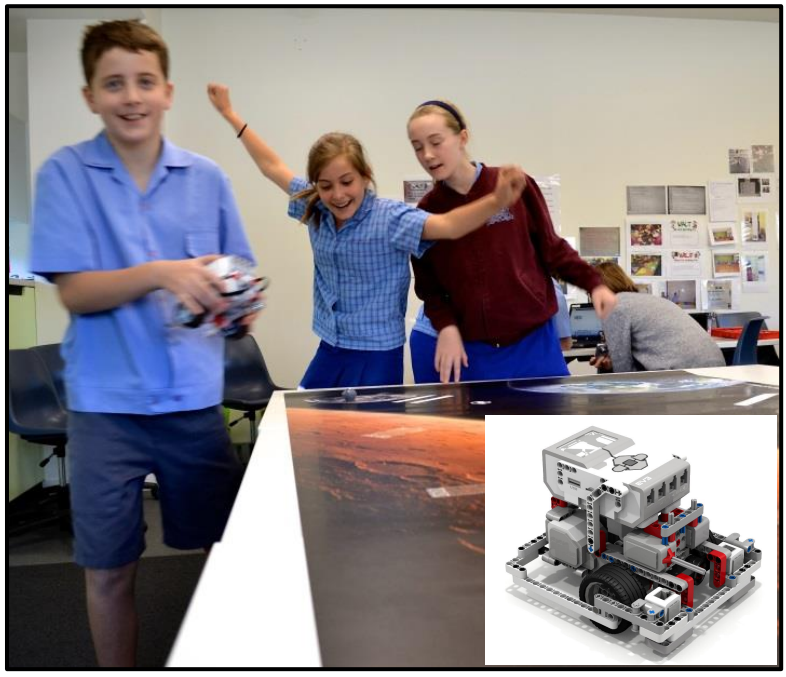
The *Robotics Social Club* Program

Teacher Manual



Teaching social skills and programming using LEGO® robotics

AutismCRC

QUT

Brisbane Catholic Education

teaching • challenging • transforming

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All resources, including appendices, are available for download from the *Robotics Social Club* program website:
http://www.autismcrc.com.au/educationresearch/robotics-social-club

The research report associated with these resources, *Utilising Robotics Social Clubs to Support the Needs of Students on the Autism Spectrum Within Inclusive School Settings*, is available for download from the Autism CRC website:
www.autismcrc.com.au

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1.0 Introduction and Rationale

1.1 The Robotics Social Club Program

The *Robotics Social Club* is an inclusive school-based program that can be held after school or during lunchtimes. Through weekly team challenges using LEGO® Robotics resources, the club aims to create opportunities for all students, including students with autism spectrum conditions, to learn social skills, make friends and socialise with peers over a common interest, and enhance their sense of engagement and belonging at school. The Club utilises students' strengths and interests in technology within inclusive school-based settings and integrates professional learning for teachers as part of the program. The program is expected to facilitate optimal outcomes for students and the generalisation of skills to the classroom and broader school context.

Students in the Robotics Club progress through Beginning, Developing, and Culminating Phases of the program over 11 to 18 sessions (ideally 1.25 – 1.5 hour sessions held weekly; the program can be split over terms). Teams of approximately three students will be given a robotics challenge each session with the goal of building and programming a LEGO® robot to complete the challenge, and demonstrating one of the Personal and Social Capabilities identified in the Australian Curriculum. The program has been designed to allow for flexibility, to ensure schools and teachers can tailor the content and focus of sessions to meet their students' particular needs. Upon completion of the Culminating Phase, the Robotics Club teacher(s) and students will be ready to continue to run the Club independently once per week with a less structured focus, gaining ideas from the Robotics Club website and allowing students to research and/or create additional robotics challenges.

1.2 Student Learning Outcomes

The Robotics Social Club aims to provide an opportunity for all students, including students with ASD, to experience social situations with their peers in a fun environment, using their common interests and strengths to learn social skills, form friendships, and enhance their motivation and engagement in school.

The standard structure of sessions involves explicit teaching, planning, practice, monitoring, and evaluation of students' demonstration of the Social Management skills within the **Personal and Social Capabilities** of the Australian Curriculum (ACARA, 2016). The focus on robotics encourages students' interest and engagement, while also learning skills from the Technologies curriculum.

The focus on the Personal and Social Capabilities and the positive social interaction between students with ASD and their peers during the Robotics Social Club sessions aims to: a) support their ability to apply social skills, b) build lasting friendship networks, and c) increase their motivation and engagement, within the classroom and broader school context.

Research has shown that students who participated in the Robotics Social Club generally increased their social connections and relationships; were protected against drops in motivation and engagement, and even improved in some aspects such as self-belief; showed some improvements in their social communication deficits; and qualitative reflections indicate improvements in teamwork skills, confidence, resilience, technological and problem-solving skills, and engagement.

Given the importance of the early high school years for students' social wellbeing and friendships, and developing positive school engagement (e.g. Bauminger & Shulman, 2003), students in Years 7 and 8 (12-14 years of age) are expected to benefit most from the Robotics Social Club program. Therefore, this resource focuses on this age group.

After completing the three phases of the program over 11 to 18 sessions, schools are equipped to continue implementing the Robotics Social Club in a way that best suits their students' and teachers' learning needs.

1.3 Teacher Professional Learning Outcomes

Essential to this program is the opportunity for teacher professional learning with a focus on both: a) identifying and meeting the needs of students with ASD, and the pedagogical practices that support student learning of the Personal and Social Capabilities, and b) knowledge, competence and confidence with robotics, programming/coding and technology.

Research has shown that teachers who participated in the *Robotics Social Club* as lead or supporting facilitators, report increased knowledge of the Personal and Social Capabilities, and of robotics and technology; increased knowledge of effective pedagogical practices, and individual students' needs; and the ability to transfer these skills to settings outside the Robotics Club, such as their classroom and the playground.

Section 5.0 Teacher Professional Learning provides contacts, links, further resources, and a collaborative space to support facilitating teachers' professional learning with regard to implementing a Robotics Social Club, as well as the broader areas of robotics and technology, and supporting students with ASD.

This section also provides suggested options for professional learning models and processes to encourage transfer of professional learning to other teachers in your school, and to teachers' classroom practice. Suggestions are provided to allow schools to tailor their professional learning to their own school culture and needs.

1.4 Australian Curriculum Content

The Robotics Social Club program directly links to the Australian Curriculum: Technologies, and the General Capabilities: Personal and Social Capability of the Australian Curriculum (ACARA, 2016). The links to these curriculum areas are described below.

1.4.1 Digital Technologies

All students will learn concepts from the Digital Technologies curriculum, such as using the Digital Technologies process (Define, Design, Implement and Evaluate) as well as programming skills such as Branching and Iteration.

Years 7 and 8 Achievement Standard

> *By the end of Year 8, students distinguish between different types of networks and defined purposes. They explain how text, image and audio data can be represented, secured and presented in digital systems.*
>
> *Students plan and manage digital projects to create interactive information. They define and decompose problems in terms of functional requirements and constraints. Students design user experiences and algorithms incorporating branching and iterations, and test, modify and implement digital solutions. They evaluate information systems and their solutions in terms of meeting needs, innovation and sustainability. They analyse and evaluate data from a range of sources to model and create solutions. They use appropriate protocols when communicating and collaborating online (ACARA, 2016).*

For further detail, see the full Digital Technologies curriculum.

1.4.2 Design and Technologies

All students will learn concepts from the Design and Technologies curriculum, such as using the Design and Technologies process – Define (Ask), Design (Plan), Produce (Create), Evaluate, and Improve (see Appendix D. Robot Design Process.). Students will also focus on the technologies contexts of: Engineering principles and systems; and Materials and technologies specialisations.

Years 7 and 8 Achievement Standard

> *By the end of Year 8, students explain factors that influence the design of products, services and environments to meet present and future needs. They explain the contribution of design and technology innovations and enterprise to society. Students explain how the features of technologies impact on designed solutions and influence design decisions for each of the prescribed technologies contexts.*
>
> *Students create designed solutions for each of the prescribed technologies contexts based on an evaluation of needs or opportunities. They develop criteria for success, including sustainability considerations, and use these to judge the suitability of their ideas and designed solutions and processes. They create and adapt design ideas, make considered decisions and communicate to different audiences*

> *using appropriate technical terms and a range of technologies and graphical representation techniques. Students apply project management skills to document and use project plans to manage production processes. They independently and safely produce effective designed solutions for the intended purpose. (ACARA, 2016).*

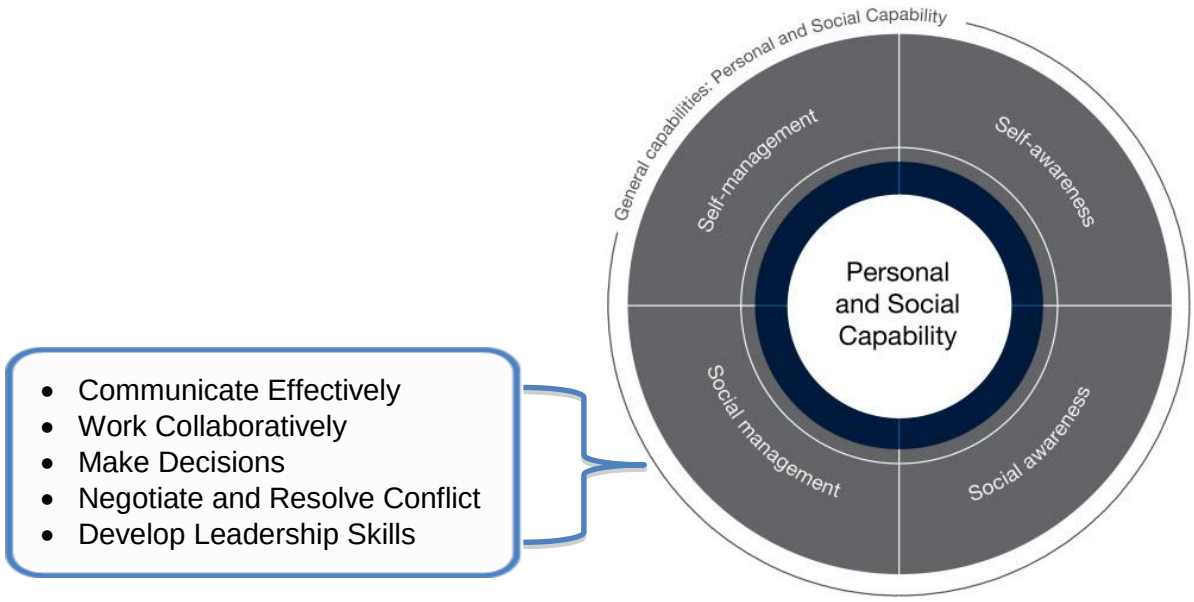
For further detail, see the full Design and Technologies curriculum.

