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In search of the code

Should children be taught computer programming and be exposed to high-tech at an early age? 'After reading, writing and arithmetic,' one expert stresses, 'it's important for kids to know programming'



A Day of Code event at Wix. Last year, 250,000 children took part in Israel.

Alan Tzatzkin

the subject as early as preschool or in elementary school. Or much later on? There is a wide range of opinions, both among parents, many of whom know next to nothing about programming and never studied computer science, and those in the know.

"Is it important for me that my kids learn how to program at a young age? Absolutely," says Yossi, an engineer at a large microchip firm who has two sons age 7 and 9. But Michal, a programmer with two daughters in elementary school, has a different view.

"No, it's really not important to me that they know about this subject at such a young age," she replies after thinking a moment – though both she and Yossi mention that they tried to interest their kids in programming, each via a different popular game, but without much success. Another mother says she prefers to distance her young children from technology and expose them to the outdoors.

Corin Degani

Three times a year, dozens of children flock to the Academic College of Tel Aviv-Yaffo. "Young Programmers' Day" attracts children and teenagers from the city, but many others arrive by bus from Jerusalem, Ramle, Lod and elsewhere around the country under the auspices of Educating for Excellence, a nonprofit group that aims to reduce socioeconomic gaps. The children learn computer programming, work with students from the college on projects, munch on pizza and present a code of their own to the other participants.

"They're thrilled by these experiences," says Amir Kirsh, a lecturer at the college's computer science school. "They also hear us say: 'We want you to come back here in the future as students.'"

Each day for programmers is designed for young people of different ages – sometimes as young as grades 1 through 4.

"It's enough that they can read just a little," says Kirsh, who teaches a course at the college on how to teach programming to children and teens. "The children see what the instructor is doing and start to play with the software, and suddenly something just happens. I tell them, 'There aren't many places where

Tzur of Wix: 'Coding can help children develop broader ways of thinking, creativity, problem-solving abilities, teamwork and feelings of being capable.'

you can ask for something and the other side will do exactly what you've asked for – like with a computer.' They see the fun in it."

The college's programming initiative, aimed at young people from Israel's social and geographic peripheries, is one of a number of similar projects around the country.

"There's a worldwide awakening to the notion of teaching programming to children, including in Brazil and Ghana, for example," says Hana Zimmerman-Karl, a vice president of pedagogy at RoboGroup, a global company specializing in technology education that has an Israeli branch in Rosh Ha'ayin. "Everybody is asking whether programming should be taught in school or only after school, how to train the teachers and in what. It's not a simple matter."

Parents are also beginning to wonder if their offspring should start learning

Robots as teachers

In July the Education Ministry announced a plan to introduce children from preschool through middle school to subjects on high-tech and computers. Curricula will emphasize scientific method and principles, along with programming. One goal is to address the serious shortage of high-tech employees.

"You might say that the school system should train more programmers because high-tech is our growth engine and because it offers terrific jobs," says Moran Tzur, an educational content developer and product manager at Wix, an Israeli software company that provides web development services.

"But that's not our approach. Coding can help children develop broader ways of thinking, creativity, problem-solving abilities, teamwork skills and also feelings of being capable, as in, 'I could be the one who will solve this problem.' Actually learning how to write lines of code on the computer is secondary."

Muhana Fares, recently appointed chief for technological education at the Education Ministry, is setting up teams to teach coding in schools. But until the ministry's plan to teach that subject in the early grades becomes operational,

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the decision on whether to acquaint children with the subject will remain with teachers and parents.

When dealing with young children, you don't even need a computer screen, says Zimmerman-Karl of RoboGroup "In kindergarten children can be familiarized with the principles of programming via a robot [such as Bee-Bot, or RoboGroup's Matatalab] that receives oral commands, or even via a game the teacher plays with them. The goal is to know how to give precise commands, because the computer is a golem, and if you don't tell it to lower its arm, it won't lower it. Another thing the children learn is that the order of actions is meaningful."

