Integrating STEAM education with English learning: Enhancing communicative proficiency

3.4 My green thumb STEAM adventure: Cultivating a love for reading, responsibility, and cross-curricular learning

Background

Hong Kong Taoist Association Wun Tsuen Ng Lai Wo Memorial School has innovatively enhanced its English Language curriculum by integrating STEAM education with Reading across the Curriculum (RaC). The school transformed its standalone annual "One Person One Flower" planting project into a cross-curricular initiative called "My Green Thumb STEAM Adventure", involving collaboration between English Language teachers and colleagues from other subjects in a primarily Cantonese-medium instruction environment.

This STEAM education project offers unique opportunities to develop students' subject knowledge, 21st-century skills such as observational and analytical thinking, and attitudes like appreciation for nature. By connecting various subjects, it deepens students' understanding of plants and nature while fostering character development and enhancing crucial generic skills.

This report explores how the English Language subject facilitated this innovative project in Primary 2, demonstrating its multifaceted impact on promoting RaC, boosting students' interest in English reading, and cultivating essential skills and character traits. The holistic approach exemplifies how cross-curricular learning contributes to students' overall development, preparing them for future challenges in an interconnected world.

Level
P2

Strategies used

The following strategies were employed to facilitate the planning and implementation of the STEAM education project, using it as the context to promote RaC and enhance students' English skills and overall learning:

1. Collaborative planning and integration
    English Language, General Studies, Visual Arts, and Mathematics teachers worked collaboratively to transform the school's annual "One Person One Flower" Planting Project into a cross-curricular STEAM initiative. Teachers from each subject met to identify topics in their P2 curriculum that were most relevant to the planting project and pinpointed the target knowledge and skills to be covered. Joint meetings were held to share plans and discuss how students could apply the knowledge and skills acquired in different subjects within the STEAM project. Adjustments were made to teaching schedules to ensure that relevant topics were covered concurrently, facilitating a seamless integration of subjects to help students connect their learning across subjects.

2. Connecting reading with real life
    To encourage students to connect their reading with real-life applications and enhance their motivation, the English teachers provided a practical example within the STEAM project. After reading a text about the types of light that favor plant growth in an English lesson, students tested the credibility of the information presented in the text through an experiment during their Class Periods. They created tinted covers of different colours under which three plants grew and recorded their growth, subsequently using their findings to help their potted flowers thrive in the STEAM project.

3. Empowering independent reading
    The English teachers focused on empowering students to read independently, enhancing their interest and knowledge base for the STEAM project. They initially provided explicit instruction on essential reading strategies through clear teaching and scaffolding across several units. For example, when teaching inferencing skills, teachers broke down the process by first asking students to identify explicit information in texts, then guiding them to connect this information with their prior knowledge through structured questions. As students became more confident, teachers gradually reduced the scaffolding, moving from heavily guided questions to more open-ended ones that encouraged independent inference making.

    This approach involved modeling techniques, guiding practice, and gradually releasing responsibility to the students to ensure deeper comprehension and engagement. Reading strategies taught included pre-reading techniques, drawing conclusions from textual clues, guessing word meanings, and making inferences using contextual clues. This systematic instruction across units was essential for preparing students for reading more extensively and independently in a later stage.

4. Encouraging extensive reading through STEAM context
    The STEAM project served as a context to encourage extensive reading. The English Language teachers designed an appealing book report template shaped like a potted flower (see Figure 1). This grade-appropriate design encouraged students to reflect on their learning from the texts they chose to read, focusing on the most important things they learnt, interesting facts, and new vocabulary about plants and how to take care of them. A reading chart displayed in the classroom allowed students to add a star upon completing a book, providing a sense of accomplishment, tracking progress, and enabling teachers to acknowledge efforts and encourage those lagging behind to catch up with their reading.

Figure 1. Sample of a Potted Flower Book Report

5. Providing access to multimodal text sets
Teachers curated grade-appropriate, high-interest multimodal text sets to facilitate students' interest and knowledge in the STEAM project topic. Students read multiple texts about plants, such as types, parts, and growing methods, as part of the "My Green Thumb STEAM Adventure"

Project. These multimodal texts included fiction and non-fiction books from the school library, eBooks, and videos of books read aloud. An online library was also established to provide students with easy access to these resources (see Figure 2).
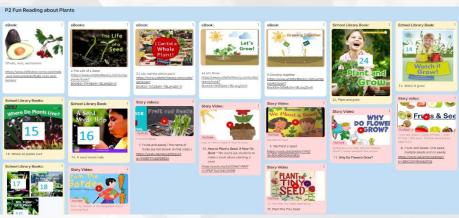

Figure 2. Curated multimodal texts on the STEAM project theme in the online library

6. Designing cross-curricular learning tasks
Learning tasks were designed to enable students to apply their knowledge acquired from cross-curricular learning and RaC in the STEAM project. Students integrated vocabulary and knowledge learnt through extensive reading of the multimodal texts on the STEAM Project theme in the online library and in General Studies lessons, and measurement and counting skills from Mathematics lessons into the completion of the STEAM project tasks. During Visual Arts lessons, students decorated their plant pots and created small tinted covers using the knowledge they acquired from the text read together in class and verified in their experiment. This hands-on approach ensured that students could see the practical application of their reading and learning across different subjects, thereby reinforcing their understanding and skills in a meaningful context.

