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Artificial Intelligence from the Perspective of High School Students

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Abstract
This study aimed to analyze the perception of 1st-year technical high school students in administration regarding the use of Artificial Intelligence (AI). Literacy in artificial intelligence (AI) has become essential in preparing students for a technology-driven world. AI can be defined as the ability of a computational system to perform tasks that would normally require human intelligence. The integration of AI in schools, with adapted curricula and practical activities, is providing students with a solid understanding of AI concepts and preparing them for an increasingly technological and challenging future. To analyze the results, perceptron neural networks were used, with the importance of AI for performance and knowledge as a dependent variable. For this, a questionnaire containing 24 questions was administered to 37 1st-year technical high school students in administration from a federal education network unit in the state of São Paulo, Brazil. The results indicate that predictors based on student responses suggest that students consider AI as complementary and could be used for team learning. They highlight that AI can contribute to organizing individual studies and, finally, emphasize that AI can be applied in technical and educational disciplines. The prohibitions of use, concerns about data security and the automatic dissemination of hate speech information were highlighted.

Keywords: Artificial intelligence; Educational Performance; Gender Inequality.

1. Introduction

Artificial Intelligence (AI) has increasingly played a significant role in education, preparing students for a constantly evolving digital world. Recent studies have explored the integration of AI in high school, aiming to develop essential skills such as computational thinking and to promote a solid understanding of AI concepts (Abdelsalam, 2014). The literature highlights the importance of introducing scientific elements into the school curriculum, especially at an opportune time such as high school, when students are mature enough to handle complex problems (McCarthy et al., 1956).

Assessing students' performance concerning computational thinking and AI knowledge is crucial for understanding their progress and identifying areas for improvement (Smith, Brown, & Jones, 2018). Furthermore, a hands-on approach to teaching AI, such as using interactive games and platforms like Scratch, has proven promising in engaging students and enhancing their understanding of AI principles and applications (Alimisis, 2019).

Given this context, this study aimed to analyze the variables that relate to the perception of the importance of AI for the performance and knowledge of technical high school students. The methodology adopted in this study involved the application of a questionnaire validated by experts to analyze the variables that relate to the student's perception of performance and knowledge about Artificial Intelligence (AI). The questionnaire contains questions about the use of AI, understanding of concepts, and other relevant variables, and was validated by three experts in the fields of Business Administration, Production Engineering, and

Education. The selection of a class of first-year students in the integrated technical course of business administration at a federal educational institution in the State of São Paulo, Brazil, allowed us to evaluate that students prefer to use AI complementarily and are concerned about data security and dissemination of hateful information.

2. Literature Review

Artificial Intelligence (AI) literacy is increasingly crucial in contemporary education, preparing students for a technology-driven world (Ali et al., 2019). The literature emphasizes the importance of introducing AI concepts from a early age. Belpaeme et al. (2018) emphasize the role of social robots in education, while Boden (2004) discusses creativity in the AI era. Buolamwini & Gebru (2018) address gender inequalities in automatic classification; furthermore, Gordon et al. (2015) explores children's curiosity in interaction with social robots.

Artificial Intelligence can be understood as the capacity of a computational system to perform tasks that would normally require human intelligence. One of the renowned authors who contributed to the development of AI is Minsky, 1968, a pioneer in this field. Minsky was a computer scientist and co-founder of the MIT's Artificial Intelligence Laboratory, and his contributions were fundamental to the advancement of AI (Minsky, 1968). Creating a timeline, Alan Turing proposed the famous "Turing Test" in 1950, which assesses the ability of a machine to exhibit intelligent behavior equivalent to or indistinguishable from that of a human (Turing, 1950). Another relevant concept is that of John McCarthy, who coined the term "Artificial Intelligence" in 1956, during the Dartmouth Conference, referring to the ability of machines to perform tasks that require human intelligence (McCarthy et al., 1950).

The implementation of AI curricula in primary and secondary schools has shown promising results. Students demonstrated the ability to understand complex ethical concepts, such as bias in facial recognition algorithms (Ali et al., 2019). Alves-Oliveira et al. (2017) highlight the co-creation of creative robots with children, while Ali et al. (2019) propose the use of social robots as tools to support creativity.

