criteria
1	AI can determine the direction of student interest at the high school level	34,6%	58%	2,5%	4,9%	agree
2	AI makes students interested in the lesson	30,9%	61,7%	2,5%	4,9%	agree
3	AI can look for errors in a learning method	23,5%	67,9%	1,2%	7,4%	agree
4	AI helps students improve their achievement in learning	28,4%	58%	6,2%	28,4%	agree
5	The use of AI is required at the High School level	32,1%	61,7%	-	6,2%	agree
6	AI makes it easier for students to understand the lessons given by the teacher	34,6%	59,3%	1,2%	4,9%	agree
7	With AI, it can identify behind students' lack of understanding in lessons	27,2%	61,7%	2,5%	8,6%	agree
8	AI helps students obtain answers to assignments given by teachers	30,9%	65,4%	2,5%	1,2%	agree
9	AI makes it easier for students to find study material	33,3%	58%	2,5%	6,2%	agree
10	The existence of AI can reduce students' interest in reading textbooks	28,4%	54,3%	11,1%	6,2%	agree
11	AI replaces the role of teachers as student	21%	55,6%	9,9%	13,6%	agree

No	Assessment Aspects	Strongly agree	agree	Don't agree	Disagree	Criteria
	educators					
12	Using AI can increase student productivity in lessons	29,6%	60,5%	6,2%	3,7%	agree
13	AI can increase stu-dent creativity	35,8%	55,6%	4,9%	3,7%	agree
14	AI can minimize student errors in les-sons	27,2%	60,5%	4,9%	7,4%	agree
15	AI's way of linking what students like with the subject matter makes students under-stand more and are enthusiastic about learning	32,1%	56,8%	3,7%	7,4%	agree

These results show that Artificial Intelligence is a factor that cannot be ignored in a quality learning process. From the data obtained, it can be concluded as follows: it illustrates that the responses were based on 81 people, both students and teachers, who were examiners and assessors in this research. Based on the results of respondents seen in the table above, many agree that AI can find errors in a learning method, getting the highest percentage of 67.9% which is included in the agree criteria. They are of the opinion that with help from AI they can find out what the problems are during This makes it difficult for students to understand the explanations given by teachers to students. The second highest evaluation result for AI which can help students find answers to assignments given by the teacher, obtained a percentage of 65.4% which is also included in the agree criteria. By using AI students can search for lesson material and help answer assignments. assignments he got from the teacher. The third highest evaluation result was that many respondents chose to agree that AI makes students interested in the lesson and can find out what is behind the student's lack of understanding in the lesson, getting a percentage of 61.7%. Therefore, a teacher should be able to utilize the role of AI in the teaching and learning process, because both teachers and students are helped by Artificial Intelligence.

Meanwhile, among the many respondents who chose to agree with the use of AI which could have an influence in improving student learning achievement at the high school level, there were also respondents who thought that the use of AI would reduce students' interest in reading books, because they were of the opinion that if it already existed their technology no longer requires books and no need to summarize the lesson material given by the teacher, there were 54.3% who agreed with this statement. According to researchers, this can be prevented by providing control from teachers to students. If teachers can control or maximize the use of AI with students well then interest in reading will not decrease. So it can be concluded that AI has a big impact in improving student learning achievement and its use at the high school level is really needed, because it can also make it easier for teachers during the teaching and

learning process and create fun learning for students so that it becomes more effective and efficient.

3.2   Discussion

As a factor that can be an influence in improving the quality of education, the use of technology which is always developing has also had a lot of influence on the learning process. The benefits of technology in the world of education are to support learning so that it can produce the desired achievements. The application of technology in education today is like exams using computers, where students usually take exams using paper answer sheets, but now with the development of technology they can answer exams using computers and with that the teacher doesn't bother to assess the student's answers, because with technology can assess student answers automatically according to what has been programmed. On the other hand, if the students take the exam using a computer, no paper is wasted afterwards and the teacher doesn't have any trouble carrying the students' answer papers, which are certainly not small, so that the students' answer papers don't get scattered.