7. Organic integration of priority values and attitudes with the cross-curricular STEAM project
The cross-curricular STEAM project was designed to organically integrate the priority values of responsibility and appreciation of the natural world. By embedding these values into the curriculum, students were provided with opportunities to connect their learning to real-life experiences. Through activities such as caring for plants and building a "greenhouse", students could witness the direct impact of their actions, which enhanced their engagement with the project. This approach not only reinforced the importance of being responsible caretakers but also helped students develop a deeper understanding of responsibility in their daily lives.

What happened
Stage one: Planning of the cross-curricular STEAM project
At the start of the school term, teachers from English Language, General Studies, Visual Arts, and

Mathematics collaborated to create a cohesive planting project (see Figure 3). They identified relevant topics and target skills, ensuring that knowledge from each subject seamlessly integrated into the STEAM project. Joint meetings facilitated discussions on applying cross-curricular skills, and teaching schedules were adjusted to cover these topics concurrently.

Science — During General Studies lessons and in the extensive reading programme of the English Language subject, students explored plant biology, learning about the life cycle of a flower, the role of water, sunlight, and soil in plant growth, and the light colour that favors plant growth. They applied this knowledge to care for their plants at home for three months.

Technology — Outside class time, supported by their families, students learnt to take photos of their plants to track their growth for their Planting Journal.

Engineering — In Visual Arts lessons, students built a "greenhouse" with tinted transparent covers for their plants using knowledge acquired through RaC about the most favourable light for plant growth.

Art — Students decorated their plant pots during Visual Arts lessons. At the end of the Green Thumb Project, they wrote and drew a four-panel picture story about their experiences in their project from their plant's perspective, combining writing and art.

Mathematics — Students used counting and measuring skills learnt in Mathematics lessons to record their plant's growth accurately.

Figure 3. An overview of the P2 "My Green Thumb STEAM Adventure" Project: The P2 STEAM project integrated various subjects and learning outside class time to enhance students' learning experience.

Stage two: Implementation of the project inside the classroom
1. **English Language**
   i. **Reading strategies:** Since the beginning of the school term, reading strategies such as pre-reading techniques, drawing conclusions from textual clues, guessing word meanings using contextual clues, and making inferences using contextual clues were introduced explicitly and recycled regularly in reading lessons. This was done to enhance students' reading skills and prepare them for RaC.
   ii. **Curated multimodal text sets:** English teachers curated grade-appropriate, high-interest multimedia fiction and non-fiction texts related to plants. These resources, including library books, eBooks, and videos of read-aloud books, were made easily accessible in an online library.

iii. **Book report template:** To build students' interest in reading and plants, teachers designed an appealing book report template shaped like a potted flower for students to reflect on and record their learning through RaC. A non-fiction book was used to teach students to use the new template, and a book report writing competition was held to

Figure 4. Proud winners of the Potted Flower Book Report Writing Competition

acknowledge students' good effort and performance (see Figure 4). Students then reflected and took notes on the content of the books of their choice using the template.

iv. **Reading chart:** A reading chart displayed in the classroom allowed students to add a star upon completing a book, providing a sense of accomplishment, tracking progress, and enabling teachers to acknowledge efforts and encourage those lagging behind.

v. **Light and plant growth:** In English lessons, students read a text to learn about the types of light that favour plant growth. The class then created three tinted covers, of different colours, for three plants to grow inside and recorded their growth (see Figure 5).

Figure 5. Students recording plant growth under different coloured covers

vi. **Plant care assignment:** Students were given a potted flower to take care of for three months. They participated in a class discussion to review what they had learnt about plant care through extensive reading and emphasised the importance of being responsible to ensure their plant grew well before they brought their potted flower home.

2. **General Studies (GS)**
   i. **Plants, Fruits, and Their Seeds:** During the GS lessons on the topic of "Plants, Fruits, and Their Seeds", students learnt about different kinds of fruits and their seeds through observation of real fruits (see Figure 6). They also made and enjoyed drinks made with fruits and leaves, enhancing their appreciation of plants in their life (see Figure 7).

Figure 6. Students cutting open real fruits to learn about their seeds

Figure 7. Students making drinks with fruits and leaves

3. **Visual Arts (VA)**
    i. **Greenhouse creation:** In the VA lessons, students applied their understanding from the light and plant growth experiment to design small "greenhouses" using tinted paper, enhancing the growth of their potted flowers (see Figure 8).
    ii. **Pot decoration:** Students decorated the pot of their plant, giving them a stronger sense of ownership and motivating them to strengthen their care for it (see Figure 9).