1.4.3 Personal and Social Capabilities

The major focus of the Robotics Social Club is supporting teachers to embed the Personal and Social Capabilities of the Australian Curriculum (ACARA, 2016) within their teaching practice, and for students to have some targeted teaching of these skills. The *Personal and Social Capability Continuum* describes typical milestones for all students by the end of Foundation, Year 2, 4, 6, 8, and 10 (see Section 3.2.1 Personal and Social Capability: Social Management Continuum). The Robotics Social Club focuses on the Year 6 to Year 8 milestones, and specifically the five **Social Management** skills (see diagram below). The Robotics Social Club aims to explicitly teach age appropriate social skills and importantly give students the opportunity to practice and demonstrate them within the school setting.

Social Management

> *This element involves students interacting effectively and respectfully with a range of adults and peers.*
>
> *Students learn to negotiate and communicate effectively with others; work in teams, positively contribute to groups and collaboratively make decisions; resolve conflict and reach positive outcomes. They develop the ability to initiate and manage successful personal relationships, and participate in a range of social and communal activities. Social management involves building skills associated with leadership, such as mentoring and role modelling (ACARA, 2016).*



For further detail, see Section 3.2.1 Personal and Social Capability: Social Management Continuum or the full Personal and Social Capability curriculum.

2.0 Establishing a Robotics Social Club in Your School

2.1 Required Resources and Logistical Considerations

The following resourcing and logistical considerations must be met in order for a successful Robotics Social Club to be established:

- Six LEGO® MINDSTORMS® EV3 Robotics Core Sets.
    - **NOTE:** it still possible to use this resource to inform a Robotics Social Club program using a different robotics platform (e.g. previous generations of LEGO® robotics; NAO robot from Alderbaran Robotics). The robotics challenges and content will need to be adapted by teachers, but the principles and resources used to teach the Personal and Social Capabilities can remain the same.
- Ready access to six computers (e.g. desktops; student laptops or iPads) with Internet access and LEGO MINDSTORMS® EV3 software installed and updated. The details on how to download the software from LEGO® are included with the core set.
    - Including one computer/teacher laptop with connection to projector.
    - If computers are not readily available, iPads or Android Tablets can be used, with the LEGO MINDSTORMS® EV3 Programmer App for Tablet installed.
- Professional Learning/Teacher Release time for facilitating teachers, ideally:
    - Access to external professional learning opportunities relating to robotics (see PL section of website for up-to-date information on available courses).
    - Equivalent of one full day allocated to planning/preparation before starting the Robotics Social Club.
    - Blocks of approximately two hours of reflection and planning time every four weeks throughout the Robotics Social Club.
- An appropriate day and time for the Robotics Social Club to be held, ideally:
    - 1.25 to 1.5 hours per session;
    - As an after-school Club, but *not* after a long, content-heavy day for students;
    - Alternatively, during Sport & Recreation time, or during lunchtimes. However, allow two lunchtimes per session described in this program, to ensure sufficient time. To foster student engagement, aim for two consecutive lunchtimes, or at least two lunchtimes within the same week, to cover each session.
- An appropriate space to hold the Club that will be consistently available. For example, a computer lab with desktop computers; open-plan classroom with both desk and floor working spaces.

2.2 Identifying Facilitating Teachers

At least two teachers will need to be identified who will be able to facilitate Club sessions consistently, with one teacher taking the role of lead Robotics teacher. The

Robotics Social Club is most effective with at least two supporting teachers/adults in the room.

Facilitating teachers will ideally:

- Have an interest in both supporting students with ASD, *and* technology/robotics.
- Be motivated to engage in a process of informal professional learning, be able to make an extended time commitment, and be ready for a challenge.
- Ideally, teach at least some of the participating students in the classroom, in order to support the transfer of skills back to the classroom environment, and strengthen teacher-student relationships.
- Teachers in Departments of Science, Maths, Information Technology, Engineering, or Design and Technology may be well-placed to fulfil the role, given their background knowledge of technology content and understanding of the links to the Digital Technologies curriculum. However, this is not necessary for the Club to be successful.

2.3 Identifying Participating Students

This program has been developed to specifically target students in Year 7 and 8, given the importance of fostering relationships with peers and teachers at the start of secondary school. However, you may choose to widen the scope to younger or older students depending on your school's needs. Care has been taken to pitch the program at students (and teachers) with no prior experience with LEGO® robotics. When identifying students who may benefit from participation:

- Aim for a total of 15 students (or 3 students per robotics kit).
- Have a mix of students with and without ASD. Both these groups can benefit from the opportunity to socialise with each other. Students without ASD who are considered at risk of disengagement from school, may also benefit the most from participating.
- Ideally, students should have an interest in learning about robotics.

You may like to invite particular students to participate, who have been identified as having the most to benefit from the program. After this round of invitational offers, expressions of interest may be opened and accepted from the wider student population. See Appendix A. Parent Information Sheet for a template that can be sent home to families of interested students. Please note, this process for identifying participating students is a suggestion only. It may be tailored to best meet your school's and students' needs.

3.0 Planning and Preparing for the Robotics Social Club

Facilitating teachers will need to work through the following steps and considerations to prepare for successfully implementing the *Robotics Social Club* program.

3.1 Essential Elements of the *Robotics Social Club* Program

While there is flexibility to how the Robotics Social Club and associated teacher professional learning is implemented in schools, the following elements of the program are considered essential to its effectiveness in a school setting. These guidelines are drawn from a review of autism intervention research by Koegel, Matos-Freden, Lang, and Koegel (2012).

1. **Individualised planning:** The program should include an individualised analysis of the social strengths and challenges of each student with ASD, using the Personal and Social Capabilities continuum as a guide to assess their current level in each area (see Section 3.2.1 Personal and Social Capability: Social Management Continuum). Ideally this would also involve monitoring of student reflections, and teacher assessment of students' demonstration of the success criteria, to help assess their response to intervention (see Section 3.2.2 Student Reflections). This will help identify target areas, and evaluate the effectiveness of the Robotics Club for the student(s) with ASD. (Koegel, Dunlap, & Koegel, 1996).

2. **Providing opportunities to communicate with peers:** Increased opportunity for positive social interaction and communication with peers and teachers in the Robotics Club setting is essential, as students with ASD often have few opportunities during the school day for positive interaction in a motivating environment (Chiang, 2009).

3. **Self-management:** The learning process students follow for planning, monitoring and evaluating their demonstration of the teamwork skills (see Section 3.3 Session Schedule & Learning Process), is essential to encourage self-management and thus generalisation of learned skills (Koegel & Koegel, 1990). Teachers are also encouraged to listen to students' preferences in planning Robotics Challenges, to maximise students' engagement.

4. **Consistent implementation:** Ensuring consistency in the running of the Robotics Club across teachers, and across sessions, will support students' progress (Koegel & Koegel, 2006).

5. **Home-school communication:** Communication between the school and parents of students with ASD to encourage reinforcement of target skills at home, has been shown to result in faster learning of skills, and assists students to maintain positive social behaviours over time (Koegel et al., 2003). Schools can use Appendix A. Parent Information Sheet, and refer parents to the Parent section of the website, to facilitate home-school communication. In

addition, it is recommended that schools invite parents to selected sessions, to enhance home-school communication and as an opportunity for students to develop leadership skills and a sense of mastery and expertise.

6. **Implemented within a school setting:** The Robotics Social Club program has been developed and researched within mainstream school settings. Many of the essential elements of this program can only occur within an inclusive school or college setting (Ormrod, 2006).

3.2 Identifying Individual Student Needs

For students with ASD to gain the most benefit from participating in the Club, it is helpful for facilitating teachers to form a picture of these students' individual strengths and needs. Suggestions and methods to help form this picture are described below.

You may like to consider completing this process for other students in the Club, who may not have ASD, but may have other learning difficulties or be considered at risk of disengagement.

Schools may also consider alternative methods of data collection and evaluation, such as the use of standardised pre-post measures of social skills (e.g. Social Skills Improvement System Rating Scales; Gresham & Elliott, 2008) and/or school engagement (e.g. Motivation and Engagement Scale; Martin, 2007).

3.2.1 Personal and Social Capability: Social Management Continuum

The table below is an extract of the Social Management continuum, taken from the Australian Curriculum, Personal and Social Capability (ACARA, 2016). The Robotics Social Club program aims to consolidate students' skills at Level 4 (end of Year 6), and develop skills at Level 5 (end of Year 8). Students with ASD may not be at expected standards, given their social communication and interaction difficulties.

Reflect on the students with ASD in your club, and use this continuum to "plot" their current skill level in each of the five Social Management areas. If you are not familiar with these students, you may like to consult with their case manager and/or class teachers to help identify their areas of strength and need.

