

# Don't Teach Robotics, use Robotics to Teach

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**Abstract.** While there is a significant push to incorporate robotics into education settings, it is pertinent to point out that robots should be considered as tools for teaching curriculum, not as content in themselves. This paper will explore the idea of 'Tools, not toys' in a Primary and Secondary Education setting and provide suggestions on how to choose an appropriate Educational Robotics platform to suit curriculum requirements.

**Keywords:** Educational Robotics.

## 1 Introduction

Having been teaching with robots for over 15 years, one of the most common questions from Teachers is "Which robot platform should I get for my school?" While this question is completely valid, it skirts the larger, more important question of "What am I trying to teach?" I've used over a dozen different Educational Robotics platforms quite extensively and I believe that the platform being used does not play a significant role in the educational outcomes of the program.

In the education realm, the Curriculum proscribed by the relevant governmental body takes precedence over all other subjects. Regardless if you agree with the requirements imposed by a Ministry of Education, schools are expected to follow these Curriculum Syllabi to ensure the students graduating will have their schooling officially recognized.

Time is short in a classroom and with many topics required to be taught, it is often impossible to be able to do any extra activities 'just for fun'. All class work is required to be meeting relevant educational outcome markers.

As a result, we should never be solely focusing on 'Teaching Robotics'; instead we should be using 'Robots to Teach.' Just like any other educational tool, Robotics platforms are just a means to teach different concepts.

## 2 Tools, not Toys

For this topic, I define ‘Teaching Robotics’ to mean the explicit teaching of a specific Robot platform. This may mean teaching students about the specific Hardware of the robot, such as Motors, Speakers, Lights, Sensors and Computational Hardware (Robot brains). In addition, the teaching of a programming language required to operate the robot is also performed. These programming languages may be graphics or text based, proprietary or open sourced. Teaching students a very specific robot platform may be considered appropriate for that moment in time, but once a ‘newer and shiner’ robot comes along, students may run the risk of having to explicitly re-learn all their skills to match the new platform.



**Fig. 1.** Examples of Educational Robotics platforms. LEGO MINDSTORMS, VEX IQ, Dash, mBot, BeeBot, Sphero

A far better approach is to ‘Use Robots to Teach’. For this, it is important to view the robot platform as a tool in which to teach higher order thinking skills.

By using the platform to teach (rather than teaching the platform), we instill in our kids the ability to solve higher order problems, think more broadly and be more adaptable with the tools they have on hand. When a new technology comes along, they are more likely to understand the tool rapidly and start using the tool to help solve their challenges.

We use these platforms to teach a wide variety of topics including but not limited to;

- Sequential Programming
- Computational Thinking

- Problem Decomposition
- Mechanical Engineering
- Branching statements
- Directional Terminology

These topics can be tailored to ensure they are age specific and meet the requirements of the Curriculum that is being implemented.

### 3 Choosing an Educational Robotics Platform

Before the decision is made to purchase a Robotics Platform, schools should initially ask the question “What are we trying to teach?” Understanding what the robots will be used for will play a large role in deciding which robots will be suitable in an educational setting.

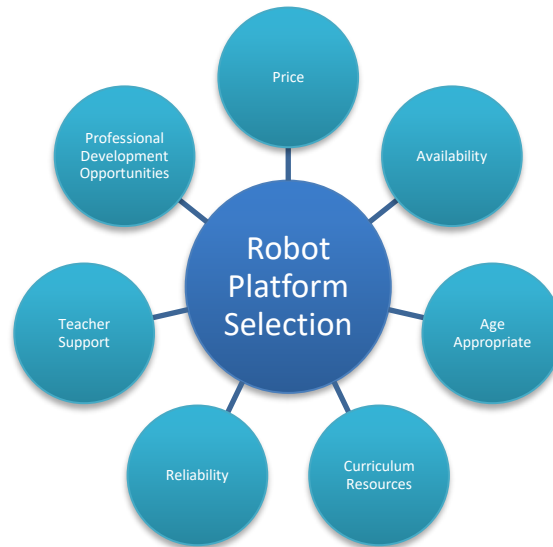
Within a typical curriculum, there will be a variety of different subject areas where robotics may prove useful in facilitating learning outcomes. These may include subjects with names like – Digital Technologies, Design Technologies, Engineering Studies, Computer Science, Physics, Mathematics. Whilst every regions’ curriculum documentation will be different, teachers will be able to see specific educational outcomes that are required and can map the use of robots to meet those outcomes.

For example, the following Content Descriptor is part of the Australian Curriculum for the Technologies Subject:

*Define and decompose real-world problems taking into account functional requirements and economic, environmental, social, technical and usability constraints (ACTDIP027)*

There are many ways this specific concept could be taught, with the use of a Robotics Platform just one possible solution. Students could conceive of a complex problem that needs to be solved and by defining and decomposing that problem, they may be able to implement a small part of the solution with a Robotics platform.

As the robot itself is just a platform that is used to teach the aforementioned concepts, there are many different possible choices that would fulfill the requirements. There will be a variety of factors that will guide teachers in to choosing a platform that suits their school best and they should include;



**Fig. 2.** Factors influencing Robot Platform Selection

**Price:** If there is a robot platform that is amazing, but it costs \$5000 per robot, is that a better investment than an adequate platform that is \$200 per robot? For the same amount of money required to purchase an expensive robot, a cheaper robot platform can be purchased which would give the opportunity to engage more students.

**Availability:** Can you easily get it in your country? Are spare parts or add-ons easy to source?

**Age appropriate:** Depending on the age group and existing abilities of the students, you may need to decide between a Graphical or Text based programming language. Each have their own benefits and challenges. Is the hardware easy to understand and use for the age group intended?

**Curriculum Resources:** Are educational based activities easy to come by? In a classroom, there is unfortunately no spare time to ‘play’ with robots. All activities need to be meeting Curriculum requirements. Are these activities affordable/ adaptable / assessable?

**Teacher support:** Often the ‘robotics’ teacher/s at a school might be only one or two teachers, which makes it a little more difficult to bounce ideas around. Many robotics platforms have extended Educator communities in the form of mailing lists, forums etc.

**Professional Development opportunities:** Are your staff comfortable using the equipment in class. Too often I’ve seen cupboards of equipment sitting idle in a classroom because the teacher who originally used it has now moved on and no-one else at

school knows how to use the gear. Is the equipment easy to use and it is just missing a teacher willing to take it on?

**Reliability:** Are you regularly having to 'repair' your robots? If you are spending too much time just getting the platform up and running, then that is time that could have been time spent solving challenges.

## 4 Conclusion

At the end of the day, the best robotics platform is the one that teacher feels most comfortable using. Comfortable not only in the technical operation of the robot, but also its use as a tool in teaching to the Curriculum. A simple robot, with simple activities that are fun, engaging and foremost educational, will always triumph over a fancier robot, that is underutilized due to its complexity.

If teachers are comfortable with a robot platform, it will complement their coursework and provide engaging, educational activities for their students, just like any other tool at their disposal.