Figure 8. Students constructing mini greenhouses for their plants during Visual Arts lessons

Figure 9. Display of students' plants in their decorated pots

Stage three: Cross-curricular activities of the STEAM project outside the classroom

1. **Plant growth record:** Students recorded the growth of their plant during the three-month period, taking photos of their plants and applying their counting and measuring skills acquired in Mathematics lessons (see Figure 10).
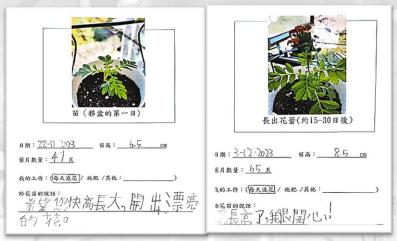

Figure 10. Sample pages of plant growth records showcasing students' use of photos, leaf counting, and plant height measurements in the STEAM project

2. **My Green Thumb STEAM Adventure Competition:** At the end of the "My Green Thumb STEAM Adventure" project, students brought their plants back to school for display. The winner was chosen based on the plant's health and appearance, including growth in height, abundance of green leaves, and presence of flowers (see Figure 11).

3. **Four-panel picture story:** Students wrote and drew a four-panel picture story about the growth of their plant from their plant's perspective in English based on their Plant Growth Record, combining writing and art (see Figure 12).

Figure 11. Proud winner with his plant and its greenhouse

4. **Award presentation:** A celebratory award presentation ceremony was held, where the three winners shared their experiences in English about growing their plants (see Figure 13). This event celebrated their achievements and the learning journey they undertook.
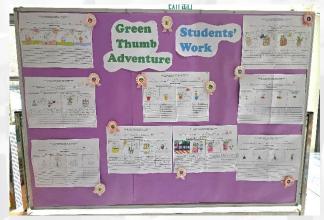

Figure 12. Display of students' four-panel picture stories

Figure 13. A winner sharing his experience of growing his plant in English at the Award Presentation Ceremony

Impact

Curriculum development

1. Integration of RaC, extensive reading, and values education
   The English Language curriculum now incorporates RaC and extensive reading initiatives, significantly enhancing students' engagement with English texts, particularly those related to the STEAM project. This integration promotes a holistic learning experience, allowing students to apply their reading skills in various contexts, and enhances their overall understanding and retention of knowledge. Additionally, values education has been organically woven into the curriculum, providing students with opportunities to connect and apply target values and attitudes to real-life experiences. In the Green Thumb STEAM Project, fostering responsibility and appreciation for the natural world were the key target values. Students learnt to care for their plants over three months, which instilled a sense of accountability and care for living things.

2. Cross-curricular collaboration
   The project has fostered greater cross-curricular collaboration among English Language, GS, VA and Mathematics, with STEAM education being successfully piloted. After the project, English Language and GS teachers continued to work together to develop two more cross-curricular units that aligned with both subjects' objectives and target proper values. These collaborative efforts ensure that students can see the practical applications of their learning and understand the interconnectedness of different fields of knowledge. The following table shows two cross-curricular English Language and GS units after the implementation of the STEAM project:

Target value and attitude	Subject	Topic/unit	Learning activities
The second cross-curricular unit			
Benevolence	English Language	"Busy Days"	• Students discussed making time for their elderly family members based on a text from their textbook. • Their learning was extended through reading multimodal texts about accessible facilities for the elderly, showing how society can make life easier for them.
	GS	"Elements of a Good Community"	• Students went on a field trip to learn about different community facilities needed by various people in the school's neighbourhood. They then shared photos taken during the field trip with English captions on an online platform to describe the facilities.
The third cross-curricular unit			
Respect for Different Cultures	English Language	"Seasons and Weather"	• Students learnt about the relationship between clothing, homes, and seasonal weather in different countries through reading their textbook and multimodal texts. • They had a class discussion on respecting people who may look different from them in Hong Kong. • They gave a very brief oral report in English of their learning from the interviews with the school NETs on an online platform.
	GS	"Colourful Life in Hong Kong"	• Students extended their learning by interviewing their NETs about their favourite activities in different seasons in their home countries and their favourite seasons.

Teacher development

1. Enhanced professional capacity and confidence
The P2 teachers found their professional capacity in cross-curricular planning and STEAM implementation significantly enhanced. They observed how integrating subjects enhanced students' holistic understanding of the factors that affect plant growth, while the hands-on nature of activities increased engagement and provided authentic contexts for language use. Linking classroom learning to tangible outcomes motivated students to apply English skills practically.

English Language teachers, in particular, gained valuable experience in implementing RaC within the STEAM context. They developed strategies to boost students' reading interest by

connecting texts to STEAM-related hands-on activities, thereby improving comprehension and knowledge retention. This integrated approach demonstrated the effectiveness of STEAM projects in creating meaningful learning experiences that promote critical thinking and problem solving skills, while simultaneously enhancing language proficiency.

