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KIDS OF THE FUTURE

The ultimate guide to
teaching STEM education

Help kids step into a technological future

Children need to be better prepared in the STEM areas starting in the elementary years, in order to prepare them for careers in the future (Murphy, 2011; NRC, 2011, 2013a). It is therefore important that we start teaching children STEM early in the classroom, otherwise our future will lack creative and confident people who can make the world a better place.

STEM education changes society by providing children with a new mindset and skills that are valued in any profession. A STEM student doesn't need to be an expert in every specific subject, but rather needs to acquire a mindset that enables them to step confidently into their future.

"Education is the passport to the future, for tomorrow belongs to those who prepare for it today" (Malcolm X, 1964).



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age 5-6



“I want to create
things!”

Beginner




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This is my world

So many new experiences!

- My world is surrounded by technology and new experiences.
- I talk about different things that are in my own world. I also draw and play about my ideas and the things I feel.
- When someone reads a story, I can tell the difference between made-up and real. Afterwards, I can answer simple questions about it.
- I can count up to 10 and I can copy simple shapes, letters and numbers. I also know a lot of colors.
- I already use technology and the internet at home, like watching YouTube and playing games on touch screen devices. I also use electronic toys and the TV remote. When I have a question in my mind, I ask it to Alexa, which is a voice assistant (smart speaker).
- I can't recognise dangers online and I don't know how to use technology safely. Sometimes I use the iPad too long and then my parents tell me to do something else.

 42% have their own tablet.

 44% asks questions to their virtual assistant.

 96% uses video-sharing platforms.

 13,5 hrs of tv per week.

TECH I USE

- Ipad
- Electronic toys
- TV remote control
- Smart speaker (voice assistant)

WHAT DO I DO WITH MY TECH?

- I watch videos and TV programs.
- I play games.
- I interact with a smart speaker.

RISKS

- That I cannot recognise dangers online.
- That I don't know how to use technology safely.



What they should learn

THIS AGE GROUP SHOULD...

- Develop computational thinking by understanding that a task can be repeated by a computer.
- Realise that many devices and toys are a kind of computer.
- Develop ICT skills by working with a (touch) screen, mouse and keyboard.
- Get to know the layout of a keyboard.
- Gain experience by playing games and educational programs on various digital devices.
- Learn what programming is and basic programming principles, such as events and position.
- Understand that certain sequences have a logical order.
- Realise that they build technology with robotics. And being able to construct a robot with guidelines and making a simple program for it.
- Learn to handle digital devices carefully.
- Learn about media literacy; learning what the internet is, how to behave on the internet, being aware of the dangers of the online environment and how to use technology safely.
- Explore the internet in a secure environment.
- Develop information skills by learning to collect information from a digital source and judge whether the information found is sufficient. Also learning to present the information found.
- Become acquainted with different forms of media messages, such as text, pictures, audio and video clips.

WHAT SHOULD THEY KNOW?

- How to use technological devices
- Basic programming principles
- Creating technology through robotics
- Collecting information from a digital source
- How to behave online

WHICH HARDWARE?

- Touch screen devices
- Computer with mouse and keyboard

WHICH SOFTWARE?

- Web browser
- Scratch
- Educational games



How to teach them

It will give them a strong base of skills

Kids at this stage will be very receptive when you teach them technology through playing and creativity. Here is a list of the fundamental learning goals and a few tools you can use to deliver the new knowledge:

- Behave online. Kids at this stage will be exposed to chats for the first time. It is now the time to understand good manners online, be respectful and be secure. Using the explore functions of Scratch (MIT) will help you explain how to be respectful to others.
- Communication skills. Let them brainstorm and design their own technological creation and display their ideas in front of the class. A simple pencil and paper are the perfect tools to get them started with the creative process. When they have searched for information online, let them draw the answers they found.
- ICT skills. At this stage it's important that they get acquainted with different technological devices. Let them experience working with different devices such as an ipad and a computer by playing educational software, like Scratch.
- Be tech-creative. At this point of their lives they should understand how easy it is to create their own video game. Using Scratch is the best approach for them to understand the most basic programming skills and feel proud of how an idea went from paper to a screen. You can integrate programming with existings subjects, like Mathematics.
- Problem-solving skills. Creating a robot is a perfect way to understand how technology is something tangible. Robotics will challenge them in their creative process of designing, building and programming. LEGO Education packs (like WeDo 2.0., Spike or Mindstorms) can be the best tool to achieve this goal. In this phase it's important that kids learn from each other.