Two of the most popular lines of software available in Israel for teaching children programming are Code-Monkey, a game that was developed locally by the Center for Educational Technology, and Scratch, a programming language that was developed at the MIT Media Lab and has become a huge global success.

The language of Scratch is based on colored, Lego-like blocks, with each block being a coding command. By connecting the blocks, children write a code and can create things like animation, games and stories. They can also, for example, create characters for their projects or record the sounds they will use.

"Scratch is essentially different from other software," says Tzur, who was a research assistant at the Media Lab as part of her master's studies at MIT. "It doesn't work by means of riddles or predefined goals such as 'Let's make the monkey reach the banana via commands.' In Scratch, the children get an almost empty screen and come up with ideas on their own. They examine what works via the game with the blocks, which encourages trial and error."

Scratch, which started out as a small project in 2003, isn't only a program but has developed into an internet community that lets children share their projects with the click of a button, allowing others to see the projects' code, learn from it and respond.

"It's a very protected social network with a huge team that ensures this," Tzur says. "The gist of the project is always support for children's creativity and their empowerment. Today the lab at MIT is busy with the question of how to transmit the principles of creative learning with the software – how not to lose the educational approach in this story; for example, so the teacher won't ask the children to open the program and execute certain commands. The emphasis is on the approach, because software is only software."

At what age should they start? According to Zimmerman-Karl, "in kindergarten or in the lower grades; if a girl is already in a soccer group and has a coach who has taught her how to cooperate, that's an invaluable asset. Or if a boy doesn't succeed at something and has an instructor who gets him to try again and again, that too will help when it comes to programming.

"Most children today will be exposed to technology and to things related to programming. At a young age it's more important to extract from yourself everything that's good for you and that will make you grow. After reading, writing and arithmetic, one of the important things for kids is to know how to program.

Zimmerman-Karl: 'The goal is to know how to give precise commands, because the computer is a golem, and if you don't tell it to lower its arm, it won't lower it.'

"Children can be acquainted with the subject at a young age. They can be encouraged to experiment. Maybe they'll decide to come back to it later. A girl who learns how to program will look at the world not only as a technology user but will also know what's happening behind the scenes. Even if she chooses not to deal with it intensively, she'll know that it's not something beyond her grasp, simply that it doesn't interest her that much."

Tzur, for her part, believes it's good to learn about coding and programming as early as possible, but says "it needs to be coordinated. A child who can't yet read or write won't learn Python but rather ScratchJr, which is adapted for 5-year-olds. The underlying principles of the software are the same: I choose, I arrange, I decide what to do so the character will get to the edge or so the ball will enter the basket.

"It's important for children to understand that the computer is a machine – we tell it what to do, and it does it. The next skill that's learned is how to think about a problem – how to break it down into little problems, how to think systematically and how to solve it. And if we move ahead a bit – how I solve a problem in a way that will help others solve it. All these are skills related to computational thinking. I won't start teaching a girl of 3 about cyber [security], but I'll teach her that the computer is dumb and we're smart, and how she can influence the technology."

Wix is involved in Hour of Code, a global project designed to provide preliminary, accessible exposure to pro-

gramming. "We've created a site that concentrates everything you need to know in order to teach children about the activities of Hour of Code," Tzur says. "One week a year in Israel we mark Hour of Code, when everyone who wants to – teachers, parents, members of youth movements and so on – are invited to organize events linked to technology and programming. There are dozens of activities."

At the outset three years ago, Wix informed various organizations about the Hour of Code activities and "now they're contacting us and asking when Hour of Code will take place this year. Last time, 250,000 children took part, and the Education Ministry entered it big-time and helped publicize the events."

'Small distances, huge gaps'

But while parents in the center of the country are dithering over whether to send their children to an after-school programming or cybergroup, are the children in the outlying areas getting the same opportunities?

"In the Israeli periphery the distances from central Israel are small but the [social and educational] gaps are terribly large," says Sagy Bar, founder and general manager of the Cyber Education Center, founded by the Rashi Foundation. "Fewer computer tracks are offered in schools in outlying areas, and there are fewer knowledgeable teachers in the field of computers and fewer in high-tech [instruction]. If you aren't exposed to high-tech as a child, how can you imagine yourself in it?"