Table: Social Management Continuum Extract (ACARA, 2016)

Level 3: Typically by the end of Year 4, students:	Level 4: Typically by the end of Year 6, students:	**Level 5: Typically by the end of Year 8, students:**
Communicate effectively identify communication skills that enhance relationships for particular groups and purposes	Communicate effectively identify and explain factors that influence effective communication in a variety of situations	**Communicate effectively** **analyse enablers of and barriers to effective verbal, nonverbal and digital communication**
Work collaboratively describe characteristics of cooperative behaviour and identify evidence of these in group activities	Work collaboratively contribute to groups and teams, suggesting improvements in methods used for group investigations and projects	**Work collaboratively** **assess the extent to which individual roles and responsibilities enhance group cohesion and the achievement of personal and group objectives**
Make decisions contribute to and predict the consequences of group decisions in a range of situations	Make decisions identify factors that influence decision making and consider the usefulness of these in making their own decisions	**Make decisions** **assess individual and group decision-making processes in challenging situations**
Negotiate and resolve conflict identify a range of conflict resolution strategies to negotiate positive outcomes to problems	Negotiate and resolve conflict identify causes and effects of conflict, and practise different strategies to diffuse or resolve conflict situations	**Negotiate and resolve conflict** **assess the appropriateness of various conflict resolution strategies in a range of social and work-related situations**
Develop leadership skills discuss the concept of leadership and identify situations where it is appropriate to adopt this role	Develop leadership skills initiate or help to organise group activities that address a common need	**Develop leadership skills** **plan school and community projects, applying effective problem-solving and team-building strategies, and making the most of available resources to achieve goals**

You may also like to focus on the broader Personal and Social Capability elements of Self-awareness, Self-management, and Social Awareness, in addition to Social Management. For further detail, see the full Personal and Social Capability curriculum.

3.2.2 Student Reflections

See Appendix C. Student Reflection Sheets. for the five student reflections which break down the “teamwork skills” within the Social Management element of Personal and Social Capability (communicate effectively; work collaboratively; make decisions; negotiate and resolve conflict; develop leadership skills; ACARA, 2016).

These Student Reflection Sheets use the Visible Learning practices of learning intentions and success criteria (Hattie, 2009), to make the focus social skills explicit and concrete for students. See Section 3.3 Session Schedule & Learning Process for more detail about students' use of the Reflection Sheets. The Student Reflection Sheets can also be used by teachers, to rate students with ASD as an additional method of identifying individual students' strengths and needs, and monitoring and evaluating learning progress.

3.3 Session Schedule & Learning Process

The table below describes the standard schedule and learning process of each Robotics Club session, to best support students' learning. While the content will change depending on the robotics challenge and matching Personal and Social Capability teamwork skill, this schedule and learning process will remain constant.

Session Schedule	
Session Element	**Steps**
Introduction **5 minutes**	1. Introduce visual schedule of the session, e.g. 3:15pm – Introduction 3:20pm – Planning 3:30pm – Robotics Challenge 3:50pm – Halfway Monitoring 4:15pm – Evaluation & Pack Up 2. Briefly outline or review the Club rules (refer to poster). 3. If necessary, teachers facilitate formation of new teams and record new team and robot names. 4. Play the short Robotics Challenge video clip on projector.
Planning **10 – 15 minutes** *What does it look like? How can I achieve this?*	1. Briefly introduce the specific teamwork skill, learning intention and success criteria (refer to Student Reflection Sheet and/or Monitoring Chart). 2. Teachers demonstrate/model the skill (e.g. through role play, or giving examples of language. You may choose to demonstrate meeting OR not meeting the success criteria). 3. Students evaluate the teacher(s) against the success criteria. 4. Students generate their own demonstration/examples of how to meet the success criteria (e.g. through a "think, pair, share" activity; use discretion as to whether students are ready to demonstrate in front of the group, this is not necessary). 5. Depending on the Robotics Challenge, you may choose to prompt students to use the Robot Design Process to plan their Robotics Challenge before beginning working time (add 5 minutes to Planning time).

Robotics Challenge & Monitoring **45 – 55 minutes** *Pause for student monitoring halfway through working time: What am I doing well? What do I need to keep working on?*	1. Teach programming content if necessary, referring to programming video as needed. 2. Working time: students complete the Robotics Challenge in their teams, and teachers implement effective strategies to support students' learning of the teamwork skill (e.g. growth mindset, prompting; praise and positive reinforcement; refer to Teacher Reflection as a reminder). 3. Monitoring by teachers: Team or Whole-Club Monitoring Chart/positive reinforcement system for successful demonstration of success criteria, throughout working time. 4. Monitoring by students: pause halfway through the Robotics Challenge working time, for students to complete the success criteria rubric and identify what they are doing well and what they can improve on. 5. If parents have been invited, they may be present for approximately last 30 minutes of session (last 20 minutes of Robotics Challenge time).
Evaluation & Pack Up **15 minutes** *What did I do well? What do I need to keep working on next time?*	1. Evaluation by students: at end of the session, students once again complete the success criteria rubric, reflect on what they did well and what they can improve on next time. Support students to self-reflect on their demonstration of teamwork skills. 2. Evaluation by teachers: refer to Team or Whole-Club Monitoring Chart/positive reinforcement system and praise/provide feedback to specific teams and students. Invite students to give positive/constructive feedback to peers. 3. Pack up, farewell and advise students of Robotics Challenge for following session, providing them with "something to think about" to help prepare for following session if helpful.

3.4 Program Planning

Use the information in this section in combination with Appendix B. Program Planning Template. and detailed information about each Robotics Challenge on the Robotics Social Club website, to design a flexible* Robotics Social Club *Program that will best fit the needs and preferences of your school and students.

It is worthwhile investing a significant chunk of planning time before commencing the Club, to enhance the facilitating teachers' competence and confidence, and help the Club run smoothly. Use Appendix B. Program Planning Template. and detailed information about each Robotics Challenge on the website, to select a sequence of Robotics Challenges and plan a draft schedule of dates for Robotics Club sessions. The Program Planning Template and webpages also outline the suggested focus Teamwork Skill from the Personal and Social Capabilities for each Challenge, and proposed parent involvement. However, teachers should remain open and flexible, and listen to students' preferences in choosing the Robotics Challenges throughout the phases of the program. The three phases of the program may be completed over 2 – 3 school terms.

3.4.1 Beginning Phase

While not essential if your school's LEGO® MINDSTORMS® EV3 Core Sets have already been assembled, the following Starter Challenge is highly recommended to maximise students' engagement and sense of ownership.

Starter Challenge: Building Your Robot (approx. 2 sessions)

Task	*Form teams and together, build your EV3 Edubot, following the instructions in the booklet or on the software.*
Videos/Links	Brief Introduction to Robots History of Robots
Programming	Nil.
Building	Building: Edubot & Driving Base • Brick • Motors
Parent Involvement	Nil.
Extra Materials	Nil.

Select a combination of activities from the options below to complete in the first 3-6 sessions.

Challenge 1: Silly Walks (1-2 sessions)

Task	*Create a robot that moves without wheels. Move the silly walk robot over 1m in the fastest time possible.*
Videos/Links	Challenge: Silly Walking Machines Programming: EV3 Software Overview
Programming	Programming: Straight Move • Rotations/Seconds • Steering – Forward
Building	Building: Driving Base • Brick • Motors
Parent Involvement	• Invited to end of session – demonstration
Extra Materials	• Tape for start and finish lines.

Challenge 2: Maze Runner (1-2 sessions)

Task	*Working with your team, program your robot to safely maneuver through the maze.*
Videos/Links	Simple Maze Runner
Programming	Programming: Curved Move • Degrees/Rotations • Steering – Forward
Building	Building: Driving • Wheels
Optional Extension	For second session: • Steering – Backwards
Parent Involvement	• Invited to end of session – demonstration
Extra Materials	• Wooden frame or tape to create maze.

Challenge 3: Mexican Wave (1-2 sessions)

Task	*Work with your team and the whole Robotics Club to create a robot Mexican wave. You can only use* forward, backward *and* wait for *commands. Film the finished product.*
Videos/Links	Challenge: Simple Mexican Wave Challenge extensions: Mexican Wave Next Steps Example 1 Mexican Wave Next Steps Example 2 Programming: Mexican Wave Programming
Programming	Programming: Wait For • Seconds • Steering – Forward
Building	Building: Driving • Wheels
Optional Extension	For second session: • Add extra synchronised sound/movement Programming: Add Sound • Pre-recorded/from file • Recording voice
Parent Involvement	• Invited to end of session – demonstration and teaching
Extra Materials	• Tape for start line. • iPad or camera for filming.

3.4.2 Developing Phase

There is the option of forming new teams and new robot names in first session of the Developing Phase. Facilitating teachers should consider students' teamwork skills progress, student feedback, and personalities, in making this decision. For more information see Section 3.6.1 Considerations Regarding Team Formation.

It is recommended this block of four sessions be completed in sequence, to maximise student engagement and learning.

Session 1: Escape from the City

Task	*Program your robot to stay within the city walls using the colour sensor. Identify the tape, move backwards, turn and then move forwards. Escape from the city first.*
Videos/Links	Challenge: Escape from the City Programming: Escape from the City Programming
Programming	Programming: Add Sensor – Colour • Colour Sensor – Light Programming: Iterations and Branching • Loop Block • Switch Block
Building	Building: Sensor • Attach Colour Sensor
Parent Involvement	• Invited to end of session – demonstration and teaching
Extra Materials	• Tape for city walls.

Session 2: Sumo Building

Task	*Design an attachment that will push your opponent off the sumo mat. Build the attachment to your sumo robot.*
Videos/Links	Challenge: Intro to Robot Sumo Sumobot Examples More Sumobot Examples
Programming	Nil.
Building	Building: Add Arms • Attachment – Push or Pull
Parent Involvement	Nil.
Extra Materials	Nil.

