



# Do robotics activities help our children learn better?

I recently enrolled my son, Zachary, to a robotics school called [Little Botz Academy](#). This school, which has a partnership with [Universiti Malaya](#), teaches children mainly between ages 8 to 12 years robotics using [Lego Mindstorm EV3](#) and [Rero](#). Also included in their curricula are computer programming and computer practical skills.



My son, Zachary, just recently started his robotics classes at Little Botz Academy. His classes are twice a week for six months.

Like most boys, Zachary loves Lego and robots. I too had my fair share of Lego and robots whilst growing up, but back then, Lego was not as popular or as

widely available as it is now. Today, there are Lego movies, Lego TV series—and, *blimey*, even Lego theme parks. Robots today too have changed. No longer docile or passive of the past but more flexible, programmable, and reactive of today. So, combine the two—Lego and robots—and what we have is a integration of two very popular playthings for children. But are Lego and robots, at the end, just that—toys? Sure, they are addictive and nice to play with, as evidenced recently when one of Zachary’s friends visited us in our home, and they played for five hours straight building Lego pieces into robots, both of them stopping only for toilet breaks and coerced lunch. But ultimately, what do Lego and robots actually teach our children?



Only some of the many bots of the highly configurable and programmable Lego Mindstorms (photo from [linuxgizmos.com](http://linuxgizmos.com)).



Another popular programmable robot is the Rero (Reconfigurable Robot) (photo from [rero.io](http://rero.io)).

No doubt many of us would intuitively regard that robotics activities will motivate and fortify our children’s learning. But if there is one thing I have learned from science is this: our intuitions, though seemingly common sense, are not always

correct.

In other words, I was looking for empirical evidence, not anecdotes, subjective experiences, or sales pitch from robotics school brochures, on how effective robotics classes would help in my son's general learning experience.

The reality, at the end of my research, is simply this: there is still insufficient evidence on robotics's actual impact on enhancing our children's learning experience. But before you conclude that robotics classes are a waste of our precious money, be aware that having robotics activities in classrooms is a rather recent novelty, so expect still an unsatisfying number of studies carried out on their effectiveness. A more serious problem, however, is how these past studies have been conducted.

Most past studies that did evaluate the use of robotics activities in school classrooms are unfortunately descriptive in nature, that solely rely on teachers' and children's mere subjective reports of their learning experience. A recent 2012 review of studies by Benitti from the [Universidade do Vale do Itajai](#), Brazil, for instance, found that during the ten-year period from 2000 to 2009, only ten studies had used empirical analysis to measure the impact of using robotics as a teaching aid in school classrooms.

Moreover, robotics in the past have mostly been used in a limited manner, typically in teaching topics directly related to robotics. Benitti remarked that robotics need not always be about robotics *per se*, but can be made general enough, without being tied down to any academic area or scope, to accommodate to the children's interests, whatever that may be. Children who are interested in cars, for instance, would apply what they have learned from robotics to create motorized vehicles, or even children who are interested in music or arts to create interactive sculptures.

Even though limited in number, the ten studies found by Benitti are nonetheless comprehensive enough in scope, covering a total of over 1,200 school students from ages 6 to 15 years old and from various countries. More importantly—to me, at least—that these studies were specifically designed to determine the effectiveness of using robotics activities not to teach robotics *per se* but to enhance children's learning in [STEM \(Science, Technology, Engineering, and Mathematics\)](#) topics.

The outcome from these ten studies are promising. They generally report that students in classes that had robotics activities scored higher in exams related to maths, computer programming, robotics, engineering, and physics than those in the control group (classes without any robotics activities). Also encouraging is robotics activities made students more intellectually stimulated and engaged about the topics being taught. The students in one robotics-aided class, for example, showed a greater understanding and appreciation in evolution topics and were more engaged in classroom discussions among their peers than those in the control group. One study found tentative evidence that the use of Lego had helped one group of students, those who perform averagely in mathematics, to improve their maths scores a year later.

Nonetheless, merely having robotic activities in the classrooms is no guarantee that they would succeed to enhance learning. There have been reports where no improvement in learning were observed. Even after a year of Lego robotics training, for instance, about 200 students in several schools across Sweden performed overall no better in mathematics and problem solving than those who did not receive any Lego training.

Consequently, the effectiveness of robotics activities in enhancing learning depends on several factors, some of which, as asserted by Lindh and Holgersson from the [Jönköping International Business School](#), Sweden, are: 1) children must be given enough space in the room to work with their robots, 2) no more than two or three students to be assigned to a single group working on a single robot or activity, and 3) the robotic tasks given to the students must be specific, realistic, and be related to the currently taught topics at schools. But the most important criteria of effective robotics training is *ultimately* the teacher, who must not only be knowledgeable in robotics, but also have a positive attitude and be motivated to steer the children's learning process.

Scientific evidence about the effectiveness of robotics activities may still be lacking or not be entirely convincing. But just like the progress of any other scientific enquiry, I am sure, over time, the effectiveness of robotics training will eventually become increasingly clear with mounting evidence. Without doubt, robotics classes are becoming increasingly popular today, especially among children, and scientists would want to establish their efficacy.

So, at the end, it is important to have realistic expectations about the

effectiveness of robotics classes. Yes, such classes can be effective, but much depends also on the school itself: their robotics curricula, how the school carry out their classes, and the kind of learning environment they create. Little Botz Academy, my son's robotics school, does appear to have the right ingredients, as I have listed earlier, but I am not sending my son there because I have become totally convinced about the effectiveness of robotics activities. No, I am sending Zachary there because I see that he enjoys playing with Lego and robots, and I am sure some meaningful learning outcome will emerge as he designs, builds, and programs his robots. It is also important to allow Zachary discover if his fascination and enjoyment of Lego and robots would go beyond of just being toys to something more meaningful and life-changing.

But most of all, I want my son to learn robotics because I do not want him to grow up thinking that learning becomes meaningful only in the absence of fun.



Zachary having a go with his Lego Mindstorms set during class.

## References

1. Benitti F.B.V. (2012) Exploring the educational potential of robotics in schools: a systematic review. *Computers & Education*, **58**, 978-988.
2. Lindh J., Holgersson T. (2007) Does lego training stimulate pupils' ability

to solve logical problems? Computers & Education, **49**, 1097-1111.