A point of concern is " automatic gender inequality", which refers to situations where algorithms or Artificial Intelligence systems demonstrate gender bias automatically, often due to biased training data that reflects existing gender inequalities in society. This can result in discriminatory or unfair decisions based on a person's gender, such as in employment selection processes, credit granting, or even in facial recognition systems which may perform variably depending on the person's gender (Buolamwini & Gebru, 2018).

However, the broad dissemination of knowledge and application of scientific reasoning is essential in technologically advanced societies (Estevez et al., 2019). The early introduction of scientific elements into the school curriculum is crucial, and high school is an opportune time, as students are mature enough to deal with complex problems. Distrust in science is a common problem, highlighting the need for a change in the way younger generations are introduced to science and technology (Estevez et al., 2019).

In recent years, the integration of artificial intelligence (AI) and emerging technologies such as virtual reality (VR) and augmented reality (AR) in educational settings has received significant attention (Southgate et al. 2019).

For Alonso (2020), Artificial Intelligence (AI) has become a strategic and prominent technology in our daily lives, impacting various sectors of society. In this context, teaching Explainable Artificial Intelligence (XAI) to high school students plays a crucial role in training capable and ethical future professionals.

The theory of multiple intelligences (Gardner, 1993) highlights the importance of carefully developing all intelligences through education, training, or experience. Following this path, one of the strategies proposed and implemented by Alonso (2020) was to develop interactive workshops that are effective in introducing XAI concepts to high school students. The results of this practical approach, with activities in Scratch (a programming language created by the Massachusetts Institute of Technology) and interactive games, allowed students to understand the principles that expose AI more tangibly. Additionally, collecting qualitative feedback from participants and teachers contributed to the continuous improvement of the program.

The teaching approach using Scratch presents to be a promising strategy to educating high school students about the principles and applications of AI. Through practical activities and simple exercises, students can develop a solid understanding of AI and its potential (Estevez et al., 2019).

In this eclectic mix of tools and options, there is a fusion of techniques and approaches that complement each other. It is worth emphasizing that one tool does not exclude the other; AI can be used complementarily to the traditional educational environment. As indicated by Castaneda, Cechonu & Bautista (2017) and Causo et al. (2016), who highlighted the potential of AI and robots as educational companions and tutors.

Thus, it is inaccurate to suggest that robots and machines will replace face-to-face classe; both will exist and complement each other. However, regarding the method, Alimisis (2009) reinforces a more constructivist approach and highlights the importance of actively involving students in the learning process. Practical activities, such as programming exercises, building robots, and group discussions, are essential to consolidate knowledge in AI. Furthermore, the introduction of intelligent agents, as described by Russell & Norvig (2009), provides students with a relevant context based on their previous experiences in robotics competitions.

Gocen & Aydemir (2020) emphasized the importance of developing intelligent tutoring systems based on domain learning principles. The study highlighted the potential benefits of AI in personalizing learning experiences for students. Furthermore, Asimov (2004) discussed the ethical implications of AI in his work "I, Robot", raising concerns about the impact of AI on human society.

Canbek (2020) explored the concept of Artificial Intelligence Leadership and its relevance in the context of Industry 4.0. The study highlighted the role of AI in transforming managerial practices and decision-making processes. Moreover, Chang & Lu (2019) investigated student participation in personalized learning against the backdrop of AI emphasizing the potential of AI to enhance individualized learning experiences.

This trajectory can be confirmed by Southgate (2019), who, from a bibliometric review of studies from 2013 to 2018,

showed that educational tools powered by AI can provide learning experiences tailored to the individual needs of students. Virtual reality (AR) and augmented reality (AR) technologies offer immersive and interactive learning environments that can enhance the understanding of complex concepts. In this way, the promising role of artificial intelligence and emerging technologies in transforming teaching and learning practices in schools stands out. Although there are challenges, such as access to technology and teacher training, the potential benefits of AI, VR and AR in education are substantial.

Abdelsalam (2014) revealed that academics, legal professionals, specialist engineers, and teachers generally had a positive view of AI developments in the education sector. Although concerns were raised about the potential drawbacks of AI, such as privacy and security issues, participants recognized the benefits of AI in improving teaching processes and the quality of education.