2. Nurturing a collaborative culture

A collaborative culture has been nurtured at the school. Teachers initiated further collaboration in two additional units, connecting related topics in the P2 English Language curriculum with experiential learning activities in GS. This collaboration involved extensive RaC reading, book reporting, and the use of multimodal text sets available online for easy access, allowing students to use the language and vocabulary acquired through RaC to report their GS experiential activities in English.

3. Raising teachers' awareness of and capacity in teaching reading strategies and integrating values in the curriculum naturally and organically

The implementation of the RaC initiative has heightened teachers' awareness of the necessity to explicitly teach essential reading strategies. To empower students to eventually read independently and expand their knowledge base, English teachers focused on strategies such as pre-reading techniques, drawing conclusions based on textual clues, and making inferences using contextual clues. They modeled these strategies, providing guided practice, and offering immediate feedback to their students. Through this process, teachers have not only gained more skills in these areas but also recognised the importance of explicit instruction in reading strategies. This approach has enriched students' learning experiences and reinforced teachers' commitment to explicit teaching of reading strategies to enable students to learn to read and to read to learn.

Additionally, teachers have developed an awareness of the importance of integrating top priority values and attitudes organically and naturally into the curriculum. This integration has provided students with opportunities to connect and apply these values to real-life experiences, thereby enhancing their personal development alongside their academic growth.

Student learning

1. Student engagement and interest in reading

Students displayed a marked increase in interest in reading English texts, particularly those related to the STEAM project. Teachers reported a significant rise in the number of books read by students, doubling from an average of 1 to 2 books per student in previous years to more than double that number this year (see Figure 14). This improvement is attributed to the explicit instruction in reading strategies, variety and appropriateness of curated multi-modal texts, easy access to thematic reading materials, and an appealing, grade-appropriate book report template design.
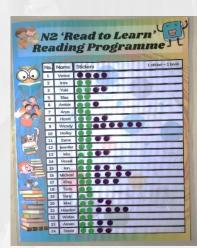

Figure 14. Reading chart displaying students' progress in the RaC Extensive Reading Programme

2. Enhanced communication skills through cross-curricular STEAM integration

The STEAM project, used as a context for RaC, has significantly enhanced students' communicative proficiency. Through class discussions, presentations of their picture stories, and project experiences, students' oral and written communication skills improved. This improvement is evident in their four-panel picture stories, which demonstrate both linguistic development and scientific understanding.

Students showed sophisticated narrative skills by creating coherent stories with clear progression across time periods (ten days, one month, forty days, two months) (see Figure 15). Their work reflects a solid grasp of plant care concepts through:

Plant care concepts	Examples extracted from student work
• Understanding of environmental needs	*"...grow next to the window..."* shows knowledge of plants requiring sunlight
• Recognition of plant growth stages	From seedling to a mature plant with flowers
• Awareness of proper care routines	*"...water me every day..."*
• Comprehension of cause-effect relationships	Linking care actions to plant health
• Understanding of plant responses	*"I am happy when David takes care of me."*

Moreover, their narratives seamlessly integrated concepts of time, growth, and care throughout, reflecting a deeper understanding of cross-curricular learning. This structured approach not only enhanced students' reading and communication skills but also fostered a greater appreciation for cross-curricular learning. By engaging in these varied activities, students were able to apply their knowledge in a practical and creative context, effectively bridging the gap between different subject areas and reinforcing their learning in a meaningful way.
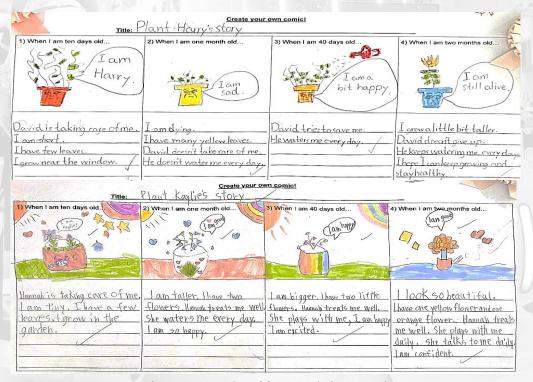

Figure 15. Samples of four-panel picture stories

3. Development of proper values and practical skills

Through the project, students developed a sense of responsibility by taking care of their plants over three months, learning practical skills such as watering daily, ensuring sufficient light, and safely positioning the plants. Interviews with students during the award presentation ceremony (see Figure 16) revealed that nearly all could articulate these necessary care steps, with one student highlighting the importance of not placing the plant on a window sill to avoid the risk of it falling.

Figure 16. Students sharing their learnings from plant care during interviews at the Award Presentation Ceremony

Additionally, students became more aware of how nature works and cherished the plants and nature around them. They developed a stronger sense responsibility through plant care (see Figure 17). This holistic approach ensured that students not only improved their practical skills and values but also deepened their understanding and appreciation of the natural world.

Student's Reflection: "I was happy and have learnt how to take care of plants patiently."