The emergence of new ways of learning that can make the learning process easier for students and teachers. With technological advances, new methods will certainly be created and with these technological advances it is hoped that students will be able to more easily understand correctly material that is still abstract in nature. Learning that previously had to be face-to-face between teachers and students, with technological developments the learning process does not have to bring teachers and students together, but can be carried out by utilizing internet services such as now which use zoom, meet, etc. Apart from that, students' learning resources are not only from teachers, but with internet services, students do not need to be dependent on information obtained from teachers, students can access study material directly from the internet. Therefore, teachers not only act as teachers, but also as guides for their students so that they do not use technology in a negative direction.

The use of Artificial Intelligence is one option to support or assist teachers in the learning process, and the final result is expected to improve student learning achievement. If the use of Artificial Intelligence can be done optimally, it will provide the best benefits for students. This means that learning will obtain perfect results or quality if it is carried out in accordance with applicable regulations. If it is not carried out in accordance with the applicable provisions, there will be a negative impact on both teachers and students. As is known, Artificial Intelligence is useful for increasing students' intelligence and helping teachers carry out effective and efficient learning activities. AI has indeed had many positive impacts in improving students' learning achievements, but it also needs to be underlined that technology can never replace the role of a teacher because its function is only as a tool of assistance.

Artificial Intelligence has several important roles in education: 1) Virtual Mentor, this can provide or assist students in finding material and answering practice questions, for example Blackboard. 2) Voice Assistant, allows students to search for various study materials, reference questions, articles or books just by providing keywords. 3) Smart Content, an example of the technology is Cram101 which functions to make a book into a more specific summary as needed. 4) Presentation Translator, the same as Voice Assistant, only this Presentation Translator can explain a text into the de-

sired language. 5) Global Courses, with this students can search for or take courses online from all over the world. 6) Automatic Assessment, using this can make it easier for teachers to prepare and hold quizzes easily and practically. 7) Personalized Learning, allows students to get services like a personal assistant [31]–[33]. Thus it can be seen that the use of AI at the high school level is very influential in increasing student achievement.

According to the research results of Joupy et al in their article 'Utilization of Artificial Intelligence Technology in Facing Teacher Teaching Challenges in the Digital Era,' increasing the effectiveness of teaching and learning will increase by utilizing Artificial Intelligence technology in the current digital era. Teachers can develop their teaching strategies by using the insights provided by AI, teachers can receive information about their teaching material that is more relevant to effective teaching techniques [34]. So that students get an optimal learning experience because analyzing student data, teaching strategies, providing recommendations, and providing personalized learning will improve student learning achievement. Therefore, AI is very beneficial for both teachers and students, especially high school students.

Fig. 1. example of Artificial Intelligence

The image above is an example of an application commonly used by students to help with the learning process, namely the photomath application called E-Learning AI. E-learning Artificial Intelligence is one form of assisting in solving mathematical problems, the E-Learning learning method is one of the many learning systems that is appropriate for students because it can help students add information systematically through learning activities about the concepts being studied. By using this photomath students can solve math problems with accurate explanations step by step explained clearly just by using the rear camera on a smartphone, with this students will be more helped in solving math problems and make students not bored in learning mathematics because students look at this mathematics is a science that is difficult to understand and boring. Apart from that, it is an alternative learning media in solving integral problems. Every process displayed by this application makes it easier for students to get answers to the problems they are looking for.

Technology has an important role in changing the learning process. Human activities have become easier with increasingly advanced technological developments. However, many people do not realize that this technology has the potential to replace the role of humans. However, technology is very helpful, one of which is in the field of education. There are several roles of technology in education, including: 1) learning becomes easier and more practical, for example students can submit assignments online using Google Classroom [35], [36]. 2) Learning can be more fun and can increase student learning competition, namely by utilizing various free platforms on the Internet with online game applications. 3) Expanding students' horizons, because students can look for references or study guides through online applications such as e-Books so they don't just rely on available books. It can be concluded that technology has a positive impact in the world of education if it is used well and if it is developed appropriately, for this reason teachers should provide learning innovations to students during the teaching and learning process.

