

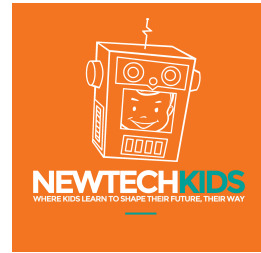
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# NewTechKids Report

## EU Code Week 2015 Teacher Training Pilot Program

Amsterdam, the Netherlands - December 2015

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## Executive Summary

NewTechKids is an Amsterdam-based startup on a mission to provide children in primary school with technology education (programming, computer science and technological literacy), beginning at age four. NewTechKids develops technology education pedagogy, teaching approaches, curricula and lesson plans which are delivered during school and as after-school activities.

In September and October 2015, NewTechKids partnered with TomTom, the Dutch technology company, to launch a pilot program aimed at creating a scaling model for technology education in primary schools. Specifically, this model engaged both primary school teachers and students around computational thinking and coding.

NewTechKids trained 75 primary school teachers from schools in Amsterdam and Delft to teach our 'Intro to Computational Thinking and Coding Concepts' lesson to students in groups one to four (ages four to seven) as part of EU Code Week 2015 activities. EU Code Week 2015 took place October 10-18.

NewTechKids organised these sessions, provided teacher training and supplied our lesson materials. TomTom covered our training fees so that the sessions were offered to teachers free of charge. The company also lent its headquarters as the training venue and provided staff volunteers for those teachers who requested extra, in-class assistance during the lesson.

The main goals of this pilot project were:

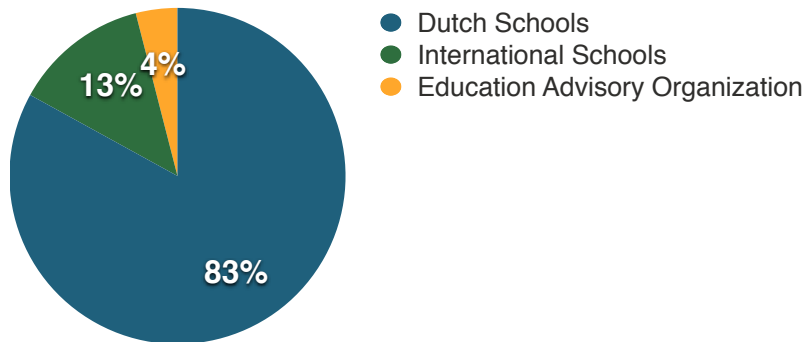
- to provide primary school teachers with hands-on experience in teaching computational thinking and coding concepts; and
- to introduce a critical mass of children to computational thinking and coding concepts as part of their formal schooling, rather than after-school activities, during EU Code Week.

Through this pilot program, NewTechKids successfully tested our scaling model. The 75 teachers we trained taught this lesson to approximately 2000 schoolchildren.



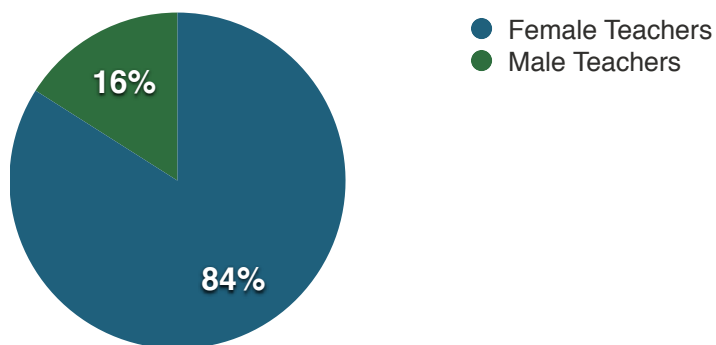
## Participating Schools

NewTechKids trained a mix of teachers from Dutch public schools and international private schools. Most of the international schools already offer ICT as part of their curriculum so it was encouraging that they chose to participate. NewTechKids also trained a representative from an education advisory organisation which trains teachers in various Amsterdam schools.



## Gender Breakdown of Participating Teachers

The majority of teachers who participated in the training pilot program were women: 63 as compared to 12 men. This reflects the high concentration of women as primary school teachers in the Netherlands and elsewhere. In NewTechKids' view, female teachers will play a key role in introducing computer science and programming education to primary school children. They should also be engaged in helping to eliminate the gender bias in technology education, beginning in the early school years.