GIVING EXPLANATIONS

- Use words and examples they are familiar with.
- Teach new concepts step by step and give instructions one by one.
- Give fixed guidelines to help them through their creative process.

LEARNING FROM EACH OTHER

- Allow them to brainstorm in groups about a topic.
- Ask your students to teach each other in front of the class or with a one-to-one approach.

SPEAKING IN PUBLIC

- Let them present their projects in front of the whole class.
- Give them the opportunity to give feedback by saying that they like or dislike something.



TIP 1



Trial and error

“It’s easy to learn if you are open to it, but you have to make time and space for it.”



- Danique, elementary school teacher

Learn from experimenting

Learning about technology is easier and more intuitive than you might think. Don't worry about falling behind with your knowledge, because if you take the first step, the rest will flow naturally.

The trial and error method will help you learn to use technology and media through experimentation. It will give you the confidence to acquire more knowledge and skills. Here is an example of how you can use this method:

- Trial: take your time to use an application that you have never used before, Scratch, for instance. Scratch is a free object-oriented software development kit that allows you to create a program or game. It develops problem-solving skills and teaches you to start a project, divide it into sub-projects and finish it. Just explore Scratch, look at some projects, paste some coding blocks in the editor and see what happens.
- Error: remember it's good to make mistakes, because this is a way to discover and to learn where the boundaries are. You'll feel more secure and understand how to solve problems yourself first. And it will teach you how to enjoy trying and learning new things. Remember that you don't have to give your pupils answers to everything, because children can learn by investigating and they learn from others.



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age 7-9



“I find technology very
interesting!”

Competent




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This is my world


I'm excited to learn more things!

- I know the basics of the technology, but there is still so much more to learn.
- I talk about things I am familiar with, but I also learn things that go beyond my own world and experiences.
- I work and play together with other kids.
- I understand words and sentences in books, I write stories and I understand speech.
- I can count backwards, I know the difference between left and right and I know what time it is.
- I use technology daily, mostly to play online games on touch screen devices and gaming consoles, like Playstation, Xbox and Nintendo Switch. I also communicate with others in online games. And I ask more and more to a voice assistant like Alexa (smart speaker).
- I am aware of social media and I find it hard to tell the difference between deepfakes and the truth. If I come across a stranger in an online game who says bad words, I don't know how to react.

 35% have their own smartphone.

 47% have their own tablet.

 74% play games.

 27% have seen worrying content online.

TECH I USE

- Ipad
- Gaming consoles with a controller
- Smart speaker (voice assistant)

WHAT DO I DO WITH MY TECH?

- I play (online) games.
- I watch videos and TV programs.
- I interact with a smart speaker.

RISKS

- That I can't tell the difference between fake and the truth.
- That I encounter bad words and don't know how to react.



What they should learn

THIS AGE GROUP SHOULD...

- Develop computational thinking, so they understand how a computer works inside.
- Be familiar with the components of a computer with a mouse, keyboard and webcam.
- Type faster with a keyboard.
- Develop ICT skills by working with digital devices, software and applications.
- Gain experience by working with educational programs.
- Learn a new programming language and use it to create their own code.
- Learn the meaning of the term "algorithm" and learn to create a simple algorithm in a concrete situation with a predefined set of instructions.
- Be able to construct a robot with guidelines and make a program for it.
- Learn to be caring and have responsibility for hardware, programs and data.
- Learn about media literacy; how to behave on the internet, how to give feedback and learn how to safely handle the information shared with others online.
- Be aware of the importance of being careful when surfing the internet. Also learning to use secure passwords and understanding their importance.
- Develop information skills by learning to collect information from a digital source and make a selection from it. Also judging whether the information is useful and learning to distinguish between facts and opinions in digital information. And learn how to present their answers in an efficient and clear way.
- Realise the scope of media for communication. Also being aware that media are used intensively.

WHAT SHOULD THEY KNOW?

- Learning more functions of the computer and touch screen devices
- Discover a new programming language
- Creating their own robot
- Distinguish between facts and opinions in digital information
- How to behave online and having responsibility

WHICH HARDWARE?