4   Conclusion

The results of this research reveal that this technology is not only used or exploited in the economic, political and business spheres, but the technology has developed into educational aspects. The very fast influence of technology and science also has positive and negative impacts. The positive impact of the development of science and technology is that information and knowledge is increasingly spread and opened throughout the world and makes education very easy to implement in any condition. If the development of this technology is not controlled properly, negative impacts will arise, such as changes in behavior, ethics, rules or morals of life that conflict with existing norms in society. To address this, the role of education is very important to develop the positive impacts of technology and improve the negative impacts of technology, so that it can produce outstanding students.

Artificial Intelligence is a part of Information Technology that exists as a form or way to improve student learning achievement. Artificial Intelligence (Artificial Intelligence) is a technology that can assist teachers during the learning process and help students to better understand the subject matter, be interested in the lesson, search for subject matter and help answer assignments given by the teacher. However, even though AI helps teachers a lot in the learning process to create outstanding students, AI will not be able to completely replace the role of a teacher, AI's job here is only to help teachers, not replace teachers' duties. Artificial Intelligence that is used optimally will provide optimal benefits for students. So that it can increase the intelligence of students and help educators in obtaining an effective and efficient learning atmosphere that is liked by students.

References

1. E. Tjoa and C. Guan, "A Survey on Explainable Artificial Intelligence (XAI): Toward Medical XAI," *IEEE Trans. Neural Netw. Learning Syst.*, vol. 32, no. 11, pp. 4793–4813, Nov. 2021, doi: 10.1109/TNNLS.2020.3027314.

2. Y. K. Dwivedi *et al.*, "Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy," *International Journal of Information Management*, vol. 57, p. 101994, Apr. 2021, doi: 10.1016/j.ijinfomgt.2019.08.002.

3. M. R. Lunn *et al.*, "A digital health research platform for community engagement, recruitment, and retention of sexual and gender minority adults in a national longitudinal cohort study——The PRIDE Study," *Journal of the American Medical Informatics Association*, vol. 26, no. 8–9, pp. 737–748, Aug. 2019, doi: 10.1093/jamia/ocz082.

4. A. Radic *et al.*, "Apocalypse Now or Overreaction to Coronavirus: The Global Cruise Tourism Industry Crisis," *Sustainability*, vol. 12, no. 17, p. 6968, Aug. 2020, doi: 10.3390/su12176968.

5. N. Haefner, J. Wincent, V. Parida, and O. Gassmann, "Artificial intelligence and innovation management: A review, framework, and research agenda☆," *Technological Forecasting and Social Change*, vol. 162, p. 120392, Jan. 2021, doi: 10.1016/j.techfore.2020.120392.

6. N. Schwalbe and B. Wahl, "Artificial intelligence and the future of global health," *The Lancet*, vol. 395, no. 10236, pp. 1579–1586, May 2020, doi: 10.1016/S0140-6736(20)30226-9.

7. Y. Ma, Z. Wang, H. Yang, and L. Yang, "Artificial intelligence applications in the development of autonomous vehicles: a survey," *IEEE/CAA J. Autom. Sinica*, vol. 7, no. 2, pp. 315–329, Mar. 2020, doi: 10.1109/JAS.2020.1003021.

8. L. Chen, P. Chen, and Z. Lin, "Artificial Intelligence in Education: A Review," *IEEE Access*, vol. 8, pp. 75264–75278, 2020, doi: 10.1109/ACCESS.2020.2988510.

9. T. Hussain, K. Muhammad, A. Ullah, Z. Cao, S. W. Baik, and V. H. C. De Albuquerque, "Cloud-Assisted Multiview Video Summarization Using CNN and Bidirectional LSTM," *IEEE Trans. Ind. Inf.*, vol. 16, no. 1, pp. 77–86, Jan. 2020, doi: 10.1109/TII.2019.2929228.

10. D. Siswanto, G. Priyandoko, N. Tjahjono, R. S. Putri, N. B. Sabela, and M. I. Muzakki, "Development of Information and Communication Technology Infrastructure in School using an Approach of the Network Development Life Cycle Method," *J. Phys.: Conf. Ser.*, vol. 1908, no. 1, p. 012026, Jun. 2021, doi: 10.1088/1742-6596/1908/1/012026.

