Professional Learning
Research
Innovation

Learning in Practice

Volume 1 Number 1 November 2017

Barker
INSTITUTE

About the Barker Institute:

- Provides a centre for research, reflective practice, professional learning and innovation in education
- Is a resource hub that facilitates the ongoing development of learning for teachers, allowing them to stay abreast of emerging practice, constantly striving to refine the quality of teaching and learning
- Looks to develop collaborative ventures with other institutions and providers, initiating research and innovation combined with the implementation of new projects and programs for the benefit of students, staff and the broader community
- Shares current research and issues with parents, professional bodies and educators around the globe through ongoing symposia, forums, lectures and conferences

About the Learning in Practice Journal:

As a leader in Christian education, Barker College aims to both demonstrate and inform best practice. This journal was developed to showcase a range of initiatives and research projects from across the School. It explains the rationale behind innovations in practice and archives pivotal developments in Barker's academic, co-curricular and pastoral realms.

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Lael Grant is the Robotics Co-ordinator at Barker College. Over the past two years, Lael has been responsible for growing the Robotics' program into a thriving and successful school activity. There are currently over 140 students involved across the School in both training and competition teams. Lael is an advocate of STEM/STEAM and has been invited to speak at several conferences including EduTech and AIS Technology in 2017. He has taught Computer Science at senior levels both locally and internationally and has also been involved in setting the HSC Trial examinations for external providers. Lael is passionate about human potential and our capacity for innovation.

A year in the life of Barker Robotics. Engaging students for a lifetime.

Learning in Practice
2017 Vol. 1 (1)

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Abstract

Problem solving, team building, forward thinking and sustainability are key concepts that have had to be built by our successful Barker Redbacks Robotics Team. They have done this through trial, experience, reflection and strategy learned during their journey in the First Robotics' Competition and through examining the progressive development of passion, skills and capabilities for future students. This has resulted in a robotics program that is building momentum throughout all stages of Barker College. This has grown in breadth to include First Lego League, First Tech Challenge, First Robotics Challenge and now VEX Robotics.

There is something special in competition that sparks innovation. The first six-minute mile, the moon landing, the rapid development of smartphones, self-driving cars, and soon, the Hyperloop. Humans thrive on the sharpening of the wit and the mental stimulation that rigorous competition can bring. Combine competition with vision and suddenly you have inspiration. Barker Robotics has achieved incredible success this year, inspired by competition on a global scale and the vision of being a top ten FIRST Robotics Competition (FRC) teams in the world.

During 2017, the Barker Redbacks competed at competitions in Shenzhen (China), Sydney (twice) and New York City. The team achieved phenomenal success, winning all four regionals and qualifying for the World Championships in Houston, Texas, where the team qualified fifth in playoffs and won all the way through to the division finals. At the end of competition season, the team was ranked 20th in the world out of a total pool of around 4500 teams.

Students have only six weeks to build their robot, receiving a new challenge every year in early January and then bagging their robot mid February to be sent to competition. Following this, there are six weeks of frenzied competition which for the Barker Redbacks included winning the competition in Shenzhen, running between the awards ceremony and the pit while packing up and then hurriedly flying out to Sydney to begin competing in the Southern Cross Regional the next day. In New York the students reconstructed the robot from multiple separate checked luggage pieces into which the robot had been separated. Once assembled they faced the challenge that the ball shooter just didn't seem to shoot quite as effectively. Such are the diverse learning experiences for these students on the world stage!

As with every competition, time is limited and the desire to succeed is enormous. It is every team's dream to defeat NASA sponsored and mentored teams or finally to make it to 'Einstein' where the top six teams in the world vie for the right to be the World Champion. Of course, success is not really achieved in the six weeks of build season or the following six weeks of competition. In such a short time frame what the team really sees is the fruit of years of development, training and planning.

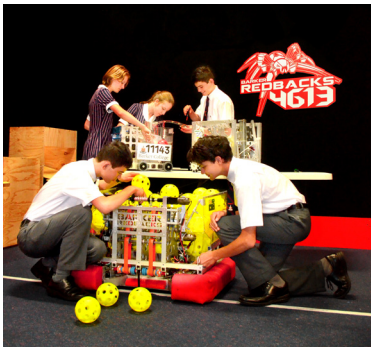
Robotics provides students with a pathway for growth. When students enter the program they may not know how to design a drivetrain or even heard of what a gearing ratio is. They may not be able to calculate trajectories for balls or design a ball shooting mechanism in CAD. However, within three years, a robotics student in the FRC program will be doing all of that and much more. They will learn to cut their own custom parts using Computer Aided Machining (CAM) as well as construct their custom ball shooter or climbing mechanism or gear pickup and then work with the programming team to provide integrated systems control using sensors and feedback loops. This year, the robot was shooting balls at a speed of over eight balls per second, emptying a full robot hopper of balls in under eight seconds into a funnel only 2.2m high.