Parent's Comment: "I think the annual 'One Student One Flower' can help students bond better with their parents and develop their sense of responsibility."

Student's Reflection: "Happy."

Parent's Comment: "Watching the plant grow with my child has been a magical experience. It allowed my child to feel the wonder of life."

Figure 17. Reflections and comments in reflection logs showing students' growing sense of responsibility and appreciation for plants and nature

Way forward

To sustain the impact of the "My Green Thumb STEAM Adventure" project and extend its benefits to more students, the teachers at Hong Kong Taoist Association Wun Tsuen Ng Lai Wo Memorial School are considering several key steps for the near future. Firstly, they are exploring the possibility of expanding cross-curricular STEAM projects across other grade levels. This would ensure that the integration of RaC and values education continues to engage students and promote cross-curricular learning throughout their school journey, while providing continuity in the learning experiences of the P2 students who participated in this project.

The teachers are also contemplating ways to further strengthen home-school partnerships to encourage greater involvement of parents and families in STEAM projects and reading activities. This could help reinforce the skills and values taught in school.

Additionally, they will continue to leverage technology and resources to expand the collection of multimodal text sets and online resources. For students at higher levels, this could include developing an interactive platform where students can not only access resources but also share their thoughts and collaborate with peers. This would ensure that students have access to a variety of engaging materials while promoting collaborative learning.

By considering these steps, the school hopes to build on the success of the "My Green Thumb STEAM Adventure" project, ensuring that more students benefit from a holistic and engaging educational experience that fosters a love for reading, interdisciplinary learning, and the development of STEAM-related proper values and attitudes.

Conclusion

The "My Green Thumb STEAM Adventure" project has successfully enriched the curriculum, enhanced teachers' professional capacity, and significantly improved students' learning experiences. This innovative model integrates STEAM education with Reading across the Curriculum (RaC), using hands-on, cross-curricular activities to create meaningful contexts for students to apply knowledge across multiple subjects. By continuing to refine and expand this STEAM-RaC integration model, the school is well-positioned to foster an increasingly engaging and impactful educational environment. This approach not only promotes cross-curricular learning but also equips students with the skills needed to thrive in an inter-connected world, setting a promising precedent for related educational initiatives in the foreseeable future.

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3.5 Promoting STEAM education at the primary level

Background

The world is fast-changing and it is important for students to learn to adapt to whatever the future holds. To nurture future-ready learners, we can integrate STEAM education into language education for developing students' language-related knowledge and skills through engaging them in hands-on and minds-on STEAM activities while simultaneously strengthening their critical thinking and problem solving skills. As many STEAM activities involve solving real-life issues and problems, by engaging students in addressing them, they can nurture proper values and attitudes such as empathy and a desire to promote the well-being of themselves and others. Recognising this, SKH Lui Ming Choi Memorial Primary School introduces STEAM education early at KS1 in order to lay a solid foundation for the development of generic and 21st century skills and inquiry thinking at later key stages. Sharing the same belief, the English teachers infuse elements of STEAM education into the school English Language curriculum. They aim to engage students in exploration of knowledge and experimentation with innovative ideas so as to reinforce their subject-specific knowledge alongside enhancing their English-related knowledge and skills, and cultivate their critical thinking skills, problem solving skills and proper values and attitudes, thereby preparing them to embrace change.

The English teachers piloted STEM education in P3 in 2021/22. In response to the major renewed emphases stated in Primary Education Curriculum Guide (Pilot Version) released in 2022, they took a step forward to add elements of visual arts and language arts into some of their STEAM-infused modules in P2 and P3 in the 2022/23 and 2023/24 s.y.. This report illustrates how STEAM education was implemented in the school using two of the P2 modules designed by the English teachers.

Level
P2

Strategies used
The following strategies were adopted to facilitate the planning and implementation of the STEAM-infused modules:

Strategies	Objectives	Details
1. Transferring a Science-related strategy, i.e. **P**redict, **O**bserve, **E**xplain (POE), to the English language learning and teaching context	- To develop students' thinking skills through exploration of scientific knowledge - To help students see the relevance and importance of STEAM education in daily life	- The POE strategy used in Science motivates students to make predictions, explore and discover knowledge by themselves, and discuss and think based on their observation. - The teachers adopted POE in some of the modules as they found it a student-friendly strategy to

Strategies	Objectives	Details
		promote STEAM education among young learners and relate their learning to daily-life issues.
2. Design Thinking	- To develop students' thinking and problem solving skills through exploration of scientific knowledge and experimentation with innovative ideas - To help students see the relevance and importance of STEAM education in daily life - To cultivate the priority value, empathy, among students	- The design thinking process involves the five stages of "empathise", "define", "ideate", "prototype" and "test". - This approach is highly relevant to STEAM education. It encourages students to address real-life issues with a sense of empathy, apply content subject knowledge to innovate, design and test a prototype, and come up with a possible solution to address daily-life issues.
3. Self-reflection tasks	- To promote a culture of self-reflection among students	- Students took on different roles such as little designers and assessed themselves on proper values and attitudes before and after the STEAM activities. This not only made them more engaged in the activities, but also improved their self-understanding and self-reflective ability.