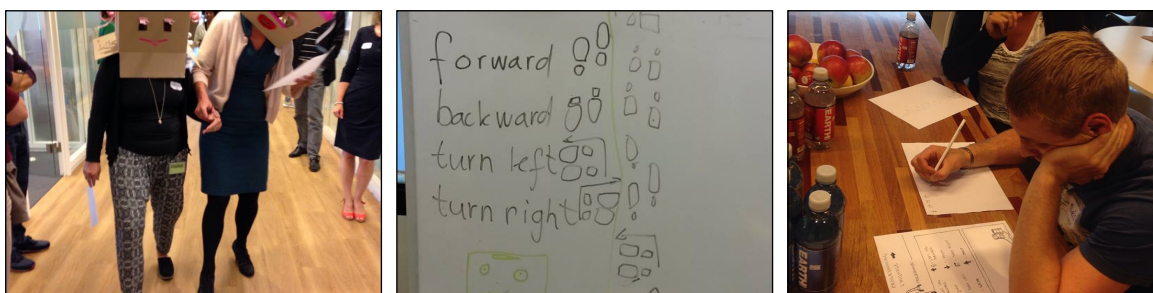


NewTechKids compiled data and feedback from participating teachers at three intervals during this pilot program via registration forms and anonymous surveys. This data and feedback is included in this report.

## Phase 1: Teacher Recruitment

NewTechKids used a combination of pre-invitations to teachers who participated in previous NewTechKids brainstorm sessions. Later, NewTechKids sent email invitations and made phone calls to school directors and heads of ICT.

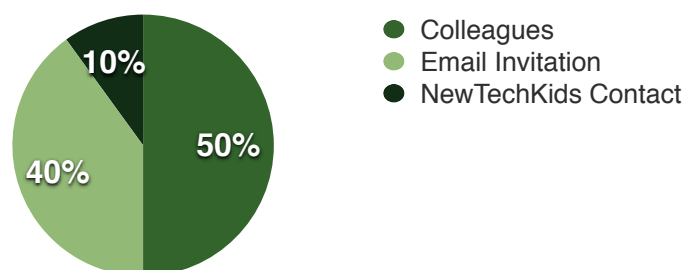
Teachers themselves were the most effective recruitment method as they recommended the training sessions to their colleagues. Direct communication with NewTechKids (email invitations and phone calls) was very important for recruitment, particularly since many schools had never heard of NewTechKids and our technology education specialisation before.



### Survey Results: Teacher Recruitment

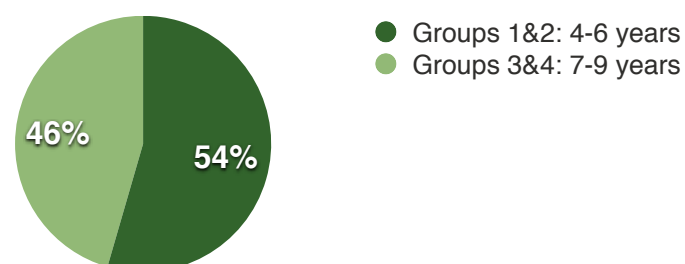
NewTechKids compiled the following data from the 75 teachers during the online registration process for teacher training.

#### How did you hear about NewTechKids' EU Code Week 2015 Teacher Training?

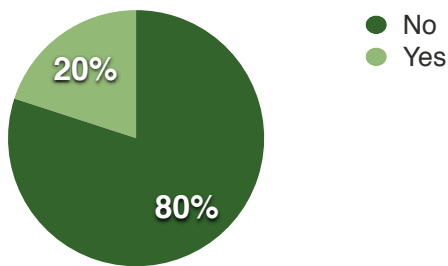


#### Age Range of Students

NewTechKids specifically targeted teachers of the lower primary school groups to introduce coding and computer science education in the first years of primary school.



## Prior Teaching Experience: Computational Thinking and Coding



## Phase 2: Teacher Training

Seventy-five primary school teachers participated in one of five training sessions, which took place between September 10, and 17, 2015. The sessions lasted two and a half hours and were taught in English by Dr. Marja-Ilona Koski, NewTechKids' Lead Teacher, who was assisted by Deborah Carter, NewTechKids Business Director.