Perhaps more impressive is that in 2016 the same team won their first ever regional, and was summarily knocked out of champs after qualifying only 31st and not proceeding to the elimination rounds. The team had experienced great success, winning the Sydney Regional, almost winning the Canada West Regional, but failing because the robot was unreliable, breaking the drivetrain almost every ten matches. That failure sparked significant reflection and development for the future.

In late 2016 the team implemented student and mentor feedback at the end of every year in order to gather data for continuous improvement. This resulted in a wholesale redesign of the team, with structured off-season skill development programs, implementation of sub-teams for robot design and greatly limited hours during build season to reduce student commitment from what was twelve hours a day to a maximum of seven hours a day. Accompanied by a deliberate emphasis on early planning and effective communication with parents and teachers, students were empowered and encouraged to prioritise and schedule their incredibly hectic, though purposeful lives. In correspondence with parents, the Robotics Co-ordinator received messages exemplified by this postscript to an email: "received X's school report .... best ever thanks to Robotics and the resultant engagement with his whole school life".

Robotics provides students with the connection and inspiration to apply their learning in Mathematics, Technology and Science in very real, holistic ways. This results in a depth of learning and substantial increase in engagement. One of the joys has been seeing this authentic application evidenced in other realms with one of our 2016 Team Captains, Oliver Nicholls, receiving the NSW Young Scientist of the Year (Yr10-12) award for his window cleaning robotic drone.

In feedback provided by students in the 2017 end of year survey, our students continuously highlighted that they felt that they grew significantly from being in the program. Interestingly, many comments in the qualitative feedback received mentioned that some of the key skills they learned were 'soft' or indirect skills.



Core skills and capacities such as communicating with parents, team mates and mentors, time management, group work and 'synergy with the team' were commonly identified themes; not the immediate skills you might expect from a robotics program, but pivotal to the effective running of a team with over thirty-five team members building, competing and travelling together in the high-pressure environment that is the three-month season of FRC. Along with that were comments on improved skills or the need for improved skill in the core robotics areas of CAD, CAM, programming and mechanical design. These provided us with important points of reference as we prepare for the year ahead.

One of the key weaknesses our mentors identified at the end of 2016 was a high skill level in a limited number of team members. This introduced unnecessary reliance on those team members which compounded their stress and time commitments. It also had the side effect of introducing fragility in the team as losing core team members for academic and sporting commitments would result in significant delays or detriment to the program, especially at critical times like the end of build season or at competitions. One of the redesigns of the program at the end of 2016 was the introduction of a comprehensive skills development program.

The program was gamified with 'badges' awarded for 'levels' of certification, which allows a team member to 'level up' to a sub-team leader or a specialist in a particular area during build season. This is also tied into other desirable promotion positions such as Team Captain. This has resulted in significant upskilling across the whole tea. For example, our certified CAD specialists grew in number from one eighth of team members now to be three quarters of the team. Perhaps unsurprisingly, it was also one of the most positively commented on aspects of the team organisation in our 2017 season feedback. Our students have seen that a broadly and highly skilled team is capable of building a robust, high-performing robot, evidenced by no lost games due to maintenance in 2017 and significantly shortened pit cycle times.

Our goal is simple: to provide the best possible robotics experience to the greatest number of students we possibly can. If we do this well, then we have the potential to compete at elite levels on a global stage. This requires highly skilled students that make robot design decisions, game strategy decisions, media and public relations presentations, business plans and involvement in every possible part of the program. To achieve this, we have partnered with VEX Robotics to bring the competition to Sydney. In the Middle School we have started a little under twenty teams with around sixty students involved. The learning curriculum VEX provides is comprehensive. It allows an accelerated growth path for small team numbers which results in high student engagement.

In the Junior School we are continuing to build capacity through the FIRST Lego League (FLL) program, where our students recently qualified for Nationals. We are planning to introduce VEX IQ to further extend our students STEM problem solving skills across the entire College.

By the end of 2019 the program has the enviable problem of having an FRC team that is likely to reach a team size of over 100 students. This would be one of the largest teams in the world. We are currently working on developing systems to help ensure a continually effective team. We are delighted that we are inspiring such passion and innovation in our students. More than that, we are excited to see our students sharing what they learn with their peers in schools around us, in China and globally.

The Robotics program at Barker has allowed students to find their voice in a range of exciting and innovative areas as part of the team and competition structure. The skills and learning opportunities are diverse and the level of growth in the Barker Robotics program seem to indicate that it an area that will be sustained for many years.

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