- Touch screen devices
- Computer with mouse, keyboard and webcam
- Gaming consoles

WHICH SOFTWARE?

- Web browser
- Scratch
- Gaming platforms
- Powerpoint and Word
- Cloud software



How to teach them

It will help them to develop their skills

Kids at this stage will be very receptive when you teach them technology through experimenting and creativity. Here is a list of the fundamental learning goals and a few tools you can use to deliver the new knowledge:

- Being respectful online. Kids at this stage already chat with others in online games. Therefore it is important to learn how to be respectful online and how to give feedback. Using the explore functions of Scratch (MIT) will help you explain how to give feedback to others in a respectful way.
- Communication skills. Let them brainstorm and debate with others about a technological creation and present their ideas in front of the class. A pencil and paper will help them with brainstorming and visualising ideas. Let them collect and present the information found online with a drawing or a powerpoint. You can integrate this practice with existing subjects, like History.
- ICT skills. In this phase it is important that they can work with different digital devices. Let them work with different devices like an ipad, computer or gaming console by playing an educational game like Minecraft Education Edition or Roblox. They can also practice making a Word document.
- Programming skills. Kids at this stage should understand how to use their creativity to create their own program or game. Using Scratch is the best approach for them to understand programming skills and feel proud when they start and finish a project. CodePen is also a great tool for creating a program and seeing the results.
- Problem-solving skills. Creating a robot is a perfect way to understand technology. They have to think and debate about creative ways to solve a problem. LEGO Education packs (like WeDo 2.0., Spike or Mindstorms) can be the best tool to achieve this goal.

GIVING EXPLANATIONS

- Use examples they are familiar with. When the knowledge goes beyond their world, explain it with a story.
- Give instructions one at a time.
- Give clear guidelines to help them through their creative process.

LEARNING FROM EACH OTHER

- Allow them to brainstorm and debate in groups about a topic.
- Ask your students to teach each other in front of the class, in a group or with a one-to-one approach.

SPEAKING IN PUBLIC

- Let them present their projects in front of the whole class with an explanation of what they did and why they did it in a certain way.
- Give them the opportunity to give feedback by saying what they like or dislike.





Integrate

“Find a connection with existing subjects.”

- Edmée, teacher Education Assistant



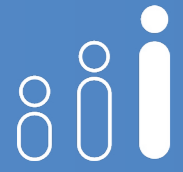
Integrate technology with other subjects

You do not need to invent a whole new curriculum, but integrate STEM with existing subjects that you already teach. That way, students will understand the whole context with technology in their daily lives. Here are some examples of how you can integrate STEM with existing subjects:

- Let students create an interactive presentation with buttons and images for History;
- Let students program a calculator on Scratch for Mathematics;
- Let them code something on the computer for English, because with coding you need to use grammar correctly;
- Let them search the answer to a question on the internet for Science;
- Ask them to make a virtual book with drawings made in art or to transform a hand drawing into a digital drawing in Scratch.



age 10-13



“I want to invent things!”

Expert




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This is my world


So many exciting challenges!

- Over the years, I have gained more confidence and knowledge about technology.
- I talk and learn about things that go beyond my own experiences. I can see from another person's perspective and I form opinions based on what I have heard.
- I learn in groups and sometimes I experience peer pressure.
- I use speech that is not necessarily literal and I use my tone of voice to communicate intentions.
- I follow written instructions and I can write about my ideas. I can also plan and deliver a speech.
- I use my smartphone a lot, especially for messaging, social media and video sharing platforms like Whatsapp, Instagram and Youtube. I also play games on gaming consoles and on the computer. And I sometimes ask a voice assistant on my smartphone when I have a question.
- I am not aware of the dangers when I spend too much time online. And when I am on social media, I might encounter a cyberbully and I don't know how to act.

 **83%** of 12-13 years have their own smartphone.

 **87%** uses social media apps/sites.

 **20,5** hrs online per week.

 **31%** have seen worrying content online.

TECH I USE

- Smartphone
- Computer with mouse, trackpad and keyboard
- Gaming consoles with a controller

WHAT DO I DO WITH MY TECH?

- I message friends.
- I interact with social media.
- I watch videos.
- I play games.
- I interact with a voice assistant.

RISKS

- That I spend too much time online.
- That I come across a cyberbully and don't know how to act.



What they should learn

THIS AGE GROUP SHOULD...