During the sessions, NewTechKids introduced the basics of coding to teachers and shared information about its pedagogy and teaching approaches. The trainers then coached teachers on how to give NewTechKids' 'intro to computational thinking and coding concepts' lesson. The trainers did this by having the teachers complete the lesson themselves.

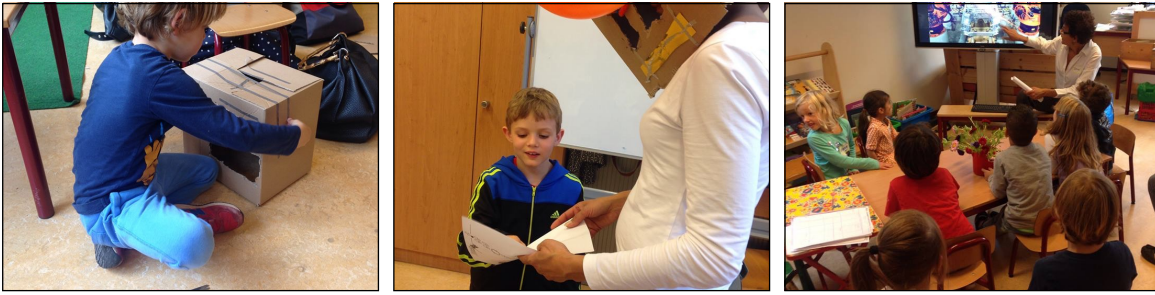
The trainers asked teachers to use NewTechKids' training and lesson plan as the foundation for teaching and inspiration. NewTechKids actively encouraged them to adapt ('hack') the lesson, taking into account their individual teaching styles, student dynamics, class size and classroom space.

### NewTechKids 'Intro to Computational Thinking and Coding Concepts' Lesson

The lesson was developed by NewTechKids to introduce students to computational thinking and key coding concepts such as algorithms, commands, design, composition and automation. The lesson challenges students to make a robot head and then put it on to dispose of toxic waste using commands (executing code).

We chose to use this lesson during training because:

- it does not require prior teaching experience related to computational thinking and coding;
- it uses tools and an environment already familiar to teachers;
- it does not require computers and software in the classroom;
- teachers play with students (as robots) while teaching; and
- it provides students with a tangible product to take home to continue exploring computational thinking and coding concepts in a playful manner.



## Lesson Structure and Phases

The 'intro to computational thinking and coding concepts' lesson integrated four phases: class discussion, a structured design process, a coding exercise, and feedback.

1. **Class Discussion:** teachers showcase coding by discussing how robots are used in everyday life. Robots represent a technology that most students are familiar with. The discussion is important for creating a social context that the students can relate to as well as forming the base for the abstract concepts being taught.
2. **Structured Design Process:** teachers challenge students to design a robot head, taking into account what kind of robot the student wanted to make (function).
3. **Coding Exercise:** children put on their robot heads to either follow code commands on a printed class handout or write their own programs with pen and paper in order to navigate a robot through an obstacle course set up in the classroom.
4. **Feedback:** the class ends with a discussion during which teachers ask their students what worked, what didn't and what they learned about coding. The goal was to give students the chance to share feedback and give constructive feedback to the student(s) they worked with.

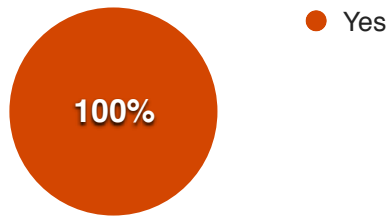
As part of the training, NewTechKids provided our proprietary lesson materials license-free. These included:

- lesson plan (Dutch and English versions);
- definitions of key computational thinking and coding concepts;
- PowerPoint presentation on robots for classroom discussion; and
- classroom handouts used for the coding activities.