According to the author mentioned above, the distribution of percentages of benefits and drawbacks by different groups indicated varied perspectives on the use of AI in education. Specialist engineers expressed a high level of confidence in the benefits of AI systems, while teachers and academics showed a more balanced view of the advantages and disadvantages of integrating AI into education.

A study conducted by Alimisis (2019) consisted of implementing an Artificial Intelligence (AI) course in a high school, involving nine students with prior knowledge of robotics. The weekly classes, taught by university researchers, covered topics such as problem solving, search, planning, graphs, data structures, automata, agent systems, and machine learning. The quantitative and qualitative assessment revealed that students acquired a solid understanding of AI concepts, recognizing the growing importance of this area and demonstrating confidence in the topics addressed, which suggests the success of the pilot course and the feasibility of integrating AI into high school education.

Another aspect that arises is the evaluation of AI performance as a contribution to learning in various areas. Computational thinking is an essential skill in today's digital world, crucial for solving complex problems and making informed decisions. Assessing performance in computational thinking is crucial to understanding students' progress in this area and identifying areas for improvement (Smith, Brown, & Jones, 2018).

The assessment of computational thinking has been a growing topic of interest in educational literature. According to Wing (2006), computational thinking involves skills such as problem decomposition, pattern recognition, abstraction, and algorithm design. The use of multiple-choice questions in assessing computational thinking has been discussed by several authors such as Smith et al. (2018), who reinforces the importance of well-designed questions that address different aspects of computational thinking, such as problem solving and algorithmic thinking.

Smith et al. (2018) evaluated computational thinking through a set of multiple-choice questions covering the different components of computational thinking. The questions were applied to a sample of 100 high school students, aged between 15 and 17 years old. The results of the quantitative assessment showed significant variation in student performance across the different areas of computational thinking. On average, students showed greater ease in problem decomposition and pattern recognition, while abstraction and algorithm design were identified as areas of greater difficulty. Additionally, a positive correlation was observed between performance on multiple-choice questions and performance in practical programming activities.

The integration of AI in education should be approached cautiously, considering diverse perspectives and potential implications for stakeholders. Future research should focus on developing robust AI systems that prioritize data privacy, security, and ethical considerations, to ensure the responsible use of AI in educational settings (Abdelsalam, 2014).

3 Methodology

This study was conducted on the first-year class of the integrated technical administration course at a federal educational institution in the State of São Paulo, Brazil, from March 4 to 13, 2023. The selection of the first year was to assess student perceptions in the initial years regarding the use AI concerning their performance. In this sense, the dependent variable "performance and knowledge" was used along with others factors as independent variables.

A Likert scale questionnaire was applied to measure this relationship, which represents a scale of attitudes and judgments (Likert, 1932), ranging from completely agree, agree, neutral, disagree and completely disagree. The instrument was validated by 3 experts, a PhD in Administration, a PhD in Production Engineering, and a PhD in Education. The questionnaire consists of 24 questions, including one related to the respondents' gender, frequency of AI use, number of computers at home, use of mobile phones over desktops and laptops, which AIs are most used, whether there is an understanding of the concept of AI, and finally, 18 other questions. The questions were developed based on the bibliographic study of this article.

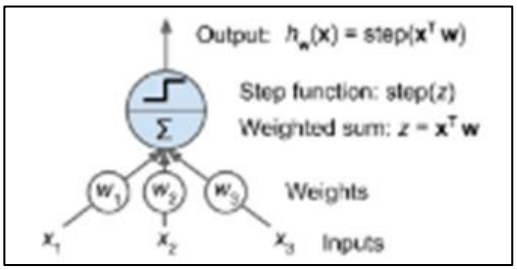
The construction of a questionnaire based on scales allows for various degrees of response. When summarizing these values, it is necessary to measure internal consistency to validate the constructs (George; Mallery, 2018). To evaluate internal consistency, Cronbach 's Alpha was used, with the index for multiple scales that must exceed 0.70 (Hair et al., 2009).