- Develop computational thinking by learning the advantages and disadvantages of performing tasks automatically.
- Form an image of common terms in relation to computers, such as network, wifi, router modem and cloud.
- Develop ICT skills by making assignments with digital devices, software and applications.
- Experience downloading, installing, reviewing and deleting apps.
- Have knowledge of three programming languages and use them to create a program.
- Being able to solve a problem by creating a reusable algorithm.
- Construct a robot with minimum guidelines and make a program for it.
- Be familiar with different file types and dealing with files on different storage media, such as saving, copying and sharing.
- Learn about media literacy; the dangers in the online environment, how to communicate online, how to give constructive feedback and how to share content safely.
- Be aware of the importance of having a secure profile on social networks. Also being able to create an 'account' for a program and working with secure passwords.
- Develop information skills by gathering information with a chosen search strategy. Also learning to judge whether the acquired information is useful, reliable and representative. And learn how to present their answers in an efficient and clear way.
- Realise the importance of digital technology in many areas of our society today and being aware of the importance of personal media skills.

WHAT SHOULD THEY KNOW?

- Making assignments with digital devices and software
- Programming an algorithm to solve a problem
- Creating an advanced robot with a program
- Using a search strategy to collect information
- Giving constructive feedback

WHICH HARDWARE?

- Touch screen devices, like a smartphone
- Computer with mouse, keyboard and webcam
- Gaming consoles

WHICH SOFTWARE?

- Web browser
- Social media
- Appstore
- File manager
- Scratch and CodePen
- Gaming platforms
- Powerpoint and Word
- Cloud software



How to teach them

It will help them to have a stronger self esteem.

Kids at this stage will be very receptive when you teach them technology through collaboration and experimenting. Here is a list of the fundamental learning goals and a few tools you can use to deliver the new knowledge:

- Giving feedback online. Kids at this stage use social media and it's important for them to understand how to communicate online and how to give constructive feedback. Doing an exercise in the explore functions of Scratch (MIT) will help you explain how to give constructive feedback to others. A role playing game is also a great way of understanding this.
- Working together. Let them brainstorm and debate with others to design a technological creation and let them present their ideas in front of the class. Pencils and paper are good tools for visualising ideas. Let them present the information found online with a powerpoint or poster.
- ICT skills. At this stage, it is important that they are able to use different digital devices to achieve a goal. Let them work with different devices such as a computer by playing an educational game like Minecraft Education Edition. They can also practice creating an account online.
- Programming skills. Kids should use their creativity to create their own program or game. Using Scratch and CodePen is the best approach for them to create their own project and feel proud of how an idea has developed.
- Creative thinking. Creating a robot is a great way to think of ways to solve a problem. They have to use their knowledge and creativity to find a solution. LEGO Education packs (like WeDo 2.0., Spike or Mindstorms) can be the best tool to achieve this goal. You can integrate robotics with existings subjects, like Mathematics.

GIVING EXPLANATIONS

- Give complete sentences and concrete terms when explaining a topic.
- Give an assignment into manageable tasks. And explain why they are going to make an assignment.

LEARNING FROM EACH OTHER

- Allow them to brainstorm, debate and create projects in groups.
- Ask your students to teach each other in front of the class, in a group or with a one-to-one approach.

SPEAKING IN PUBLIC

- Let them present their projects in front of the whole class with an explanation of what they did, why they did it a certain way and what they would do next time.
- Give them the opportunity to give constructive feedback by saying what they like or dislike and why.





collaborate

“You don’t have to know everything yourself, but you can explore together with your students.”

- Lieke, producer creative education



Collaborate with your students and colleagues

Don't think you need to know more about technology than your students. Children are already using technology, but it is important that they are prepared for the future and have a role model who provides a safe environment for them to experiment. Here are tips to help you work together:

- Ask your colleagues for help. Ask them to give you some knowledge or ask if they can teach a lesson to your students.
- Be honest with your students and tell them, for example, that you don't know much about a certain subject, but that you will learn and find solutions to a problem together during the lesson.
- Children learn from each other, so let them work together on an assignment, let them teach each other and give feedback. Giving feedback is very important and easy to develop while learning STEM.
- Remember that everyone has different skills in STEM. Some students like to build code and others are better at building something in 3D. It is good to have them working together so that they learn from each other's skills.



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