Session 3: Sumo Programming & Testing

Task	*Program your robot to stay in the ring using the colour sensor, and perhaps to charge at opponents using the ultrasonic sensor. Test your programming and attachment, then redesign and make improvements.*
Videos/Links	Programming: Simple Robot Sumo Programming (no ultrasonic sensor) Dr Graeme's Robot SUMO Tutorial Omar's Design Tech Blog: SUMO Robotics EV3
Programming	Programming: Sensor – Ultrasonic • Loop Block • Switch Block • Ultrasonic Sensor
Building	Building: Add Arms (continued) • Attachment – Push or Pull
Parent Involvement	Nil.
Extra Materials	• Sumo mat *or* tape to create sumo ring/square.

Session 4: Sumo Battles

Task	*Compete against other teams in a sumo wrestling competition. Can your team's robot push your opponent out of the ring?*
Videos/Links	See previous two sessions for videos relating to building and programming.
Programming	Programming: Sensor – Ultrasonic (continued) • Loop Block • Switch Block • Ultrasonic Sensor
Building	Building: Add Arms (continued) • Attachment – Push or Pull
Parent Involvement	Invited to whole session – celebration/sumo event.
Extra Materials	• Sumo mat *or* tape to create sumo ring/square.

3.4.3 Culminating Phase

Once again, there is the option of forming new teams and new robot names in first session of the Culminating Phase. Facilitating teachers should consider students' teamwork skills progress, student feedback, and personalities, in making this decision. For more information see Section 3.6.1 Considerations Regarding Team Formation.

Select a combination of activities from the options below to complete over at least 4 sessions. The list of suggestions below includes ideas for continuing the Robotics Social Club into the future, after completion of the 11-18 sessions of the program.

Celebrate Challenge (2 – 3 sessions)

Task	*Teams design and build a robot to celebrate the Robotics Club when it senses a human (wave, fist bump, high five, etc).*
Videos/Links	Inspiration: Robots dancing to *Single Ladies* by Beyonce; *Harlem Shake* by Baauer; *Tik Tok* by Kesha.
Programming	Open-ended, e.g. ultrasonic sensor, sound sensor.
Building	Open-ended.
Parent Involvement	Invited to end of final Celebrate session – showcase and teaching opportunity.
Extra Materials	Nil.

Space Challenge (2+ sessions)

Task	*With your team, choose and/or create one or more challenges using the Space Mat in the time provided.*
Videos/Links	Challenge: Intro to Space Challenge Around the Moon (no Space Mat required)
Programming	Open-ended.
Building	Open-ended.
Optional Extensions	• Challenge another team to complete your challenge. • Teach your parents how to complete your challenge.
Parent Involvement	Invited to final Space Challenge session – showcase and teaching opportunity.
Extra Materials	Space Challenge Activity Pack or alternative props.

Create Your Own Challenge (3 – 4 sessions)

Task	• *Teams create their own Robotics Challenge (1 – 2 sessions).* • *Pair up with another team: complete each others' challenges, help each other achieve the challenge (1 session).* • *Parent/community involvement: Invite younger students, students from outside the club, and/or parents. Teams teach and support newcomers to complete the challenge (1 session).*
Videos/Links	See links in Section 3.5.1 Developing Technological Knowledge: LEGO® MINDSTORMS® EV3 Robotics if your students need inspiration. Examples could include creating a robot that draws; a robot that can do a household chore; any possibility students can think of.
Programming	Open-ended.
Building	Open-ended.
Optional Extensions	• Challenge another team to complete your challenge. • Teach your parents how to complete your challenge.
Parent/ Community Involvement	Invite younger students, students from outside the club, and/or parents. Teams teach and support newcomers to complete the challenge (final session).
Extra Materials	Nil.

Robot Creation Challenge (2+ sessions)

Task	*Students choose to follow instructions for alternative MINDSTORMS® EV3 models in the LEGO® Education software package, or create their own robot design from scratch.*
Videos/Links	Challenge: Intro to Creative Challenge
Programming	Open-ended.
Building	Open-ended. Option of following instructions in the LEGO® Education software package.
Optional Extensions	• Challenge another team to complete your challenge. • Teach your parents how to complete your challenge.
Parent Involvement	Invited to final session – celebration, showcase and teaching opportunity; presentation of certificates.
Extra Materials	Nil.

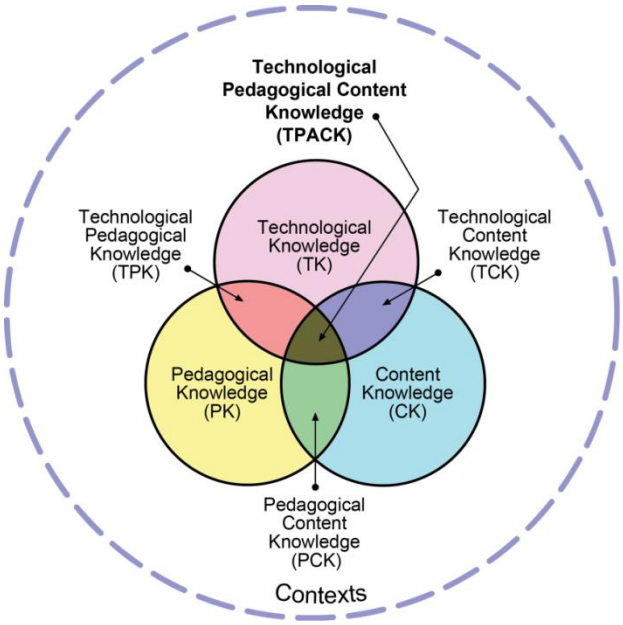
Links to further ideas:

- FIRST® LEGO® League
- RoboCup
- See Section 3.5.1 Developing Technological Knowledge: LEGO® MINDSTORMS® EV3 Robotics, and the Professional Learning Section of the website, for further links and up-to-date information.

3.5 Identifying Teacher Professional Learning Needs

The Technology, Pedagogy, and Content Knowledge (TPACK) framework (Koehler & Mishra, 2009) identifies teachers' professional learning needs that are critical to effective teaching with technology. It represents a complex interaction between three bodies of knowledge needed to successfully integrate technology use into teaching. In relation to the Robotics Social Club program:

- **Technological knowledge** involves understanding the LEGO® Robotics software, hardware and programming;
- **Pedagogical knowledge** involves understanding and applying teaching practices such as Visible Learning strategies, positive reinforcement, and visual supports among others, that are particularly relevant to teaching students with ASD; and
- **Content knowledge** involves understanding of the Personal and Social Capabilities, along with elements of the Technologies curriculum.



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Teachers can use this as a framework to identify, reflect on, and track their professional learning needs throughout the program.

Consider, in which of these areas do you feel you would benefit from further information and support, to feel confident in implementing the* Robotics Social Club *program?

3.5.1 Developing Technological Knowledge: LEGO® MINDSTORMS® EV3 Robotics

Many resources exist for teachers to develop their knowledge, competence, and confidence in working with robotics. The following suggestions are provided for teachers both completely new, and already familiar with LEGO® Robotics.

- Refer to Teacher Professional Learning in this manual, and on the website, for:
  - Links to further resources
  - Contacts and networking opportunities
  - Professional learning seminars and opportunities around Australia.

- MINDSTORMS® EV3 Software – Robot Educator
  - Step-by-step tutorials for programming:
    - Basics
      - Configuring Blocks
      - Straight Move
      - Curved Move
      - Tanks Move
      - Move Object
      - Stop at Line
      - Stop at Angle
      - Stop at Object
      - Brick Programming
    - Beyond Basics
      - Multitasking
      - Loop
      - Switch
      - Multiple Switch
      - Sensor Blocks
      - Compare
      - Colour Sensor – Calibrate

- EV3 Software support website
  - FAQs
  - Downloads
  - Software requirements
  - App Bluetooth support
  - Quick Guides
  - Software updates

- Other websites/tutorials:
  - Dr Graeme Tutorials for Absolute Beginners
    - Beginner Course
  - Classroom Activities for the Busy Teacher (Damien Kee)
    - Broader resources at http://www.damienkee.com/
  - LEGO EV3 Programming Basics

    - The LEGO ® MINDSTORMS® EV3 Discovery Book: A Beginner's Guide to Building and Programming Robots
    - LEGO® Engineering (Ian Chow-Miller)
    - The NXT Step is EV3: LEGO® MINDSTORMS® Blog
    - NXTPrograms.com
    - Omar's Design Tech Blog: SUMO Robotics EV3

- Suggestions for networking within your state/organisation:
    - FIRST® LEGO® League
    - RoboCup

3.5.2 Developing Pedagogical Knowledge: Effective Strategies

Previous research has identified effective pedagogical practices to support students with ASD to fully participate and access the curriculum. However, every student with ASD is unique, and the effective strategies used to support different students will vary. As a result, the *Robotics Social Club* program aims to:

a. develop teachers' knowledge of and ability to implement effective strategies, with a specific focus on supporting the students' development of the Personal and Social Capabilities,
b. encourage teachers to reflect on what is effective for the individual students they work with, and
c. support teachers to transfer these strategies from the Robotics Club setting to their classroom practice.

It is acknowledged that teachers acting as facilitators will vary greatly in their previous experience in working with students with ASD. Therefore, it is hoped that all facilitating teachers, no matter their previous level of experience, will engage in their own professional learning process through their involvement in the *Robotics Social Club* program.

During the development of the program, research identified the following key strategies listed in 3.5.3 Weekly Teacher Reflection below as effective for use within the *Robotics Social Club* context to support the use of effective practices and strategies. It is recommended that this checklist be used weekly by all facilitating teachers as a reminder regarding the implementation of effective practices and strategies.