Perceptron Neural Networks were used, which is a simple artificial neural network model used for supervised learning of binary classification. It was originally proposed in 1957 by Frank Rosenblatt (Geron, 2017).

A Perceptron consists of one or more inputs, one or more neurons, and an output. Each input is multiplied by a weight, all weighted inputs are added, and the result is passed through an activation function to produce the neuron's output. The activation function usually uses a threshold to produce a binary output (Geron, 2017 & Sharma et al. 2022). According to Sharma et al. (2002), in more technical terms, a perceptron is a mathematical model consisting of multiple inputs (features), weights associated with these inputs, an activation function, and a linear combination function. During training, the perceptron 's weights are iteratively adjusted to minimize the difference between predicted outputs and actual outputs, allowing the perceptron to learn to correctly classify input data. Perceptrons are fundamental building blocks in more complex neural networks, such as multilayer neural networks, and play a crucial role in performing machine learning tasks such as classification and

regression.
According to Geron (2017), when training a perceptron, a set of labeled training examples is provided, and the perceptron adjusts its weights to minimize the difference between its predictions and the training examples labels. This is done by backpropagating the classification error and updating the weights via gradient descent.
To calculate the Perceptron, the formula proposed by Geron, (2017, p. 284) is used, as shown in Figure 1:

Fig. 1: Logical Boundary Unit.



Source: Géron (2017, p. 282)

Figure 1 represents the schematic of a simple artificial neuron, which is the basic building unit of artificial neural networks. The bottom part shows three layers, which would be input variables or signals that the neuron will process (questionnaire responses). Weights (*Bias*) are associated with these inputs. These are adjustable parameters during the network learning process. The function of the neuron is to calculate a weighted sum of these inputs, which is what the summation (Σ) is doing, resulting in an output z=x (importance ranking or predictions) (Geron, 2017).

$$Z = x1 * w1 + x2 * w2 + x3 * w3 \quad (1)$$

After calculating the weighted sum, this value is passed through an activation function to produce the neuron's final output. In this particular diagram, the activation function is referred to as a "step function" (step(z)). Activation functions determine whether a neuron is activated or not based on the weighted sum of the inputs. In the case of the step function, if the weighted sum reaches a certain threshold, the output will generally be 1, indicating that the neuron has been activated; otherwise, the output will be 0, indicating that the neuron has not been activated. The output is then marked as hk (x), which is equal to step(z), or the result of applying the step function to the z value. This output can then be used as input to another neuron in a more complex network.
Equation 2 represents the Perceptron learning rule, also known as the weight update rule. In this equation, the components have the following meanings:

$$w_{i,j}^{(next\ step)} = w_{i,j}^{(r)} + \eta\left(y_j^{(r)} - \hat{y}_j^{(r)}\right)x_i^{(r)} \quad (2)$$

Being:
$w_{i,j}$: is the weight of the connection between the 1st input neuron and the 1st output neuron.
• X_I : is the input value of the current training instance.
• y_j : is the output of the j output neuron for the current training instance.
• y_j : is the target output.

This equation describes how the weights of connections between neurons are adjusted during Perceptron training. If the output of the output neuron does not match the desired output, the connection weights are updated to reduce the error. This process is repeated for multiple training instances until the network reaches a state where errors are minimized, and the network can make more accurate predictions.
This learning rule is essential for the effective functioning and training of Perceptron and other artificial neural networks (Gèron, 2017). To support the calculations of this study, the statistical software SPSS 25 ®, owned by IBM, was used.

4 Results and Discussion
This research included 37 high school students from the technical administration course, with 23 (62%) females and 14 (38%) males. Regarding AI usage, 18 (49%) students rarely use it, 5 (13.5%) use it weekly, 5 (13.5%) daily, 4 (10.5%) monthly and 5 (13.5%) do not use it at all. Concerning the most used AI, 26 students indicated ChatGPT, 1 mentioned LuzIa, 1 used Pictory, 3 used ChatGPT and LuzIa and 6 did not use AI.
Cronbach 's Alpha index was used to validate the questionnaire, which in multiple scales should exceed 0.70 (Hair et al., 2009) , with values above 0.81 showing almost perfect consistency (Landis; Koch, 1977). The index for this study's questionnaire was 0.818, demonstrating almost perfect consistency, as shown in Table 1.