11. A. Y. Q. Huang, O. H. T. Lu, and S. J. H. Yang, "Effects of artificial Intelligence–Enabled personalized recommendations on learners' learning engagement, motivation, and outcomes in a flipped classroom," *Computers & Education*, vol. 194, p. 104684, Mar. 2023, doi: 10.1016/j.compedu.2022.104684.

12. A. Barredo Arrieta *et al.*, "Explainable Artificial Intelligence (XAI): Concepts, taxonomies, opportunities and challenges toward responsible AI," *Information Fusion*, vol. 58, pp. 82–115, Jun. 2020, doi: 10.1016/j.inffus.2019.12.012.

13. M. Mustak, J. Salminen, L. Plé, and J. Wirtz, "Artificial intelligence in marketing: Topic modeling, scientometric analysis, and research agenda," *Journal of Business Research*, vol. 124, pp. 389–404, Jan. 2021, doi: 10.1016/j.jbusres.2020.10.044.

14. N. Ameen, A. Tarhini, A. Reppel, and A. Anand, "Customer experiences in the age of artificial intelligence," *Computers in Human Behavior*, vol. 114, p. 106548, Jan. 2021, doi: 10.1016/j.chb.2020.106548.

15. X. Chen, H. Xie, and G.-J. Hwang, "A multi-perspective study on Artificial Intelligence in Education: grants, conferences, journals, software tools, institutions, and researchers," *Computers and Education: Artificial Intelligence*, vol. 1, p. 100005, 2020, doi: 10.1016/j.caeai.2020.100005.

16. S. J. H. Yang, H. Ogata, T. Matsui, and N.-S. Chen, "Human-centered artificial intelligence in education: Seeing the invisible through the visible," *Computers and Education: Artificial Intelligence*, vol. 2, p. 100008, 2021, doi: 10.1016/j.caeai.2021.100008.

17. X. Shu and C. Xu, "Artificial Intelligence-Based English Self-Learning Effect Evaluation and Adaptive Influencing Factors Analysis," *Mathematical Problems in Engineering*, vol. 2022, pp. 1–9, Oct. 2022, doi: 10.1155/2022/2776823.

18. I. A. Akour, H. Muhammad Alshurideh, H. M. Alzoubi, M. T. Alshurideh, and Y. Ahmad Antouz, "Integrating Artificial Intelligence in Improving Educational System: The Mediating role of Smart Learning," in *2023 International Conference on Business Analytics for Technology and Security (ICBATS)*, Dubai, United Arab Emirates: IEEE, Mar. 2023, pp. 1–5. doi: 10.1109/ICBATS57792.2023.10111284.

19. S. Zhang and X. Chen, "Applying Artificial Intelligence into Early Childhood Math Education: Lesson Design and Course Effect," in *2022 IEEE International Conference on Teaching, Assessment and Learning for Engineering (TALE)*, Hung Hom, Hong Kong: IEEE, Dec. 2022, pp. 635–638. doi: 10.1109/TALE54877.2022.00109.

20. Y. Chen, "The Impact of Artificial Intelligence and Blockchain Technology on the Development of Modern Educational Technology," *Mobile Information Systems*, vol. 2022, pp. 1–12, Jul. 2022, doi: 10.1155/2022/3231698.

21. T. Jiang, W. Li, J. Wang, and X. Wang, "Using Artificial Intelligence-based Online Translation Website to improve the Health Education in International Students," in *2021 2nd International Conference on Artificial Intelligence and Education (ICAIE)*, Dali, China: IEEE, Jun. 2021, pp. 25–28. doi: 10.1109/ICAIE53562.2021.00012.

22. X. Dong, X. Huang, and M. Lin, "Application of Data Mining Technology in Public Welfare Sports Education in the Era of Artificial Intelligence," *Mobile Information Systems*, vol. 2021, pp. 1–13, Nov. 2021, doi: 10.1155/2021/8692292.

23. M. Chassignol, A. Khoroshavin, A. Klimova, and A. Bilyatdinova, "Artificial Intelligence trends in education: a narrative overview," *Procedia Computer Science*, vol. 136, pp. 16–24, 2018, doi: 10.1016/j.procs.2018.08.233.