Links to resources for teaching and working with students with ASD:

- Autism Friendly Practice
- Queensland Department of Education and Training – Autism Spectrum Disorder Online Resource Kit (many links to further resources)
- Autism Queensland – Useful Information – Education and Interventions
- Autism CRC
- British Columbia Ministry of Education – Teaching Students with Autism: A Resource Guide for Schools
- Government of South Australia – Quality Educational Practices for Students with Asperger Syndrome
- Victorian State Government Education and Training Autism Resources

3.5.3 Weekly Teacher Reflection

After each Robotics Club session, complete the following checklist of effective strategies to quickly reflect on what is working well that you should **continue**; what is not working for your club and what you might **change** for next time; and any new ideas that you might like to **start** trying next time. Feel free to add your own ideas and strategies.

Table: Weekly Teacher Reflection

	Effective Strategies	√	**Comment** *What worked well? What could I do differently next time?*
To encourage robotics task completion and success:			
1	Display and stick to the routine/schedule.		
2	Implement time management (e.g. use a countdown timer, remind students of remaining time).		
3	Use visuals (e.g. videos, posters, schedule).		
4	Give clear, explicit instructions; allow time for students to process information; repeat instructions if needed.		
5	Break tasks down into steps and smaller parts.		
6	Allow for differentiation (e.g. more time and support vs extension) to ensure all students' sense of success.		
To teach personal and social capability:			
1	Model and demonstrate skills (e.g. role play during introduction/planning phase).		
2	Take a learning focus/growth mindset (e.g. focus on positives; "It's okay not to know"; prompt and coach).		
3	Provide opportunities for practice and repetition.		
4	Provide praise, positive reinforcement and feedback (e.g. whole-club monitoring chart, verbal praise).		
To foster friendships and engagement:			
1	Create a safe, trusting, casual, fun environment.		
2	Listen to and consider students' preferences when deciding on groups/teams.		
3	Adjust the size of teams based on individual students' needs, to provide the right amount of challenge while ensuring success.		
4	Listen to and consider students' preferences when deciding on robotics challenges.		
How can I translate these effective strategies to my classroom practice?			

3.6 Before the First Session

This section outlines practical considerations to address before implementing the Robotics Club, to help sessions run smoothly.

3.6.1 Considerations Regarding Team Formation

It is important to carefully consider the best way to group participating students together into teams of 2 to 3, in order to encourage a fun, relaxed, positive environment, and successful practice and demonstration of the Personal and Social Capabilities.

If you do not teach some of the participating students, it is helpful to obtain background information about them, their social skills and networks from your colleagues who do teach them.

As a general rule, it is suggested that students are able to be in a team with fellow students who they are familiar with and are within their “comfort zone” in order to maximise engagement, before extending them by mixing teams and placing students with unfamiliar peers at one or two points throughout the program (i.e. when moving from the *Beginning* to the *Developing* Phase; and from the *Developing* to the *Culminating* Phase). Base these decisions on individual students’ needs and progress.

When teams are organised in Session 1, students will identify a team name, and a name for their robot. Ensure each kit is labelled. This encourages a sense of ownership and responsibility for the assigned robot and kit.

In the space below, you may like to list participating students, consider possible groupings of students into teams of 2-3, consider whether to allow students to choose their own teams initially, and any special considerations such as known personality clashes.

3.6.2 Encouraging Positive Behaviour and Collaboration

Like any learning environment at school, during the *Robotics Social Club* it is important to provide a safe and supportive environment and set up expectations that foster positivity, cooperation and positive relationships with and between students. Here are some suggested rules that work well in Robotics Social Clubs.

Ideally, print and display the colour poster of rules (see Appendix G. Poster of Rules.) in the room each week, and remind students of them regularly. These rules can be referred to as appropriate to reward students' positive behaviour.

Rules

1. **Have fun**: with your teacher, friends and all students in the Club.

2. **Be friendly**: with your speech and actions.

3. **Be respectful**: of other people by listening and focusing on the positive aspects of ideas and designs. Look after the equipment and ask other teams before borrowing their equipment.

4. **Be safe**: with the computers, robots and people in the Club.

5. **Ask for help**: from your friends and teachers. All designs can be shared and copied by others. Sharing and combining ideas will help us make awesome robots.

3.6.3 Session Checklist

Ensure you complete the items on this checklist before each session, so that each session runs smoothly. Technical issues are not uncommon, so it is helpful to go through this list at least a day or two before the Robotics Club, to allow time for troubleshooting and/or preparing resources.

√	**Before each session make sure:**
	Batteries are charged.
	Firmware is updated. This needs to be done *every few weeks.*
	LEGO® Core Sets are organised and ready to hand out.
	Each team has reliable computer access to the LEGO® MINDSTORMS® software, and internet.
	Extra challenge-specific materials/resources are available and set up e.g. duct tape; Space Mat.
	Teacher computer is open to the Robotics Club website and the relevant Challenge page, connected to projector ready to display videos.
	The relevant Teacher Monitoring Chart is prepared (printed and laminated for re-use, or projected), and relevant Student Reflection Sheets (or Student Booklets) are printed and ready to hand out.
	You have reviewed your Teacher Reflection from the previous session, and have a plan to implement strategies.
	Schedule of the session is written on the board, and a poster of the Club rules is displayed.

4.0 Implementing the *Robotics Social Club* Program

At least a day or two before the next Robotics Club session, refer to your prepared Program Planning Template and go to the relevant Phase/Robotics Challenge page in the Teacher Section of the *Robotics Social Club* website. If you are not familiar with the programming required for an upcoming Robotics Challenge, allow yourself adequate time to view relevant videos/tutorials and attempt the programming yourself, to ensure your confidence in teaching the robotics content to students.

The Robotics Challenge webpages contain all the reminders, documents and links you will require for each Challenge in the one place, including:

- Challenge/session overview
- Session checklist
- Any extra materials/resources required
- Suggested parent involvement
- Session schedule & learning process
- Videos and/or external links demonstrating the robotics challenge and relevant programming
- The relevant Student Reflection Sheet
- Robot Design Process
- The relevant Teacher Monitoring Chart
- Weekly Teacher Reflection

You can choose whether to print out relevant resources (e.g. Student Reflection Sheets and Robot Design Process for students) week-by-week; or alternatively, print out a copy of this Manual for yourself, and a copy of the Student Booklet for each participating student, to use throughout the duration of the Robotics Club.

List of links to Robotics Challenge webpages:

- Beginning Phase:
  - Starter Challenge
  - Silly Walks
  - Maze Runner
  - Mexican Wave
- Developing Phase:
  - Escape from the City
  - Sumo Building
  - Sumo Programming & Testing
  - Sumo Battles
- Culminating Phase:
  - Celebrate Challenge
  - Space Challenge
  - Create Your Own Challenge
  - Robot Creation Challenge

Students are able to access their own version of each Robotics Challenge webpage through the Student Section of the website.

5.0 Teacher Professional Learning

Essential to *Robotics Social Club* program is the opportunity for teacher professional learning with a focus on: a) identifying and meeting the needs of students with ASD, and the pedagogical practices that support student learning of the Personal and Social Capabilities, and b) knowledge, competence and confidence with robotics, programming/coding and technology.

For resources covering these two focus areas aimed at facilitating teachers, please refer back to Section 3.5.1 Developing Technological Knowledge: LEGO® MINDSTORMS® EV3 Robotics, and Section 3.5.2 Developing Pedagogical Knowledge: Effective Strategies

Further to this is a wider goal that aims to transfer the professional learning that takes place within the Robotics Social Club setting *to classroom practice*, and *to other teachers' practice* within the school environment. Below are a number of suggestions outlining how to go about this transfer of learning, based on the initial research outcomes. Schools are encouraged to choose an approach or mix of approaches to suit their professional learning culture and needs.

5.1 Teacher Mentoring, Observation, and Feedback

To facilitate the transfer of professional learning from the *Robotics Social Club* context to classroom practice and other teachers' practice, **it is recommended that other teachers in the school, particularly those who may teach the students with ASD participating in the Robotics Club, take part in a mentoring process/relationship with the teachers facilitating the Robotics Club.** For example these teachers could be members of the Learning Support/Inclusive Education team; identified by the Learning Support/Inclusive Education team; or self-identified due to their interest in supporting students with ASD and interest in robotics. **If this is not possible or practical, at the very least, the two facilitating teachers should engage in this process together.**

Teacher mentoring has been shown to be an effective professional learning model, where mentoring interactions occur regularly over time, and is focused on diagnosing learning needs and implementing specific pedagogical practices (Jensen et al., 2014). To be most effective, the mentoring process should involve identification of needs, planning, observation of each other's lessons, reflection, and provision of feedback on strengths and areas for improvement. Through active collaboration, this model can help teachers to identify effective practices to use within their school setting. It may also help to build teacher-student relationships, which enhance student engagement and have been identified as a positive outcome of the Robotics Social Club.

It is recommended that teachers who are engaged in the mentoring process:

1. Identify their own professional learning needs (see Section 3.5 Identifying Teacher Professional Learning Needs).

2. Identify the specific learning needs of individual students they teach in the classroom, who are involved in the Robotics Social Club (see Section 3.2 Identifying Individual Student Needs).
3. Observe a minimum of two Robotics Social Club sessions and complete a brief reflection on how the pedagogical practices used in the Club can be transferred back to the classroom setting (use 3.5.3 Weekly Teacher Reflection as a prompt).
4. Engage in a planning session with the Robotics Club facilitating teacher(s), provide and receive feedback, brainstorm, and plan for implementing the content and pedagogy in their classroom teaching.
5. Ideally, observe each other's classroom lesson in which the planned content and pedagogy is implemented. Meet to reflect, provide and receive feedback on this classroom lesson, and review effective pedagogical practices for individual students with ASD.
6. Continue to plan and reflect on classroom practice individually, regarding effective pedagogy for particular students with ASD.
7. Evaluate whether the identified student learning needs and professional learning needs have been met, and assess students' response to intervention.