## Survey Results: Teacher Training

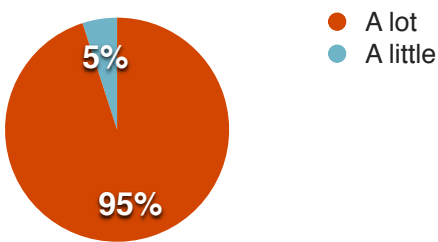
NewTechKids compiled the following data based on anonymous responses from 56 of the 75 teachers (75%) who attended the five teacher training sessions. Please note that the Dutch comments have been translated into English.

**Do you feel prepared to give the lesson to your students during EU Code Week?**

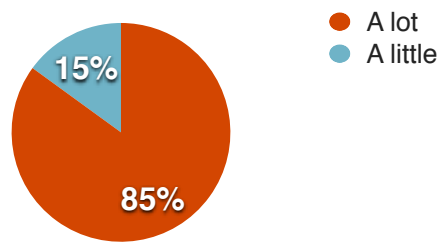


**How much did you enjoy the NewTechKids session you attended?**

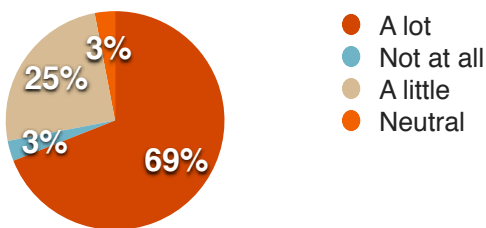
**Theory and Concepts**



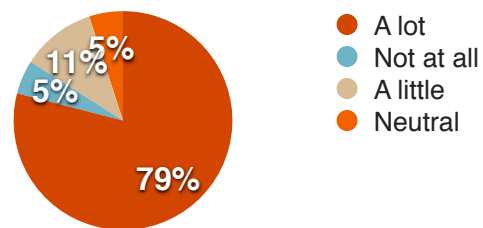
**NewTechKids Teachers**



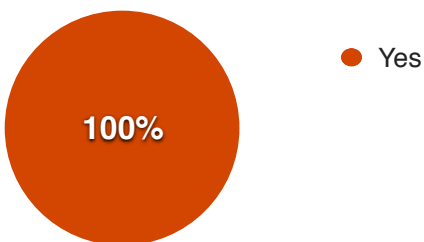
**Designing Robot Heads**



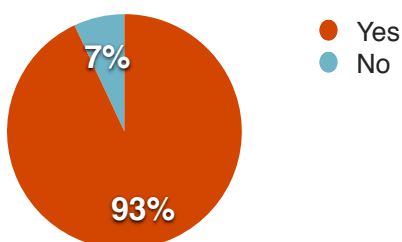
**Writing Commands and Code**



**Would you recommend NewTechKids as a teacher training provider for technology, programming and computer science education?**



**Would you be interested in attending additional NewTechKids teacher training sessions?**



## Additional comments or feedback



- o Thumbs up for all the good work, hospitality and generosity.
- o Keep on going!
- o It was GREAT!
- o I thought the session was well planned and delivered. I came away from the session knowledgeable about how to teach this lesson. I have shared what I learnt with colleagues and others are interested in taking part. I do feel that the lesson would take more than 90 minutes in class and will probably teach it over a couple of days.
- o Thanks for the hospitality and the great enthusiasm from your side.
- o I think it would be great to give a mini-course in computer science concepts and allow the teachers in the consequent workshops to then design lines of inquiry for those concepts.
- o Please use recycled materials to make the robot heads.
- o I really enjoyed the training!
- o I really like your learning approach. Part of the reason it's necessary to have the 'A' for Art in STEAM is that it's the learning process that matters, not the soon-to-be-outdated technology. Learning the underlying methodology, design process and rationale of coding is what really counts. A very enjoyable and thought-provoking event. Thanks!
- o I loved what you said about making errors and trying things repeatedly. It's great to teach children a growth mindset.
- o Designing the robot heads was fun to do but I do not think it was necessary for the training. To get a better idea of the format of the lessons that are going to be given during EU Code Week, it may be helpful to have a more detailed training with more examples of ways to implement lessons.
- o Very interesting and useful.
- o Making the robot heads took a little too long. We understood the idea so maybe you should focus more on the coding part of the lesson.