A major program run by Bar's center is Magshimim, which was developed in cooperation with the Defense Ministry and other entities including the National Cyber Directorate and the information and communications technology unit of the National Digital Israel Initiative. Aimed at youth in the geographic and social periphery, the project now attracts 1,700 students a year.

"The aim is to help them get to technological positions in the army and in high-tech," says Bar, noting that about 70 percent of Magshimim's graduates go on to do their military service in cyber and technology units.

"Two things happened along the way. We saw that in some places in the country's outskirts, starting such instruction in the 10th grade is too late, so we've launched a program designed for grades 8 and 9" – though he believes that children in grades 3 or 4 should study such subjects. "In addition, we launched a project for outstanding girl students where the atmosphere will be less competitive, after we realized that they would really rather work cooperatively."

Bar adds that local authorities in the center of the country are willing to pay to receive the Magshimim program, but he's not offering it to them, considering that there are already so many



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Scratch software. Not only a program, but now an internet community that enables children to share their projects. Hadar.horowitz

opportunities in Tel Aviv and in central Israel. "There are excellent schools in the center," he says. "We're interested in improving social mobility."

The Education Ministry has also launched a program making its mark in the outskirts, in computational thinking and robotics designed for grades 3 to 6. Around 32,000 children took part last year, including youngsters enrolled in special education. Fifty-two percent of the participants were girls, and about half were Arabic speakers.

"The program operates in all the communities: Druze, Arab, state-religious education, Bedouin – even among the ultra-Orthodox," says Hanuna Fares of the Education Ministry. The ministry has also joined forces to support another initiative, along with the Israel Advanced Technology Industries, the country's high-tech umbrella organization: the Israeli Cyber Championship, in which hundreds of thousands of students compete every year in programming and math assignments.

Last year the Education Ministry launched a new curriculum focusing on computer science and robotics for grades 4 to 12. It's expected to be adopted by about 50 schools this year, according to Avi Cohen, chief inspector of computer science at the Education Ministry. In addition, computer science is taught at about 350 middle schools (out of a total of about 1,000 nationally), divided more or less equally around the country.

"Relative to Europe, we're very advanced," Cohen says. "They focus more on teaching computer applications like



Moran Tzur. "I could be the one who will solve this problem."

Office. Here we focus on the hard core of the subject and we're working hard to develop thinking skills. Already in the senior year of high school, students submit projects based on machine learning, and in the near future on quantum computing. Later, instruction in these areas will also be made available to younger ages. One of our problems is a shortage of teachers in computer science. I hope that with time more teachers will undergo the necessary training."

Also working hard in the country's outskirts is Cyber School, a private business that offers programming and

cyberclasses from first grade through high school. Omri Sagron, founder and CEO of Highdele Holdings, acquired Cyber School about two years ago and moved its headquarters from Even Yehuda near Netanya to Carmiel in the Galilee. The move aimed to "increase the presence of cyber in the north," says Sagron, who is based in the Upper Galilee town of Kiryat Shmona.

Cyber School classes are available today around the country in school lessons underwritten by parents, in cooperation with community centers, and in extracurricular studies.

"We're in every school in Kiryat Shmona: primary, middle school and high school," Sagron says. "But also in other places in the north, in the center and in the south – Ashdod, Ashkelon and Be'er Sheva. If there are places that have a problem hiring our services, we help them find subsidies, because the courses are expensive."

Zimmerman-Karl says "Israel is in a superb place" in computer education, "even if the road ahead is still long." She notes that besides Magshimim and the Education Ministry's coding and robotics projects, many nonprofit groups are active in the outlying areas including QueenB, Alice Code and SheCodes.

Have the problems in the outskirts been solved?

"No," she admits, "but the periphery isn't being neglected. There are fewer people there in high-tech, but those who are there are trying very hard to address the subject."