Best Practice Guide:

Elements of successful school-industry STEM partnerships

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Disclaimer

This Best Practice Guide is a summary of elements of the *National STEM School Education Resources Toolkit*. The Australian Government Department of Education commissioned Dandolopartners International to develop the Toolkit to assist schools and industry to establish new STEM initiatives, form school-industry partnerships, and evaluate existing and future STEM initiatives.

The Toolkit uses real-world examples of events and activities offered by education departments, industry and other providers. Inclusion of references and links to external sources does not imply endorsement of any company, product or program by the Australian Government.

What are key elements that contribute to successful STEM education initiatives?

This guide is designed for schools, businesses and others that would like to understand key elements of best-practice STEM education. Use this guide to:

- Learn about nine principles for effective STEM education

- Identify and understand different STEM education initiative types

Successful STEM education initiatives share similarities

To increase student engagement and achievement, STEM education in the classroom needs to reflect what's happening in STEM's exciting fields outside the classroom.

There are nine principles you should always try to apply in STEM education. These are shown in the table below. Not every principle will be appropriate in every situation, but each will provide strong guidance. Many of the principles go well together, for example, equipping and empowering teachers to be confident in using inquiry-based learning.

Principle	What is it?	Why is this important?	Examples
1. Use inquiry-based learning	Inquiry-based learning is an education approach that focuses on investigation and problem-solving.	Students learn key STEM and life skills through inquiry-based learning: social interaction, exploration, argumentation, comfort with failure.	Build active learning into teaching practices through problem-based scenarios to encourage students to think critically.
2. Solve real-world problems	Students tackle real-world STEM problems from businesses and the community.	Demonstrates relevance of STEM; can enhance student motivation and interest.	Ask your local council or a local business for a challenging problem they're working on. Take it to your students and see what they come up with.
3. Teach integrated STEM learning	Integrated STEM learning combines the subject matter of two or more STEM subjects into a joint learning experience.	Supports cross-disciplinary STEM skills; can enhance student interest.	You can teach Science using an Engineering process (design-based learning).

	Principle	What is it?	Why is this important?	Examples
4.	Equip and empower teachers	Equipping and empowering teachers means providing them with the right resources (e.g. high-quality professional learning opportunities, up-to-date technology) and skills to teach best practice STEM education.	Teachers have the greatest influence on in-school achievement and engagement in STEM.	Connect a STEM teacher with a STEM mentor from a local business.
5.	Create partnerships between schools, businesses and community	Schools, businesses and other organisations create STEM education initiatives to improve student outcomes.	Exposes students to the workplace, inspires enthusiasm about STEM and enhances and complements curriculum.	Choose partners to work with on a STEM problem. Reach out to schools, businesses, museums, local councils and government.
6.	Engage parents and families	Encourage parents and guardians to be active in their children's education.	Improves enrolment, achievement and belief in importance of STEM education.	Invite parents and families to a STEM exhibition day to show them all the exciting things students are working on.
7.	Use technology as an enabler	Selective use of technology to support high-quality teaching and learning.	Accelerates student learning, increases confidence and ability in using technology.	Get students to program a technology instead of showing them what something does.
8.	Differentiate for different levels	Learning is tailored to the needs and abilities of individual students.	Supports all students' needs, regardless of starting point.	Assess student capability formally and informally so lessons can be tailored.
9.	Link education to 21st century learning	Build in development of 21st century skills such as critical thinking, creativity and collaboration.	21st century skills are highly valuable for students' future careers.	Encourage teamwork and healthy debate. Let students 'play' with the subject matter.

There are many different STEM education initiatives to consider

There are lots of different approaches to improving STEM outcomes through education and industry partnerships. Some are more established than others. New and innovative approaches are developing all the time.

The evidence about which types of initiative work best, and for what, is growing but incomplete. Below you can find information on **13 common types** of STEM education initiatives.

Green/ Positive: There is evidence that this initiative type has a positive impact on student STEM engagement or achievement.

Orange/ Mixed: There is evidence that this initiative type has mixed impacts on student STEM engagement or achievement.

Red/ Negative: There is evidence that this initiative type has a negative impact on student STEM engagement or achievement.

Grey/ Unclear: There is not enough clear evidence to draw a conclusion about the impact of this initiative type on student STEM engagement or achievement. This means further research is needed, but not that it doesn't work.