What happened

1. **Mapping the curriculum of the English Language subject and other subjects**

   As STEAM education involves the application of subject-specific knowledge, English teachers conducted curriculum mapping with teachers of other subjects including non-language subjects to select appropriate themes for the modules. Apart from mapping relevant themes, the teaching schedule of the subjects involved was synchronised as much as possible to facilitate making connections across subjects by students.

   The table below summarises the key features concerning different subjects of the two P2 modules implemented in the English lessons:

	Module 1	**Module 2**
Themes	Healthy eating	Together we are very strong
Key messages	We should have a balanced diet and should not be picky eaters who only eat tasty but unhealthy food.	Our family members work hard. We should understand and appreciate their hard work and work hand in hand to keep our flat clean and tidy.

Content knowledge introduced/ reinforced	- Healthy and unhealthy food, a balanced diet*
	  • General Studies: subject-specific knowledge taught in Chinese
	  • English: subject-specific knowledge reinforced in English using theme-related learning materials
		- Doing sums involving up to three numbers, 3D shapes
		  • Mathematics: subject-specific knowledge taught in Chinese
		- Warm and cool colours
		  • Visual Arts: subject-specific knowledge taught in Chinese
		- English: the above target subject-specific knowledge reinforced in English
		- English: The science behind strong structures introduced using a language arts text in English

English-related learning objectives	- Language/vocabulary items: Simple present tense, "there is/are", vocabulary about food and drinks including healthy and unhealthy food - Reading skills: Working out the meaning of unfamiliar words using pictorial cues	- Language/vocabulary items: Simple present tense, "there is/are", using "He is…" to describe feelings, vocabulary/ phrases about household chores, cardinal numbers, 3D shapes (e.g. prisms) - Reading skills: Working out the meaning of unfamiliar words using pictorial cues, locating specific information
STEAM activities	Oil level test	Paper stand design
Strategies	POE	Design Thinking
Generic skills	Thinking skills	Thinking and problem solving skills
Priority values	Empathy, benevolence	Empathy, benevolence, unity

*The theme-related subject-specific knowledge was also reinforced in the Chinese, Putonghua and Library lessons.

2. Selecting and designing theme-related learning materials for contextualisation and teaching of subject-specific and English-related knowledge

Theme-related reading materials, introduced by theme-related characters such as a nurse and an old man, were used to spark students' interest in reading. In the first module, a nurse who promoted healthy eating among students shared the healthy and unhealthy food posters she made (see Figure 1) to reinforce the healthy and unhealthy food taught in the General Studies and English lessons. In the second module, an old man who was too tired and weak to do housework alone shared his story, which is also a well-known fable called "The Old Man and His Son" (see Figure 1). The fable not only brought out the priority value, unity, but also paved the way for the teaching of the science behind the structure of a bundle of sticks. In both modules, the reading materials gave students an opportunity to consolidate the use of the simple present tense and "there is/are". They also gave students a sound reason to find out more about healthy eating and strong structures in the subsequent STEAM activities.

Apart from reading materials, other theme and daily life-related materials were selected. In the second module, for instance, everyday examples such as paper tube chairs, honeycomb chairs and honeycomb wrapping paper were shared to explain the concept "Together we are very strong" (see Figure 2). Students reinforced their knowledge of strong structures and saw the relevance and importance of the science concept in their daily life.

Figure 1. Using food posters and a fable for contextualisation and knowledge building

Figure 2. Using everyday examples to explain the concept of "Together we are very strong"

3. **Connecting learning of English and subject-specific knowledge for the promotion of STEAM education**

   The reading texts used for introducing and reinforcing subject-specific knowledge was also employed to teach and reinforce reading skills. For example, in the second module, the teachers demonstrated how to work out the meaning of unfamiliar words in the fable "The Old Man and His Son" by using the strategy of highlighting. Keywords in the text (e.g. bundle) and relevant pictures were circled in the fable, as a scaffolding strategy, for students to work out word meanings. Then students read other texts – a photo of a paper tube chair and honeycomb chair and its caption – to practise and consolidate the strategy. Alongside reading skills development, students' knowledge of strong structures was reinforced through the reading texts. For instance, they tried to figure out why the paper tube chair and honeycomb chair could withstand heavy weight by applying their knowledge of strong structures, paving the way for the subsequent paper stand STEAM activity.