Table 1: Cronbach 's Alpha.

Cronbach 's alpha	Cronbach 's alpha based on standardized items	N of items
0.810	0.818	17

Source: Own preparation, 2024

To classify the importance of predictors in relation to the critical zone, Artificial Neural Networks (ANN) were used. ANNs resemble the biological functioning of neurons with inputs, which are processed in the hidden layer and generate *outputs* (Géron, 2019). ANNs are used in machine learning, therefore utilizing two groups: training and testing, learning and testing. For the training group, the following parameters were used:

Table 1: Partitions of Artificial Neural Networks.

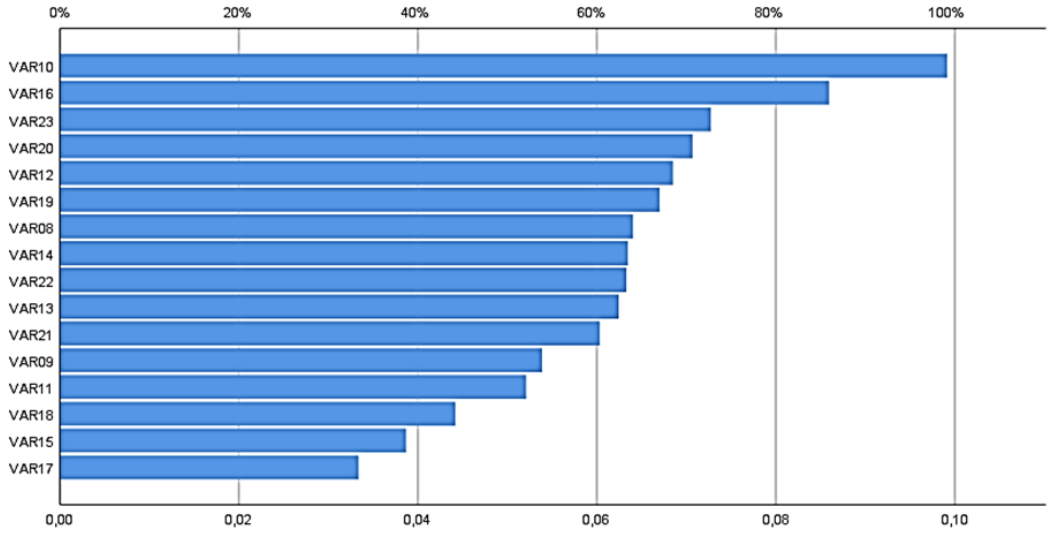
Partition	Relative Number	%
Training	7	70
Test	3	30
Total	10	100

Source: Own elaboration based on SPSS 25 ®

Decisions are formed by certainty and uncertainty when evaluating paraconsistent fuzzy logic, which accepts degrees of belief and disbelief in the same proposition, differentiating it from classical logic (Andrade, Reis & Amorim, 2021). There is always a bias to be considered in the Decision-Making. To estimate the lowest level of error, simulations must be done with the variables to analyzed which model is the best in the ANNs. In this study, the error of incorrect training predictions was 0%, and for testing, it

was 20%. After rounds of variable exclusion to check for the best fit, maintaining all variables represented the best model adjustment. Graph 1 shows the normalized importance of the model, representing the predictive classification of variables in the model, i.e., the variables that influence the recognition of AI in performance and knowledge.

Graph 1: Normalized Importance of the Model.



Source: Prepared based on SPSS 25® Tests.

To analyze the variables, those representing more than 60% of the model were considered, classified by order of importance as VAR.10, VAR16, VAR23, VAR20, VAR12, VAR19, VAR08, VAR14, VAR22 and VAR13. Table 2 presents the description of the variables.

Table 2: Main Factors for Student Retention.