5.2 Sharing via Staff Meetings

Teachers facilitating the Robotics Social Club will undoubtedly develop:

- Content knowledge about the *General Capabilities: Personal and Social Capability* curriculum (ACARA, 2016);
- Pedagogical knowledge about effective practices for working with students with ASD; and
- Technological knowledge about robotics, coding and programming.

This professional learning could be shared with other teachers in the staff meeting forum. Options for how to structure this information sharing should be based on your school's and teachers' needs. For example:

- Sharing an overview of the learnings of the Robotics Social Club at a whole of staff meeting, highlighting take-home messages for all teachers;
- Sharing and exploring methods to teach and develop the Personal and Social Capabilities with the Pastoral Care team;
- Sharing effective pedagogical practices for particular students (especially students with ASD) with Year Level teams and Inclusive Education teams;
- Sharing technology, robotics and programming skills and applications with Science, Mathematics, Engineering, Information Technology, and/or Design and Technology departments.
- This could occur as repeat meetings so all involved are engaging in professional learning together over time (e.g. monitoring students' progress and responding to evolving learning needs); or less frequently, depending on resourcing, identified needs and practicalities.

5.3 Informal Information Sharing

Encourage informal conversations and sharing between teachers as relevant and needed. For example:

- A weekly email could be sent to staff and/or parents after each Robotics Club session, with pertinent information e.g. the web link to the current robotics challenge, students' achievements, particular friendships to foster or discourage, suggestions for strategies to implement or skills to reinforce in the classroom/playground/at home.
- The Robotics Social Club facilitating teachers could be listed as a contact person on individual students' files, as someone who can provide information about their social functioning, or provide support to the student in question if needed at times of stress or anxiety. These teachers may also be able to provide advice in relation to identifying strategies that have worked in the Robotics Club to support the student in question and their learning and social needs.
- Facilitating teachers may be invited to have input into participating students' Individual Education Plans.

5.4 The *Robotics Social Club* Interactive Learning Community

The Professional Learning section of the website provides a hub of resources, including:

- Links to further resources relating to robotics, and supporting students with ASD.
- Listings of relevant professional learning workshops and courses in your state.
- Networking contacts and suggestions in your state.
- The opportunity to interact with teachers in other schools who are implementing *Robotics Social Clubs,* to share experiences and learnings.

Please utilise this opportunity to share your experiences, and learn from others.

6.0 Evaluating the *Robotics Social Club* Program

It is important to reflect and evaluate the effectiveness of the *Robotics Social Club* program and the outcomes for students and teachers in your school, to inform necessary changes and maximise positive outcomes in the future.

6.1 Evaluating Student Outcomes

Upon completion of the manualised Robotics Social Club program, assess and rate the Personal and Social Capabilities of the participating students with ASD by plotting them on the Social Management continuum (ACARA, 2016). You may also review and assess their demonstration of the success criteria using the Student Reflection Sheets. Then, reflect on the strengths and needs of these students that were identified in Section 3.2 Identifying Individual Student Needs before starting the Robotics Social Club, using the Social Management continuum and Student Reflection Sheets.

For each student with ASD, has there been an observable shift and demonstrable learning outcomes? What are their strengths? Where have they shown improvements? In what areas would they benefit from further support and teaching?

Ideally, this information should be shared:

- With students' classroom teachers.
- With students' parents, providing parents with the option of an individual feedback meeting. Endeavour to seek feedback about the program, and suggestions for improvement, from parents.
- With students themselves, through individual feedback and reflection, to recognise and celebrate their achievements, and identify future goals. Endeavour to seek feedback about the program, and suggestions for improvement, from students.

You may like to consider completing this process for other students in the Club, who may not have ASD, but may have other learning difficulties or be considered at risk of disengagement.

Schools may also consider alternative methods of data collection and evaluation, such as the use of standardised pre-post measures of social skills (e.g. Social Skills Improvement System Rating Scales; Gresham & Elliott, 2008) and/or school engagement (e.g. Motivation and Engagement Scale; Martin, 2007).

6.2 Evaluating Teacher Outcomes

Upon completion of the program, reflect on your own professional learning journey, and key messages to share with other teachers through the professional learning opportunities described in Teacher Professional Learning. Provide feedback and recommendations to your School Leadership Team regarding future implementation of the *Robotics Social Club* in your school.

Congratulations on completing the Robotics Social Club program!
It is hoped you will continue to find this manual and the online resources a useful tool in supporting your students.

7.0 References

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Appendix A. Parent Information Sheet Template.

Dear Parents/Carers,

This year we are running the *Robotics Social Club* program in our school. Your child has been invited, or expressed an interest, in participating.

Who?
A mix of students in (Years 7 & 8) are invited to participate. We have capacity for (approximately 15) students to participate in the Club. The Club will be facilitated by (insert teachers' names and positions here).

Why?
The *Robotics Social Club* program has been developed to create opportunities for all students, including students with autism spectrum conditions, to learn social skills, make friends and socialise with peers over a common interest, and enhance their sense of engagement and belonging at school.

How?
Students learn programming, problem solving and social skills at school, by working in teams to complete robotics challenges using LEGO® MINDSTORMS® robotics equipment and software. There is a particular focus on developing students' *Personal and Social Capabilities* (a part of the Australian Curriculum), particularly the ability to communicate effectively, work collaboratively, make decisions, negotiate and resolve conflict, and develop leadership skills.

Teachers facilitating the program will partake in an ongoing professional learning process, and develop stronger teacher-student relationships.

What, When, Where?
Robotics Club sessions will be held on (insert day of the week) from (insert start and finish time) in (insert room). It is intended these sessions will be held weekly, starting on (insert start date) with the program scheduled to finish on (insert end date).

Parents/carers are invited to attend (two) key milestone sessions, currently scheduled for (insert proposed dates of Sumo Battle session and Final session). You will be advised if these dates change. You are also welcome to come in for the last 20 minutes of certain sessions, to observe the teams of students, and their creations, in action.

It is strongly encouraged that you discuss your child's participation with them, and look at the Parent section of the *Robotics Social Club* website at (insert web address), for information about the specific robotics challenges and social/teamwork skills.

We hope the *Robotics Social Club* is a rewarding experience for your child. Please contact (insert contact name and details) if you have any questions about your child's participation.

Yours sincerely,

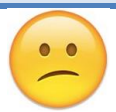
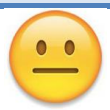
Appendix B. Program Planning Template.

Program Phase & Session #		Personal and Social Capability (Teamwork Skill)	Activity	Programming & Building	Parent Involvement	Proposed Date
BEGINNING PHASE	Pre	**Communicate effectively** Learning intention: to be able to use our words and body language to politely listen to others, and explain our ideas to others.	*OPTIONAL, DELETE ROW IF UNNECESSARY* **Starter Challenge** Welcome and Introduction to Robotics Club. Form teams and decide on team names. In your teams, build your LEGO® MINDSTORMS® EV3 Edubot.	**Building:** Edubot & Driving Base • Brick • Motors	N/A	
	Pre	**Communicate effectively** Learning intention: to be able to use our words and body language to politely listen to others, and explain our ideas to others.	*OPTIONAL, DELETE ROW IF UNNECESSARY* **Starter Challenge** Continue to build LEGO® MINDSTORMS® EV3 Edubot in teams. Teams who finish early offer help to other teams. Name robots and test connectivity to software.	**Building:** Edubot & Driving Base • Brick • Motors	N/A	
	1	**Make decisions** Learning intention: to be able to make decisions as a group, in a way that is fair for all group members.	*IF NOT ALREADY COMPLETED, INCLUDE HERE:* **Welcome and Introduction to Robotics Club. Form teams; name teams and robots.** **Challenge: Silly Walks** Create a robot that moves without wheels. Move the silly walk robot over 1m in the fastest time possible.	**Programming:** Straight Move • Rotations/Seconds • Steering – Forward **Building:** Driving Base • Brick • Motors		
		Make decisions Learning intention: to be able to make decisions as a group, in a way that is fair for all group members.	*OPTIONAL, DELETE ROW IF UNNECESSARY* **Challenge: Silly Walks continued** Create a robot that moves without wheels. Move the silly walk robot over 1m in the fastest time possible. Test your robot and make improvements.	**Programming:** Straight Move • Rotations/Seconds • Steering – Forward **Building:** Driving Base • Brick • Motors	Invited to end of session: Demonstration	
		Communicate effectively Learning intention: to be able to use our words and body language to politely listen to others, and explain our ideas to others.	**Challenge: Maze Runner** Working with your team, program your robot to safely maneuver through the maze.	**Programming:** Curved Move • Degrees/Rotations • Steering – Forward **Building:** Driving • Wheels		
		Communicate effectively Learning intention: to be able to use our words and body language to politely listen to others, and explain our ideas to others.	*OPTIONAL, DELETE ROW IF UNNECESSARY* **Challenge: Maze Runner continued** Working with your team, program your robot to safely maneuver through the maze – *backwards.*	**Programming:** Curved Move • Degrees/Rotations • Steering – Backwards	Invited to end of session: Demonstration	
		Work collaboratively Learning intention: to be able to work together as a team to achieve a goal.	**Challenge: Mexican Wave** Work with your team and the whole Robotics Club to create a robot Mexican wave. You can only use *forward*, *backward* and *wait for* commands. Film the finished product.	**Programming:** Wait For • Seconds • Steering – Forward **Building:** Driving • Wheels		
		Work collaboratively Learning intention: to be able to work together as a team to achieve a goal.	*OPTIONAL, DELETE ROW IF UNNECESSARY* **Challenge: Mexican Wave continued** Work with your team and the whole Robotics Club to create a more complex robot Mexican wave. Discuss what each group wants to add (e.g. movement or sound). Film the finished product.	**Programming:** Add Sound • Pre-recorded/from file • Recording voice **Building:** Driving • Wheels	Invited to end of session: Demonstration, and opportunity to teach parents	