4. **Using STEAM activities to solve daily-life problems**

   STEAM activities were used to help students solve daily-life problems. The first module was implemented around the Chinese New Year. Students read a text on Chinese New Year food. To show empathy and benevolence to students who put on a lot of weight or got sick after eating too much unhealthy festival food, they did an oil level test using the POE strategy, explored knowledge by themselves, and gave advice on how to eat healthily during Chinese New Year (see Figure 3 and Figure 4).
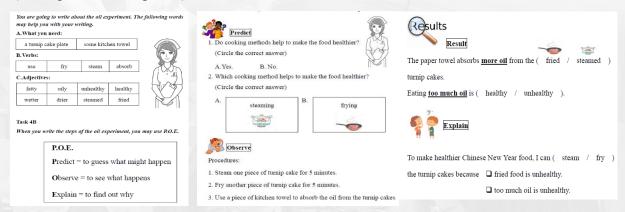

Figure 3.
P: Predicting if steamed or fried turnip cakes is healthier
O: Observing the amount of oil absorbed by kitchen paper
E: Drawing a conclusion and justifying it based on the amount of oil absorbed

Figure 4. Applying knowledge of healthy eating in the oil level test

In the second module, students connected the world of the fable, "The Old Man and His Sons", with their own world. They learnt the moral of the fable "Together we are very strong" and realised it was everyone's responsibility to keep his/her flat tidy and when family members

worked hand in hand, they could greatly relieve their parents' workload. As books, clothes and toys lying all over the place after their examinations is a common problem among students, they designed a paper stand for putting things neatly. In this activity, "Together we are very strong" is a moral as well as a science concept presented in a student-friendly language. Students were engaged in the design thinking process (see Figure 5 to Figure 8) to apply their knowledge of strong structures for making a sturdy paper stand.
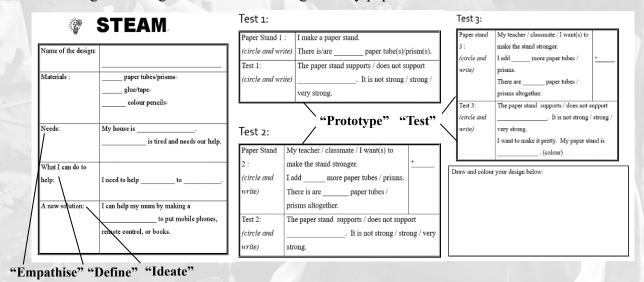

Figure 5. Design Thinking introduced in a student-friendly language

Figure 6. Test 1: Making and testing a paper stand with one cylinder

Figure 7. Tests 2 & 3: Finding out why one cylinder failed to withstand the weight of a book and suggesting creative ideas to solve the problem with peers

Figure 8. Applying Visual Arts knowledge by choosing a warm or cool colour their parents like for their paper stands

5. Assessing student learning in the STEAM-infused modules

A variety of assessment strategies was adopted to track student learning progress in the STEAM-infused modules. Emphasis was placed on both the learning process and learning outcomes.

For science tests such as the oil level test in the first module, the teachers observed if students were able to make predictions, record findings of the test, draw conclusions and give sensible, informed advice. In the second module, as the design of a prototype/product was involved, students were assessed on whether they were able to improve their design using the target STEAM-related knowledge and skills (e.g. adding prisms and counting extra prisms needed to make their paper stand stronger).

Language-related assessments include observing if students could apply the target language and vocabulary items in the STEAM activities, such as using "There is/are" and cardinal numbers to describe the number of tubes or prisms used to make paper stands. Students'

progress in the target reading skills was tracked by analysing their scores in a reading pre-test and an identical post-test. It helped teachers identify those reading skills students needed to work further on and take the necessary action to support them.

In both modules, student underwent a self-reflection process. Before students took on the role of a little nurse or little designer, they reflected on if they were benevolent (i.e. caring, helpful and kind). After completing the STEAM activities, which involved group collaboration, they looked back at their learning experiences, reflected on whether they were helpful and supportive when they were taking part in the activities, and assessed themselves on the same priority value again.

Impact

Curriculum development

A variety of learning materials, including language arts texts (e.g. a fable) and English texts on subject-specific knowledge (e.g. healthy eating) was drawn upon to teach English-related knowledge and skills and subject-specific knowledge in English. This paved the way for students to explore the world of STEAM education and enhance their thinking and problem solving skills through actively engaging themselves in exploration of new knowledge and experimentation with innovative ideas.

Student learning

From improving one's knowledge and skills to enhancing quality of life

The STEAM activities gave students hands-on and minds-on learning experiences to develop their thinking and problem solving skills. Young as they are, they demonstrated their abilities to explore new knowledge and experiment with innovative ideas as they took part in both activities. In the oil level test, they were able to predict the oil level in fried and steamed turnip cakes, observe and record the test findings, explain the results and draw a conclusion sensibly and in an informed manner. Through the paper stand activity, students developed their problem solving skills. They tested the strength of their paper stand and suggested creative ideas (e.g. adding more prisms and layers) to solve the problems they had encountered through reviewing their work critically by themselves and with peers (see Figure 9 to Figure 11).