Variables	Importance	Meaning
Var10	0.099	Could learn more with group activities and discussions with the application of AI to aid learning
Var16	0.086	Education systems should consider AI as a complementary teaching strategy
Var23	0.073	I'm terrified of thinking that AI could increase social inequality, due to the lack of accessibility and resources in Brazilian public schools.
Var20	0.071	AI's expertise in individualizing learning is important.
Var12	0.069	I believe there is a relationship between the use of AI and learning in common core curriculum subjects
Var19	0.067	The use of AI allows me to personalize my studies and helps answer my questions
Var08	0.064	If I had learned Artificial Intelligence early on, I would be better prepared for the workforce
Var14	0.063	The security of my data in AI is something that concerns me
Var22	0.063	I fear that AI could spread anger and hate, especially in matters of gender and xenophobia.
Var13	0.062	I believe AI would be more applicable to technical disciplines

Source: Own elaboration, 2024

The students believe that AI could be used as a complementary tool for team learning, as pointed out by Castaneda, Cechonu & Bautista (2017) and Causo et al. (2016), who demonstrate that AI can be used as "tutors".

Students expressed concern when comparing the resources of private institutions with public ones, especially regarding aspects of technology and digital literacy, as stated in Ali et al. (2019), where Artificial Intelligence (AI) is increasingly crucial in contemporary education, preparing students for a technology-driven world.

VAR 20 and VAR 19, which deal with the individual experience and customization of studies, confirm the study by Chang & Lu (2019), which identified student participation in personalized learning against the backdrop of AI, emphasizing the potential of AI to enhance individualized learning experiences.

VAR 12 and VAR13 indicate that AI can be used both in the common core and, with less force, in technical parts, meaning there is no distinction in the use of AI.

VAR08 indicates that students recognize that early learning promotes better conditions for entry into the workforce. According to Abdelsalam (2014), Artificial Intelligence (AI) has played an increasingly relevant role in education, preparing students for a constantly evolving digital world.

Regarding data security, VAR14, students pointed it out as an important classification criterion. In studies by Abdelsalam (2014), although concerns were raised about the possible drawbacks of AI, such as privacy and security issues, participants recognized the benefits of AI in improving teaching processes and the quality of education. Regarding the quality of education, this study did not notice a significant weight; the responses were more related to the individual and team learning format.

In VAR 22, what is said by Buolamwini & Gebru (2018) about the approach to Gender Inequalities in automatic classification is confirmed, by propagating existing information, AI predictors may replicate learning based on questioned experiences, thus redefining concepts in AI remains quite challenging.

5 Conclusion

We can conclude that Artificial Intelligence is a multidisciplinary field that seeks to develop systems and machines capable of performing tasks that would normally require human intelligence. The "Turing Test", proposed by Alan Turing, and the term "Artificial Intelligence", coined by John McCarthy, are significant milestones in the history and development of this field.

The discussion about ethics, governance, and education in Artificial Intelligence is also essential to ensure the responsible and beneficial use of these technologies. In this aspect, the application of Artificial Neural Networks (ANN) for first-year students in the technical high school presented a high degree of importance and a concern about the dissemination of knowledge that reinforces and propagates hatred. However, the focus expressed by the students was on the complementary use of AI, particularly in discussions and teamwork, followed by the possibility of support and organization of individual studies, which can be used in both propaedeutic and technical core.

In this way, the model presented highlights the teaching methodology as a driving force for the application of AI, which is implicit in the lesson plan, the moment in which the teacher determines the contents, methodological paths, and necessary resources. Thus, subverting the idea that AI is related to teacher training and the freedom of the chair to apply AI, provided the infrastructure is required.