- o Thank you for the inspirational session. You made coding and computer science education feel like so much fun. I would love to bring that enthusiasm to the kids during EU Code Week 2015.
- o I would like to continue to be able to teach this to students in groups 6, 7 and 8, not just the younger groups.

## Phase 3: Teaching During EU Code Week 2015

During the school days of October 12 – 16, 2015, the teachers who completed NewTechKids' training gave our computational thinking lesson in their classes during school time.

A few of the teachers who attended our teacher training sessions trained additional colleagues to give our lesson. In this way, they became trainers themselves, helping to reach more students in their schools. The School of Understanding, a newly-opened school located outside of Amsterdam, gave the lesson to all of its students.

NewTechKids was very happy to learn that the majority of the teachers we trained used our lesson as a starting point and adapted it in some way. We firmly believe that in order for teachers to embrace technology education, they must take an active role in developing their own lines of enquiry, lesson plans and class activities.

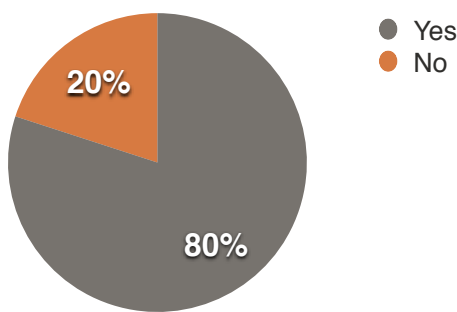
Most of the teachers who participated in this pilot program are interested in attending additional NewTechKids teacher training sessions. However, when asked if they would be willing to train their colleagues, half of them said no. This unwillingness is a serious factor which needs to be address in order to expand technology education in primary schools and create peer support networks.

### Survey Results: Teaching during EU Code Week 2015

NewTechKids compiled the following data based on anonymous responses from 47 of the 75 teachers (63%) who taught our lesson during EU Code Week. Please note that the Dutch comments have been translated into English. We had hoped that more teachers would complete the survey. In the future, we will give more attention to incentivising teachers to provide data and feedback, perhaps offering them more complimentary lesson plans.



## Did you adapt NewTechKids' lesson in any way?



### If so, how?

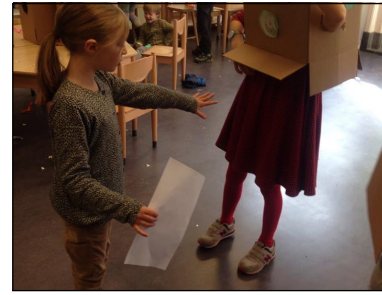
- o I spread the lesson over several days to correspond to the planning blocks here in our school.
- o I changed the beginning of the lesson and started with another example that you provided to explain algorithms and coding. I took my students through the peanut butter and jelly sandwich algorithm you mentioned and then I started talking about robots.
- o I gave two lessons instead of one. I also combined two classes: younger students with older students. During the first lesson, the older students helped the younger students make the robot heads. During the second lesson, the older students created an obstacle course and wrote the code to get through. They gave it to the younger students who put on the robot heads and followed the codes.
- o I spread the session over several days. I gave a demo on how to write code on the board. I then created a program of commands but got stuck as there weren't enough commands to follow. I asked some of the children to quickly write some commands on the board so that I could move. They really liked this and it really showed that if the command is not precise enough, the robot cannot move properly. They loved the challenge of disposing of toxic waste. I made little cans with toxic waste labels.
- o I gave the lesson over three days. On the first day, I introduced the concept of coding with the PowerPoint presentation you provided and then we made the robot heads. On the second day, we wrote the codes and on the third day, we had a lively class discussion during which students reviewed what they did and gave feedback on the experience and what they learned. I made the children clean up before they went ahead with the programming language.
- o We made the robot head in pairs. We spent more time learning about the commands and what they meant to make sure the children got the composition right. I tested them by showing them individual commands and asking them to explain what they meant and what their robots were supposed to do when they saw this command. This resulted in better hand-written programs.