24. X. Chen, H. Xie, and G.-J. Hwang, "A multi-perspective study on Artificial Intelligence in Education: grants, conferences, journals, software tools, institutions, and researchers," *Computers and Education: Artificial Intelligence*, vol. 1, p. 100005, 2020, doi: 10.1016/j.caeai.2020.100005.

25. M. Jones (Colbourn), "Applications of artificial intelligence within education," *Computers & Mathematics with Applications*, vol. 11, no. 5, pp. 517–526, May 1985, doi: 10.1016/0898-1221(85)90054-9.

26. S. J. H. Yang, H. Ogata, T. Matsui, and N.-S. Chen, "Human-centered artificial intelligence in education: Seeing the invisible through the visible," *Computers and Education: Artificial Intelligence*, vol. 2, p. 100008, 2021, doi: 10.1016/j.caeai.2021.100008.

27. G. R. Bauer and A. I. Scheim, "Advancing quantitative intersectionality research methods: Intracategorical and intercategorical approaches to shared and differential constructs," *Social Science & Medicine*, vol. 226, pp. 260–262, Apr. 2019, doi: 10.1016/j.socscimed.2019.03.018.

28. D. Strijker, G. Bosworth, and G. Bouter, "Research methods in rural studies: Qualitative, quantitative and mixed methods," *Journal of Rural Studies*, vol. 78, pp. 262–270, Aug. 2020, doi: 10.1016/j.jrurstud.2020.06.007.

29. M. Chassignol, A. Khoroshavin, A. Klimova, and A. Bilyatdinova, "Artificial Intelligence trends in education: a narrative overview," *Procedia Computer Science*, vol. 136, pp. 16–24, 2018, doi: 10.1016/j.procs.2018.08.233.
30. L. I. Kelley-Quon, "Surveys: Merging qualitative and quantitative research methods," *Seminars in Pediatric Surgery*, vol. 27, no. 6, pp. 361–366, Dec. 2018, doi: 10.1053/j.sempedsurg.2018.10.007.
31. N. Ameen, A. Tarhini, A. Reppel, and A. Anand, "Customer experiences in the age of artificial intelligence," *Computers in Human Behavior*, vol. 114, p. 106548, Jan. 2021, doi: 10.1016/j.chb.2020.106548.
32. R. Hasan, R. Shams, and M. Rahman, "Consumer trust and perceived risk for voice-controlled artificial intelligence: The case of Siri," *Journal of Business Research*, vol. 131, pp. 591–597, Jul. 2021, doi: 10.1016/j.jbusres.2020.12.012.
33. M. Mustak, J. Salminen, L. Plé, and J. Wirtz, "Artificial intelligence in marketing: Topic modeling, scientometric analysis, and research agenda," *Journal of Business Research*, vol. 124, pp. 389–404, Jan. 2021, doi: 10.1016/j.jbusres.2020.10.044.
34. J. G. Z. Mambu, D. H. Pitra, A. R. M. Ilmi, W. Nugroho, and A. M. A. Saputra, "Utilization of Artificial Intelligence (AI) Technology in Facing Teacher Teaching Challenges in the Digital Era," vol. 06, no. 01, 2023.
35. H. Guo, "Computer and Information Technology Analysis of Internet Finance's Supporting Strategy for College Students' Innovation and Entrepreneurship," in *2020 International Conference on Applications and Techniques in Cyber Intelligence*, J. H. Abawajy, K.-K. R. Choo, Z. Xu, and M. Atiquzzaman, Eds., in Advances in Intelligent Systems and Computing, vol. 1244. Cham: Springer International Publishing, 2021, pp. 22–27. doi: 10.1007/978-3-030-53980-1_4.
36. F. A. Y. Mei and S. A. O. Liuqing, "Development of Intelligent School P.E.in the Era of AI," *J. Phys.: Conf. Ser.*, vol. 1684, no. 1, p. 012027, Nov. 2020, doi: 10.1088/1742-6596/1684/1/012027.