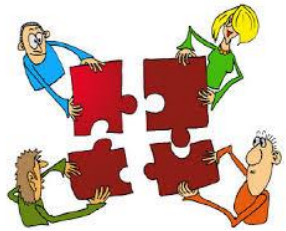
DEVELOPING PHASE	**1**	**Work collaboratively** Learning intention: to be able to work together as a team to achieve a goal.	**Option to FORM NEW TEAMS; name teams and robots.** **Challenge: Escape from the City** Program your robot to stay within the city walls using the colour sensor. Identify the tape, move backwards, turn and then move forwards. Escape from the city first.	**Programming:** Add Sensor – Colour • Colour Sensor – Light **Programming:** Iterations and Branching • Loop Block • Switch Block **Building:** Sensor • Attach Colour Sensor	Invited to end of session: Demonstration, and opportunity to teach parents	
	2	**Negotiate & resolve conflict** Learning intention: to be able to listen, make compromises, and reach a solution when there is a disagreement.	**Challenge: Sumo Building** Design an attachment that will push your opponent off the sumo mat. Build the attachment to your sumo robot.	**Building:** Add Arms • Attachment – Push or Pull		
	3	**Negotiate & resolve conflict** Learning intention: to be able to listen, make compromises, and reach a solution when there is a disagreement.	**Challenge: Sumo Programming & Testing** Program your robot to stay in the ring using the colour sensor, and perhaps to charge at opponents using the ultrasonic sensor. Test your programming and attachment, then redesign and make improvements.	**Programming:** Sensor – Ultrasonic • Loop Block • Switch Block • Ultrasonic Sensor		
	4	**Negotiate & resolve conflict** Learning intention: to be able to listen, make compromises, and reach a solution when there is a disagreement.	**Challenge: Sumo Battles** Compete against other teams in a sumo wrestling competition. Can your team's robot push your opponent out of the ring?	**Programming:** Sensor – Ultrasonic continued. **Building:** Add Arms continued.	Invited to whole session: Sumo Event and Celebration	
CULMINATING PHASE		**Teacher-selected Teamwork Skill based on student needs** **OR** **Student self-selected Teamwork Skill based on identified areas to improve on**	**Option to FORM NEW TEAMS; name teams and robots.** FOR REMAINING 4 – 6 SESSIONS, CHOOSE TWO FROM: • Celebrate Challenge (2-3 sessions) • Space Challenge (2+ sessions) • Create Your Own Challenge (3-4 sessions) • Robot Creation Challenge (2+ sessions)	Open-ended.		
		Teacher-selected Teamwork Skill based on student needs **OR** **Student self-selected Teamwork Skill based on identified areas to improve on**	*OPTIONAL, DELETE ROW IF UNNECESSARY*	Open-ended.		
		Teacher-selected Teamwork Skill based on student needs **OR** **Student self-selected Teamwork Skill based on identified areas to improve on**		Open-ended.	Invited to end of session: Opportunity to teach parents	
		Develop leadership skills Learning intention: to be able to teach other members of the school community, by planning and carrying out a project.	*START FINAL CHALLENGE*	Open-ended.		
		Develop leadership skills Learning intention: to be able to teach other members of the school community, by planning and carrying out a project.	*OPTIONAL, DELETE ROW IF UNNECESSARY*	Open-ended.	Potential opportunity to invite *other students* to Robotics Club: Club students teach new students about their creation.	
		Develop leadership skills Learning intention: to be able to teach other members of the school community, by planning and carrying out a project.		Open-ended.	Invited to whole session: Showcase/teaching, Celebration, and Presentation of Student Certificates	
	CONGRATULATIONS, YOU HAVE COMPLETED THE ROBOTICS SOCIAL CLUB PROGRAM! See additional ideas and links under "Culminating Phase" for further activities to continue your school's Robotics Social Club.					

Appendix C. Student Reflection Sheets.

Teamwork skill: Communicate effectively

Learning Intention: to be able to use our words and body language to politely listen to others, and explain our ideas to others.							
Success Criteria		 **Needs improve-ment**	 **Fairly good**	 **Good**	 **Great**	 **Fantastic**	**Comment** *How did I demonstrate this?* *What do I need to keep working on?*
1	**I listen quietly and patiently when my team mates are talking.**						
2	**I come up with ideas and explain them to my team mates.**						
3	**When I am talking or listening to someone, I turn my body towards them and look at their face.**						
4	**I give helpful and friendly feedback.** E.g. *"That's a good idea, I didn't think of that! Maybe we could also…"*						
5	**I listen and stay calm when people give me feedback.**						

Teamwork skill: Work collaboratively



Learning Intention: to be able to work together as a team to achieve a goal.							
Success Criteria		 **Needs improve-ment**	 **Fairly good**	 **Good**	 **Great**	 **Fantastic**	**Comment** *How did I demonstrate this?* *What do I need to keep working on?*
1	**I have a role in my team, and my team mates know what my role is** (e.g. builder, programmer, finder, tester).						
2	**I swap roles with my team mates if they would like a turn.**						
3	**I ask my team mates, other students, and teachers for help when I need it.** E.g. *"I can't work this out, can you please help me?"*						
4	**I ask others if they would like help.** E.g. *"That part was tricky, would you like me to show you what I did?"*						
5	**I give compliments and encouragement to others.** E.g. *"That's an awesome idea!", "Never mind, we can try again."*						

Teamwork skill: Make decisions

Learning Intention: to be able to make decisions as a group, in a way that is fair for all group members.							
Success Criteria		 **Needs improve-ment**	 **Fairly good**	 **Good**	 **Great**	 **Fantastic**	**Comment** *How did I demonstrate this?* *What do I need to keep working on?*
1	**I come up with and share ideas about how to solve the challenge.**						
2	**I listen to and think about each of my team mates' ideas.**						
3	**I talk about the strong points and not-so-strong points of different ideas with my team.**						
4	**I ask my team mates if they agree before making a decision.** E.g. *"Maybe we could try it this way, what do you think?"*						
5	**I take turns at making decisions with my team mates.**						

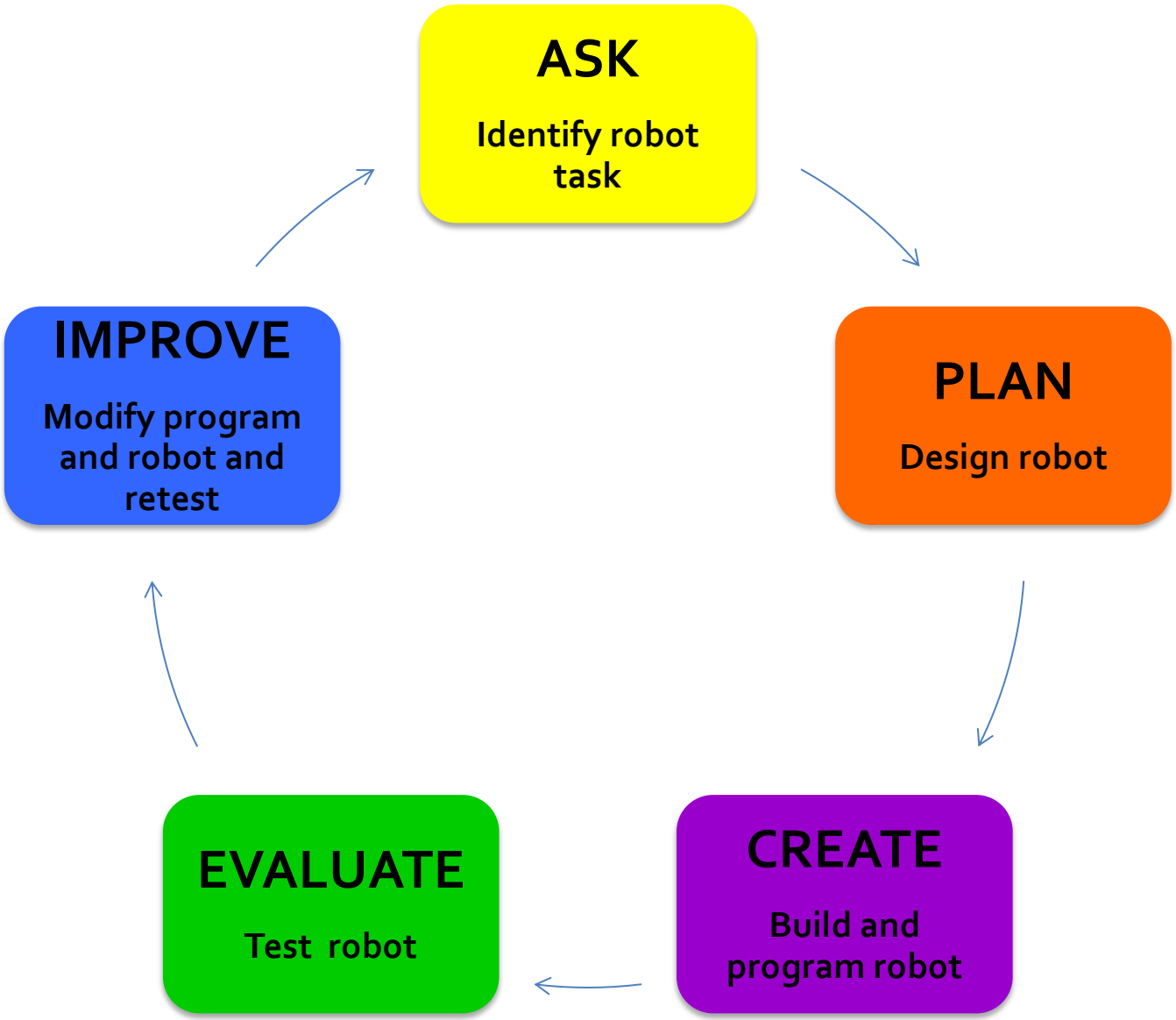
Teamwork skill: Negotiate and resolve conflict

