

Artificial Intelligence in Primary and Secondary Education: a Review of Educational Activities Development

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October 23, 2023



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Context

- **Intelligent systems** are an integral part of the society

Machines equipped with artificial intelligence are spreading

- Urgent need for citizens to have some **knowledge on AI**

AI left scientific obscurity to reach business world / public at large



Motivations

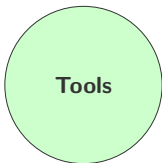
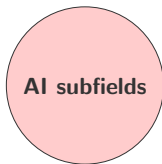
- AI processes are seen as a **blackbox** for many users

Justified reason to do so in consumer products since not trivial

- Need to **understand AI** at some level since we interact with it
 - Impacts, opportunities and limits on personal lives/society
 - Very big challenge in schools and for lifelong education
- Important to **build familiarity** with AI technologies
 - Understand and explain AI-related phenomena
 - Select and use the relevant AI-based tool for a given need
 - Like, fear, criticise... AI

Subfields, Tools and Activities

What areas of artificial intelligence are taught in schools?



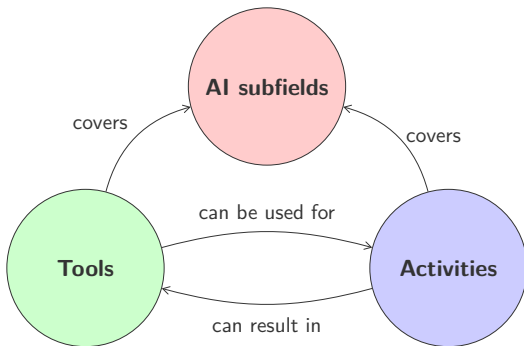
What specific tools are used to teach artificial intelligence in schools?



what types of activities are designed to teach artificial intelligence in schools?

Subfields, Tools and Activities

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what types of activities are designed to teach artificial intelligence in schools?

What to teach pupils?

Default (GPT-3.5)



You are a researcher in computer science education and you are doing research about teaching artificial intelligence in primary and secondary schools. Shortly, what would you advice to teach to young pupils?

What to teach pupils?



When teaching AI to young pupils, focus on:

1. **Basic Concepts:** Algorithms, Data, Machine Learning.
2. **Ethics:** Bias, Privacy, Transparency.
3. **Practical Applications:** Hands-on activities, Real-world examples.
4. **Problem-Solving:** Interactive challenges, Critical thinking.
5. **Collaboration:** Group projects, Discussions.
6. **Continual Learning:** Stay updated, Encourage curiosity.
7. **Assessment:** Quizzes, Feedback.
8. **Interdisciplinary Approach:** Connect with other subjects.
9. **Inclusivity:** Diverse representation.
10. **Creativity:** Explore AI in art and creativity.

How to teach pupils?



Thanks! And, shortly again, what kind of concrete activities would you organise in schools with pupils?

How to teach pupils?



Here are concise AI activities for students:

1. Algorithmic Puzzles
2. Data Collection & Analysis
3. Design a Chatbot
4. Bias Detection Exercise
5. Privacy Dilemmas
6. AI in Art or Music
7. Ethical Debates
8. AI in Everyday Life Hunt
9. AI-Assisted Storytelling
10. Societal Impact Projects
11. Robotics and AI Demos
12. Role-Playing Scenarios
13. AI Game Design
14. AI in Nature Exploration
15. Language Translation with AI

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Guide students in creating a simple chatbot that can respond to basic questions or prompts.

Have students collect simple data (e.g., favorite colors, pet types) and analyze it together.

Guide students in creating simple games that incorporate AI elements (e.g., decision-making NPCs).

Explore tools that generate story prompts or help in creative writing using AI.