In the learning process, students also reinforced the target language and vocabulary items. In the oil level test, students could use the simple present tense to talk about their learning (e.g. "Steamed turnip cake is healthy."). In the paper stand activity, they could apply the target language and vocabulary (e.g. using "There is/are", vocabulary about numbers and 3D shapes to describe their paper stand). After implementing the two modules, a post-reading test was conducted and students from all proficiency groups showed improvement in the mastery of the target reading skills.

Apart from knowledge and skills, most important of all, the learning experiences enabled students to see how STEAM-related knowledge could solve everyday problems and make their life better (e.g. suggesting how to eat healthily and how to make their home a better place to live in), thereby promoting the well-being of themselves and others.
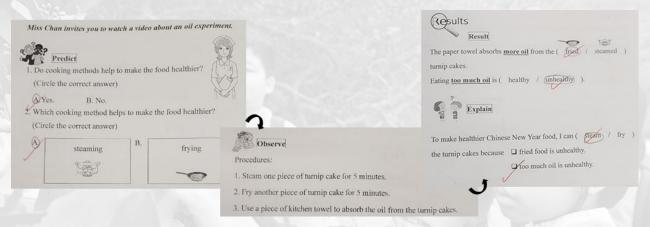
Figure 9. Students making predictions, observing and explaining the results in the oil level test

Figure 10. Applying Mathematics knowledge and consolidating vocabulary about numbers and 3D shapes in the design process

Figure 11. Testing and perfecting their paper stands by adding more prisms and layers

Promoting a culture of self-reflection among students

Ample opportunities were given to students for putting into practice and reflecting upon the target priority value before and after the STEAM activities. For example, before they took part in the paper stand design activity, they assessed themselves to get a better understanding of their own perception of their level of benevolence. Then they took on the role of a little designer and put into practice the target priority value by helping one another to overcome the problems encountered in the design process. Afterwards, they reviewed the learning process and completed a post-activity self-reflection form to assess themselves on the same priority value. A similar self-reflection cycle was promoted in almost all the P2 and P3 STEAM-infused modules to foster a culture of self-reflection among students (see Figure 12 to Figure 14).

Figure 12. Pre-activity self-reflection

Figure 13. Post-activity self-reflection

Figure 14. Showing kindness and helpfulness in solving the problems encountered in the design thinking process

Teachers' professional development
Practising "Together we are very strong"

The English teachers worked on their own without any support from the STEAM education-related subjects when they first piloted STEM education. As their experience grew, there were more cross-curricular links in almost all the STEAM-infused modules in P2 and P3. These links not only enriched their knowledge about and skills in organically integrating elements of STEAM education into the school English Language curriculum, but also contributed to a collaborative culture in their panel and across panels (see Figure 15).

Figure 15. The P2 English teachers working hand in hand to promote STEAM education

Conclusion
Facilitating factors
1. STEAM made fun and easy for young learners

STEAM education was successfully implemented in P2. Students took part in the lessons enthusiastically and completed the learning activities smoothly. This was largely attributable to the strategies adopted by the English teachers to enhance the motivation of and cater for the needs of the young learners:

- To improve students' engagement, the teachers used different characters (e.g. the old man) for contextualisation of the modules. Also, students showed active participation in the STEAM activities as they were assigned a well-defined role (e.g. a little designer).
- The language used in the modules was pitched at the level of P2 students. Simple language was used and complex concepts were put in student-friendly terms (see Figure 16).

Used	Instead of
Caring, kind, helpful	Benevolent
Together we are very strong	Together we are stronger
Predict	Hypothesise
A new solution	Ideate

Figure 16. Examples of simple words and expressions used in the modules to cater for P2 students' learning needs

- Apart from designing a module booklet for all students, the English teachers also prepared a supplementary booklet to support their learning in their own time. It contains the target language and vocabulary items of the module for students' revision. There are also extended theme-related vocabulary and learning materials on subject-specific knowledge related to the STEAM activities. As teachers observed, the less proficient students focused more on the target language and vocabulary while the more proficient ones tended to explore subject-specific knowledge in English more. The supplementary booklet served as a "buffet" for students to select learning materials to help them with their learning in the module including their learning in the STEAM activities.

2. Effective use of language arts to promote STEAM education

The letter "A" in "STEAM" refers to the arts including language arts. The experience of this school shows that language arts, when appropriately integrated with other domains in "STEAM", can greatly contribute to the promotion of STEAM education. For instance, by drawing upon the plot and moral of the fable "The Old Man and His Son", the otherwise complex scientific concept related to strong structures was effectively explained to P2 students. By connecting the scientific content to a famous story, it sparked students' learning interest and facilitated their learning in the subsequent STEAM activity.

Way forward

With the experience gained, the English teachers were better equipped to support the implementation of STEAM education. More possibilities of implementing STEAM education across subjects will be explored at various levels to further strengthen students' abilities to explore knowledge and experiment with innovative ideas. The teachers will continue to work together to broaden students' knowledge base, improve their English, and cultivate critical thinking skills, problem solving skills and proper values and attitudes among them, getting them ready for the challenges facing them in later key stages.

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