- o Instead of asking the kids to draw each code, I scanned the codes so the kids could cut them out and assemble them like a puzzle.
- o I made my own program so that each child was able to complete the activity by walking through the obstacle course and back. My code was something like 'walk, walk, walk, walk, crouch, stand up, turn, walk, walk, walk, walk'. I wrote the code from left to right because my students are learning that you read from left to right. I put the code in an oblong box so that some children could make their own codes and use the same box.
- o I changed the order. The students wrote a code so they returned to the exact spot where they started, instead of the end of the obstacle course.
- o I changed the challenge from 'disposing of toxic waste' to being kind and standing up to bullies. I found the focus on toxic waste to be too heavy a topic for young students.
- o I made the commands more complex and required more precise instructions. I made students specify exact footstep lengths and the angle of a turn. I also added loops.
- o I did the lesson with a small group of six children. All of them successfully made robot heads. I gave the PowerPoint on the white board and then let a team of students write their programs on the white board while the other team executed the program. Then vice versa.
- o I broke the lesson into two parts. On Friday, my students focused on designing the robot heads. The following Tuesday, I gave a lesson focused on the coding phase. I asked older students to write the codes used by the younger students to navigate through an obstacle course. This was a great success!
- o All of the children in groups 1-4 at our school participated. Children in groups 1 and 2 only made the robot head and participated in a group discussion about coding based on the robot PowerPoint presentation you provided. They then danced in the playroom to electronic music with their robot heads on. The students in groups 3 and 4 spent the whole week focused on understanding coding and writing their own programs on paper. They gave each other assignments. On the last day, we made applications on iPads and Chromebooks.
- o EU Code Week coincided with the Netherlands' National Book Week. I adjusted the class coding challenge so that my students became good robots trying to save books from evil robots. (This also seemed more age appropriate than toxic waste for the younger kids. I also spread the lesson over several days.
- o I changed some things a bit in order to tailor the lesson to the needs of my class more and we used more time so that there was ample time for higher level thinking in both the design and coding phase.

- o My students had difficulty understanding that every small movement required a code command. When they executed their own codes, they often didn't correct their errors.
- o The lesson worked well. Children generally understood that you had to give very specific executable instructions. They understood the theory as well and enjoyed the class discussion about robots. I was happy to observe that they came up with their own ideas. The most difficult part of the lesson was writing the code but this may have been because I made the obstacle course too complicated. The lesson worked well with a small group of students but was more challenging with the whole group.
- o Actually, it went very well. I spent less time on robot head design because I didn't have any extra help.
- o I made the children clean up before they went ahead with the programming language.

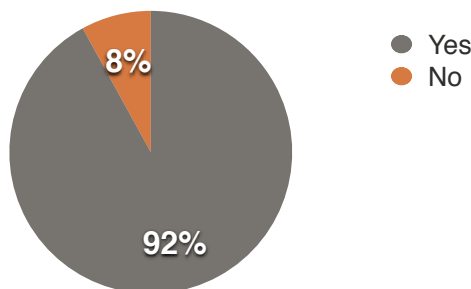
### **What worked and didn't work when you taught the lesson?**

- o Everything worked but it was initially difficult to get the kids to do something 'practical' instead of making something beautiful.
- o The children had fun with the boxes and the coding exercise worked well.
- o Most of the class went well. Teaching a large group, I struggled to provide individual guidance to help all of the kids design the robot heads and walk the route afterwards. The children found the code writing part of the lesson to be quite challenging. They preferred to use more abstract command symbols than the ones on the class handout you provided.
- o Having older children help the younger children worked well.
- o My students were enthusiastic and their designs were well thought out. What did not work well was all of the leftover craft materials. It would have been better if I had the children clean up the class before they began the coding part of the lesson.
- o Making the robot heads went very well and my students did a great job of thinking about features. The volunteers were very helpful during this phase. What could have been better was if the lesson was split into two lessons: one for the design of the robot heads and another for the code writing. Also, the TomTom volunteers did not speak Dutch. It would have been better if they could communicate with my students.



- o The timeframe of one lesson for these concepts was too short. Luckily, I anticipated this and adjusted the lesson timeframe.
- o For me, it worked well when two children made one robot head. Also, instead of having students draw the code commands, I printed out the ones you provided so kids could just cut and paste them onto a paper in the right order.
- o Everything worked well. I did not encounter any problems when I taught the lesson as you showed us.
- o All children made a robot head and wrote a code on Friday. The children were very enthusiastic.