Initiative type	Evidence	Especially good for	Be aware that	What can industry do?
Excursions Take students out of the classroom for a different kind of experience	Unclear	Sparking excitement and curiosity Exposing students to real-world STEM environments	Be aware that excursions primarily aim to boost engagement, not directly improve achievement.	Design an excursion program for schools that involve STEM professionals or programs based on real problems.
Incursions STEM professionals and businesses visit the classroom to motivate and inspire	Unclear	Generating excitement and interest in STEM	Be aware that incursions primarily aim to boost engagement, not directly improve achievement.	Visit a partnering school to speak with students about STEM applications in the real-world.
Competitions Engage students individually or in groups to solve problems and challenges	Positive	Challenging high-achieving students	Be aware that competitions should focus on participation and learning, not just results.	Provide funding or resources to support established STEM competitions, include a STEM competition in a school partnership program or create a new competition open to entry by many schools.
Residential programs Immerse students in an intensive STEM learning environment	Unclear	Challenging high-achieving students in a particular field or group	Be aware that costs for residential programs can be high.	Support an existing STEM residential program e.g. sponsor participation. Partner with an existing program provider to scale up a residential program or consider creating or sponsoring a new STEM residential camp.
Extended real-world projects Challenge students to tackle a real-world problem using STEM, over an extended time period	Mixed	Enhancing problem-solving skills Developing collaboration and creativity	Be aware that implementing real-world projects can be complex.	Help schools identify and plan engaging and relevant STEM projects, host site visits to kick off projects, provide employees to visit schools to share real-world perspectives, provide employees for an 'expert panel' to which students present their work.

Initiative type	Evidence	Especially good for	Be aware that	What can industry do?
Extracurricular activities Extend learning beyond school hours with groups and projects that may be run by schools or other organisations	🟢 Positive	Creative STEM learning beyond the school curriculum	Be aware that extra-curricular activities tend to attract students who are already engaged in STEM, or students whose parents are engaged in STEM.	Provide services or funding to enhance or scale up existing initiatives, partner with a school to set up a new initiative, establish a new extracurricular STEM education initiative that is open to students from many schools or from an entire region.
Work experience Applies STEM learning in the real world, with STEM professionals to inspire and encourage career planning.	🟢 Positive	Exposing students to real-life STEM careers	Be aware that work experience requires some outreach and coordination with workplaces. Be sure to check legal and regulatory requirements.	Host student work placements / experiences, review and improve work experience opportunities for students.
Online professional learning Increase STEM teachers' knowledge and capacity through online courses and experiences	🟢 Positive	Reaching a high volume of teachers Allowing teachers to learn at their own pace	Be aware that online professional learning may need to be complemented with face-to-face professional learning or peer collaboration.	Design an excursion program for schools that involve STEM professionals or programs based on real problems.
Professional learning communities (PLC) Teachers work together to improve STEM teaching and learning	🟢 Positive	Supporting school-wide improvements to STEM teaching practices	Be aware that PLCs are only as strong as the commitment of participating teachers.	Visit a partnering school to speak with students about STEM applications in the real-world.

Initiative type	Evidence	Especially good for	Be aware that	What can industry do?
Gamification Enhance learning using gaming techniques such as progression, levels, storytelling and reward	Mixed	Individualised learning at different ability levels	Be aware that gamification can be a distraction if not well linked with learning objectives.	Provide funding or resources to support established STEM competitions, include a STEM competition in a school partnership program or create a new competition open to entry by many schools.
Equipment Use of specialised equipment supports hands-on, inquiry-based STEM learning	Unclear	Engaging, hands-on STEM learning in the classroom	Be aware that costs for equipment can be high and will require maintenance.	Support an existing STEM residential program e.g. sponsor participation. Partner with an existing program provider to scale up a residential program or consider creating or sponsoring a new STEM residential camp.
Teacher partnerships with STEM professionals Create relevance through collaboration between teachers and STEM professionals	Positive	Boosting teacher confidence and knowledge Exposing students to real-world STEM challenges	Be aware that it's important to clearly establish partnership expectations early	Help schools identify and plan engaging and relevant STEM projects, host site visits to kick off projects, provide employees to visit schools to share real-world perspectives, provide employees for an 'expert panel' to which students present their work.
Parent engagement Get parents involved in their children's STEM education	Positive	Changing attitudes towards STEM	Be aware that parent engagement is most effective when sustained across multiple communication channels	Provide services or funding to enhance or scale up existing initiatives, partner with a school to set up a new initiative, establish a new extracurricular STEM education initiative that is open to students from many schools or from an entire region.