Learning Intention: to be able to listen, make compromises, and reach a solution when there is a disagreement.							
Success Criteria		 **Needs improve-ment**	 **Fairly good**	 **Good**	 **Great**	 **Fantastic**	**Comment** *How did I demonstrate this?* *What do I need to keep working on?*
1	**I listen quietly and patiently to my team mates' ideas and feelings, even when I disagree.**						
2	**I stay calm and tell my team mates how I am feeling, when we disagree.** E.g. *"I feel annoyed when you do all the building, because I'd like to try my ideas too."*						
3	**I suggest ways to solve disagreements.** E.g. *"If you build onto the front of the robot, maybe I can build onto the sides, so we can use both our ideas."*						
4	**I change what I am doing to help reach a solution, even if it isn't what I want to do.**						
5	**I say sorry if I do or say something that upsets someone.**						

Teamwork skill: Develop leadership skills

Learning Intention: to be able to teach other members of the school community, by planning and carrying out a project.							
Success Criteria		 **Needs improve-ment**	 **Fairly good**	 **Good**	 **Great**	 **Fantastic**	**Comment** *How did I demonstrate this?* *What do I need to keep working on?*
1	**I come up with and share ideas with my team to plan a new challenge activity or robot creation.**						
2	**I suggest solutions to problems, and ask if everyone agrees.**						
3	**I help new people learn by clearly explaining the goal of the challenge, or how our robot works.**						
4	**I encourage and help others to learn and try new things.** E.g. *"Have you tried this before? That's okay, I can show you… Now you have a go!"*						
5	**I give compliments and congratulate others when they do things well.** E.g. *"Wow, well done making it move like that! You learned that really quickly."*						

Appendix D. Robot Design Process.



Teamwork skill: Communicate effectively
Team Monitoring Chart

Learning Intention: to be able to use our words and body language to politely listen to others, and explain our ideas to others.							
Success Criteria		**Tally** *How many times did the teachers see this today?*					**Comment** *Which teams or students did this particularly well today? How?*
		Team 1:	**Team 2:**	**Team 3:**	**Team 4:**	**Team 5:**	
1	**I listen quietly and patiently when my team mates are talking.**						
2	**I come up with ideas and explain them to my team mates.**						
3	**When I am talking or listening to someone, I turn my body towards them and look at their face.**						
4	**I give helpful and friendly feedback.** E.g. *“That’s a good idea, I didn’t think of that! Maybe we could also…”*						
5	**I listen and stay calm when people give me feedback.**						

<u>Teamwork skill: Communicate effectively</u>
Whole-Club Monitoring Chart

Learning Intention: to be able to use our words and body language to politely listen to others, and explain our ideas to others.			
Success Criteria		**Tally** *How many times did the teachers see this today?*	**Comment** *Which teams or students did this particularly well today? How?*
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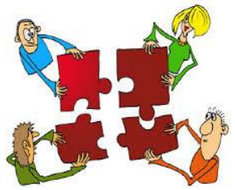
5	**I listen and stay calm when people give me feedback.**		



Teamwork skill: Work collaboratively
Team Monitoring Chart

Learning Intention: to be able to work together as a team to achieve a goal.							
Success Criteria		**Tally** *How many times did the teachers see this today?*					**Comment** *Which teams or students did this particularly well today? How?*
		Team 1:	**Team 2:**	**Team 3:**	**Team 4:**	**Team 5:**	
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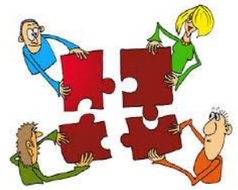
Teamwork skill: Work collaboratively
Whole-Club Monitoring Chart



Learning Intention: to be able to work together as a team to achieve a goal.			
Success Criteria		**Tally** *How many times did the teachers see this today?*	**Comment** *Which teams or students did this particularly well today? How?*
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Teamwork skill: Make decisions
Team Monitoring Chart

Learning Intention: to be able to make decisions as a group, in a way that is fair for all group members.							
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<u>Teamwork skill: Make decisions</u>
Whole-Club Monitoring Chart

Learning Intention: to be able to make decisions as a group, in a way that is fair for all group members.			
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5	**I take turns at making decisions with my team mates.**		

Teamwork skill: Negotiate and resolve conflict
Team Monitoring Chart

Learning Intention: to be able to listen, make compromises, and reach a solution when there is a disagreement.

	Success Criteria	**Tally** *How many times did the teachers see this today?*					**Comment** *Which teams or students did this particularly well today? How?*
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4	**I change what I am doing to help reach a solution, even if it isn't what I want to do.**						
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<u>Teamwork skill: Negotiate and resolve conflict</u>
Whole-Club Monitoring Chart

Learning Intention: to be able to listen, make compromises, and reach a solution when there is a disagreement.			
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Teamwork skill: Develop leadership skills
Team Monitoring Chart

Learning Intention: to be able to teach other members of the school community, by planning and carrying out a project.

	Success Criteria	**Tally** *How many times did the teachers see this today?*					**Comment** *Which teams or students did this particularly well today? How?*
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<u>Teamwork skill: Develop leadership skills</u>
Whole-Club Monitoring Chart

Learning Intention: to be able to teach other members of the school community, by planning and carrying out a project.			
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4	**I encourage and help others to learn and try new things.** E.g. *"Have you tried this before? That's okay, I can show you… Now you have a go!"*		
5	**I give compliments and congratulate others when they do things well.** E.g. *"Wow, well done making it move like that! You learned that really quickly."*		

Appendix F. Weekly Teacher Reflection.

After each Robotics Club session, complete this checklist of effective strategies to quickly reflect on what is working well that you should **continue**; what is not working for your club and what you might **change** for next time; and any new ideas that you might like to **start** trying next time. Feel free to add your own ideas and strategies.

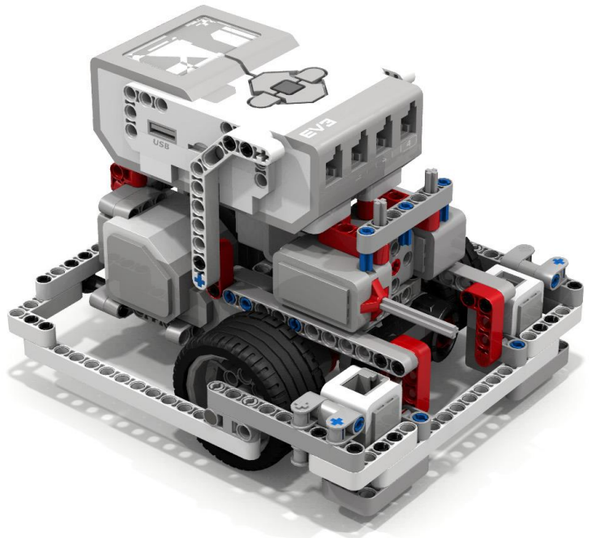
	Effective Strategies	√	**Comment** *What worked well? What could I do differently next time?*
To encourage robotics task completion and success:			
1	Display and stick to the routine/schedule.		
2	Implement time management (e.g. use a countdown timer, remind students of remaining time).		
3	Use visuals (e.g. videos, posters, schedule).		
4	Give clear, explicit instructions; allow time for students to process information; repeat instructions if needed.		
5	Break tasks down into steps and smaller parts.		
6	Allow for differentiation (e.g. more time and support vs extension) to ensure all students' sense of success.		
To teach personal and social capability:			
1	Model and demonstrate skills (e.g. role play during introduction/planning phase).		
2	Take a learning focus/growth mindset (e.g. focus on positives; "It's okay not to know"; prompt and coach).		
3	Provide opportunities for practice and repetition.		
4	Provide praise, positive reinforcement and feedback (e.g. whole-club monitoring chart, verbal praise).		
To foster friendships and engagement:			
1	Create a safe, trusting, casual, fun environment.		
2	Listen to and consider students' preferences when deciding on groups/teams.		
3	Adjust the size of teams based on individual students' needs, to provide the right amount of challenge while ensuring success.		
4	Listen to and consider students' preferences when deciding on robotics challenges.		
How can I translate these effective strategies to my classroom practice?			

Appendix G. Poster of Rules.

ROBOTICS CLUB RULES

Have fun

with your teacher, friends and all students in the Club.



Be friendly

with your speech and actions.

Be safe

with the computers, robots, and people in the Club.

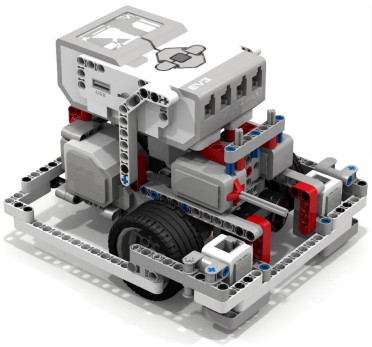
Be respectful

of other people by listening, and focusing on the positive aspects of ideas.
Look after the equipment and ask other teams before borrowing equipment.

Ask for help

from your friends and teachers. All designs can be shared and copied by others. Sharing and combining ideas will help us make awesome robots!

Appendix H. Student Certificate Template.



ROBOTICS CLUB

This is to certify that

_____

has successfully completed the Robotics Club program, and has developed these skills:

Teamwork skills:

- ✓ Communicate effectively
- ✓ Work collaboratively
- ✓ Make decisions
- ✓ Negotiate and resolve conflict
- ✓ Develop leadership skills

Robotics skills (using LEGO® MINDSTORMS® EV3):

Building:

- ✓ Edubot
- ✓ Driving base
- ✓ Attaching sensors
- ✓ Attachments
- ✓ Creative building

Programming:

- ✓ Straight move
- ✓ Curved move
- ✓ Wait for
- ✓ Add sound
- ✓ Colour sensor
- ✓ Ultrasonic sensor
- ✓ Iterations and branching

Signed: _____