**Do you feel that the children understood the concepts you taught (computational thinking, coding, algorithms, automation) and were engaged during the lesson?**

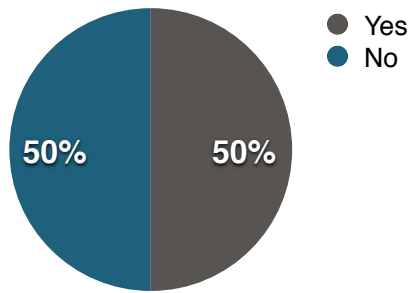


### Comments and Feedback

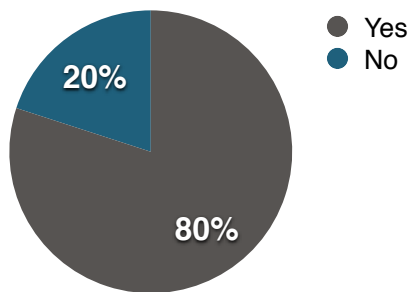
- o The children understand that the brain of a robot is empty and that they had to program it for every action it took: walking, stopping, sitting and standing.
- o The children made many coding mistakes at the beginning but we tested our code and then improved it. A great learning process!
- o They were very enthusiastic and invented their own solutions. The robot PowerPoint provided many opportunities for discussion.
- o The kids were not really focused on the coding concepts but rather with the 'leuke opdracht' (designing robot heads).
- o At the end of the lesson, my students were able to explain the concepts I taught.

- o My students now know that people make robots and that robots are programmed by people.
- o They have a good understanding. We have been referring to the concepts I taught through a poster we made in class after EU Code Week. We have been adding examples of new commands and automated systems since.
- o I kept the coding exercise simple for the toddlers and it went well.
- o For an introductory class, I think my students understand the coding concepts reasonably well. Writing a code and having someone else act it out was very difficult for some of the children.
- o They were so enthusiastic, they could not stop drawing codes and robots 'machines'.
- o Some children could write a code but for some, this was a step too far. Those who couldn't write code were allowed to focus on reading code. If this was still too difficult for some, they could become robots and follow the commands of other children.
- o The children were involved when they themselves wrote a code.
- o Designing the robot heads was a fun exercise and the coding and following commands was very engaging for the children.
- o My students quickly adapted the robot head design and corrected their code to fix errors spotted in testing. The iterative design process was very natural.
- o Yes, the toddlers figured out how they could make a code. They understood that a robot code was needed to do something. They made all kinds of codes and buttons on their robot head.
- o We had lots of discussion with the children about robots using the PowerPoint you provide. They enjoyed the lesson but the younger students have difficulty drawing.
- o I was surprised at how fast the children in groups 1 and 2 [4-6 years] figured out how they could make a code.
- o The children grasped the limited abilities of computers and the importance of the coder mostly by making mistakes themselves.
- o During the lesson, yes. I am not sure how much went into long-term memory so there should be schema on which to build.
- o Some thought the coding part was boring.
- o Kids enjoyed inventing robots. I linked the lesson to National Book Week since the theme was science. We teachers became the robots that our students programmed. They loved it!

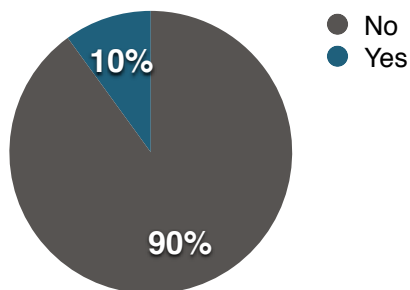
**Next year, would you be interested in training other teachers at your school to give a coding lesson during EU Code Week?**



**Are you interested in future teacher training opportunities organised by NewTechKids related to computational thinking and coding?**



**Would it be difficult for you to complete teacher training in English?**



## Conclusion

NewTechKids is very pleased with the results of our first teacher training pilot program. For us, it represents a strong example of the power of collaboration between technology education specialists, schools and teachers, and technology companies.

We are a learning organisation so we plan to use this project experience to fine-tune our teacher training and scaling strategy. We will also use the feedback from teachers to improve our lessons and develop new learning modules and lesson plans related to computational thinking and coding concepts further.

# Contact

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