References

1. Andrade, AG, de Amorim, FR, & dos Reis, NF (2021). Prospective Scenarios for Social Innovation. Research, Society and Development, 10(5), e35810515111-e35810515111.
2. Abdelsalam, A.M. (2014). A proposal model of developing intelligent tutoring systems based on mastery learning. *Third International Conference on E-Learning in Education*, 106–118.
3. Ali, S. et al. (2019). Leveraging social robots as a creativity support tool for young children. Conference on Creativity and Cognition.
4. Alimisis, D. (2009). Teacher Education on Robotics-Enhanced Constructivist Pedagogical Methods. School of Pedagogical and Technological Education.
5. Alonso, J.M. (2020). Teaching Explainable Artificial Intelligence to High School Students. *International Journal of Computational Intelligence Systems, 13*(1), 974–987. DOI: https://doi.org/10.2991/ijcis.d.200715.003
6. Alves-Oliveira, P. et al. (2017). Yolo, a robot for creativity: A co-design study with children. Proceedings of the 2017 Conference on Interaction Design and Children.
7. Asimov, I. (2004). *I steal*. New York: Bantam Books.
8. Belpaeme, T. et al. (2018). Social robots for education: A review. Science Robotics, 3(21).
9. Boden, M. A. (2004). The creative mind: Myths and mechanisms. Routledge.
10. Buolamwini, J., & Gebru, T. (2018). Gender shades: Intersectional accuracy disparities in commercial gender classification. Conference on Fairness, Accountability and Transparency.
11. Canbek, M. (2020). Leadership in Artificial Intelligence: Emulating the Managerial Roles of
12. Causo, A., Vo, GT, Chen, IM, & Yeo, SH (2016). Design of robots used as educational companion and tutor. In J. O. Gazeau, M. Labribi, & S. Zeghloul (Eds.), Robotics and Mechatronics (pp. 75-84).
13. Castaneda, L., Cechonu, A., & Bautista, A. (2017). All-school aggregated findings 2016-2017 – VR. Foundary 10. Retrieved from http://foundry10.org/wp-content/uploads/2017/09/All-School-Aggregated-Findings-2016-2017.pdf
14. Chang, J., & Lu, X. (2019, August). The study on students' participation in personalized learning under the background of artificial intelligence. In 2019 10th International Conference on Information Technology in Medicine and Education (ITME) (pp. 555- 558). IEEE.
15. Estevez, J., Garate, G., & Graña, M. Jr. (2019). Gentle Introduction to Artificial Intelligence for High-School Students Using Scratch. Computational Intelligence Group, University of the Basque Country. DOI: 10.1109/ACCESS.2019.2956136
16. Gardner, H. (1993). Multiple intelligences: The theory in practice. Basic Books.
    a. George, D.; Mallery, P. (2018). IBM SPSS Statistics 25 Step by Step. titles: SPSS for Windows step by step. Description: Fifteenth edition. | New York, NY: Routledge.
17. Géron, A. (2022). Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow. "O'Reilly Media, Inc."
18. Gocen, A., & Aydemir, F. (2020). Artificial intelligence in education and schools. Research on Education and Media, 12(1), 13-21.
19. Gordon, G. et al. (2015). Can children catch curiosity from a social robot? Proceedings of the Tenth Annual ACM/IEEE International Conference on Human-Robot Interaction.
20. Hair, JF, Black, WC, Babin, BJ, Anderson, RE, & Tatham, RL (2009). Multivariate data analysis. Bookman publisher.
21. Landis, J.R., & Koch, G.G. (1977). The measurement of observer agreement for categorical data. biometrics, 159-174.
22. Likert, R. (1932). A technique for the measurement of attitudes. New York: Archives Of Psychology.
23. McCarthy, J., Minsky, M. L., Rochester, N., & Shannon, C. E. (1956). A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence. AI Magazine, 27(4), 12- 14.
24. Minsky, M. (1968). Matter, mind, and models. In Semantic Information Processing (pp. 479- 501). MIT Press.
25. Russell, S., & Norvig, P. (2009). Artificial Intelligence: A Modern Approach. Pearson.
26. Sharma, K., Cerezo, M., Cincio, L., & Coles, P.J. (2022). Trainability of dissipative perceptron- based quantum neural networks. Physical Review Letters, 128(18), 180505.
27. Smith, J., Brown, A., & Jones, C. (2018). Assessing computational thinking in K-12: A systematic review. Journal of Educational Technology, 42(3), 345-362.
28. Southgate, E., Blackmore, K., Pieschl, S., Grimes, S., McGuire, J., & Smithers, K. (2019). Artificial Intelligence and Emerging Technologies in Schools. Research Report commissioned by the Australian Government Department of Education.

29. Turing, A. M. (1950). Computing Machinery and Intelligence. Mind, 49(236), 433-460.
30. Wing, J. M. (2006). Computational thinking. Communications of the ACM, 49(3), 33-35.