Review

- Papers found on **widespread publishers** and search engine

ACM, IEEE, Springer, Google Scholar and MDPI

- **Four-step process** to obtain the examined papers

- 1 Initial set of papers obtained with a keyword search

"artificial intelligence K-12", "children teaching artificial intelligence"

"machine learning K-12", "activity to learn artificial intelligence children"

- 2 Relevant references from the first set have been examined

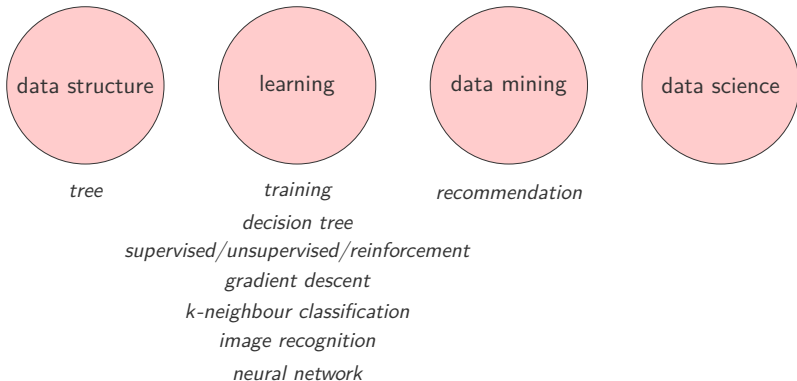
- 3 Only kept those published after year 2000

- 4 Only kept those with activities for children (≤ 18 y.o.)

AI Subfields

- **Four main subfields** of AI have been identified

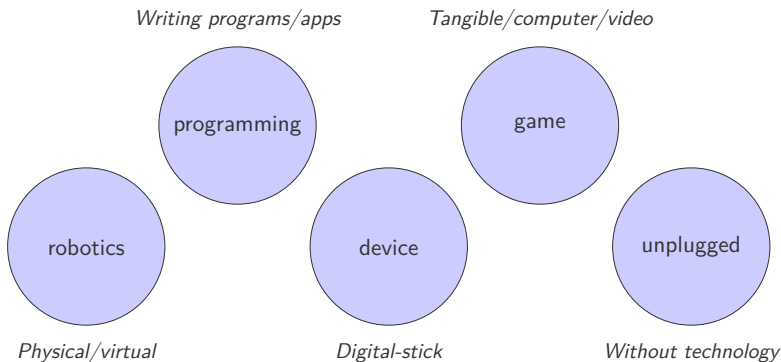
Classified based on the focus put in the designed activities



Activities

- **Five main categories** of activities have been identified

Classified based on the main mean used for the activity



Tools

- Only **a few tools** specific to the learning of AI are available
Except for tangible games or material for unplugged activities
- **Google Teachable Machine** used to create ML applications
Web-based tool to quickly create machine learning models
- **Adacraft** used to create programs with AI
Scratch-based extension compatible with ML extension blocks

Context

- **Three main kinds** of organised events have been identified

Classified based on the context where they are organised



Discussion

- **Machine learning** is the most popular subfield without surprise

Very large part of modern AI in broad public applications

- **Programming** physical/virtual objects is popular

And then unplugged activities but for younger pupils

- Organising activities during **workshops** is most frequent

Attract many people in short time, without need for curriculum

Conclusion and Future Work

- **Many fields** of AI can be taught with different activities

Still, not all subfields are covered by activities for pupils

- **Future work** will be conducted following up this research
 - Refining the analyses to take into account age groups
 - Building a database to make it possible to search for activity
 - Searching for tools and activities not covered by research

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- And integrate the **results obtained by ChatGPT** ;-)

Credits

- <https://www.rawpixel.com/image/5920124/photo-image-background-public-domain-hands>.
- John Tekeridis, May 3, 2018, <https://www.pexels.com/photo/round-grey-speaker-on-brown-board-1072851/>.
- Marco Verch Professional Photographer, September 14, 2020, <https://www.flickr.com/photos/30478819@N08/50341294687>.
- Sanket Mishra, April 18, 2023, <https://www.pexels.com/photo/webpage-of-chatgpt-a-prototype-ai-chatbot-is-seen-on-the-website-of-openai-on-iphone-or-smartphone-16461434/>.