

Final Report

Development of a vegetable education resource – Stage 2

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Summary

This project aimed to develop and evaluate a new vegetable education program for primary schools to increase children's enjoyment of vegetables and willingness to consume them. Low acceptance of vegetables is a key reason for low intake. Vegetable liking can be learned, and childhood is a critical time in the development of these preferences.

The school environment provides good opportunities to promote vegetable consumption as it reaches all children. A teacher-led vegetable education program (VERTICAL- Vegetable Education Resource To Increase Children's Acceptance and Liking) was developed consisting of units of 5x1hr lessons across the three stages of primary school, and aligned to the Australian curriculum. The program is based on a sensory science framework and scientific knowledge on increasing vegetable acceptance. Vegetable tastings are a critical part of each lesson. An online training module for teachers with theory and implementation information supports the program.

The effectiveness of VERTICAL on student outcomes was determined in a large cluster randomised controlled trial (1639 students from 25 NSW and SA schools). Students who followed VERTICAL significantly increased their knowledge, ability to verbalise sensations, vegetable acceptance, intentions to increase vegetable consumption, willingness to try vegetables and the number of new vegetables consumed, compared to students who followed the regular curriculum. A survey amongst teachers demonstrated that teachers were positive about the program and its delivery. Importantly, teachers felt it aligned well to the curriculum. Face-to-face training of teachers in addition to the online training had some benefits on engaging teachers but did not affect student outcomes.

Stakeholder engagement was undertaken with nutrition and education experts to determine the best model for national roll-out of the program. The strong scientific evidence base of the program was deemed a critical element for uptake. A state-by-state approach is recommended.

This project has developed and evaluated the tools (lesson materials and teacher training) and platform (website) that will allow for national school access to this program. Media communication can provide initial promotion for the program. To ensure maximum uptake and reach of the program in Australian primary schools to deliver the impact, support and continued investment from suitable delivery/support partners will be needed. State government partners supported by a core team for communication, promotion and coordination of the program seem the best way forward. A further delivery project to ensure and measure implementation and actual uptake is recommended.

Ultimately, the vegetable education program is expected to positively influence vegetable consumption, and therefore increase demand. As children's food preferences have been shown to flow into adulthood, this program may also contribute to setting lifelong eating habits, increasing future demand for vegetables even further.

Keywords

Vegetables; sensory education; primary school; young children; acceptance; knowledge; verbalisation skills; teacher; students; exposure.

1. Introduction

Children’s consumption of vegetables is too low in Australia (Mihirshahi et al., 2019). Vegetable consumption is important for prevention of certain types of cancers and cardiovascular diseases (Wang et al., 2014). Vegetables can also be an important part of a weight-management strategy when these low energy density foods replace high energy density foods in the diet.

Schools provide a good setting to promote healthy eating behaviours in children as it reaches all children regardless of background and parental behaviours and attitudes. A meta-review investigating the effect of school based nutrition interventions on fruit and vegetable intake in primary school-aged children found an average increase of .24 portions of fruit but only .07 portions of vegetables (Evans, Christian, Cleghorn, Greenwood, & Cade, 2012). Thus, there is a need for novel school-based interventions that target vegetable consumption. Experiential learning strategies are associated with the largest effects in school nutrition education programs (Dudley, Cotton, & Peralta, 2015).

A novel education program for Australian primary schools was developed by CSIRO scientists and educators aiming to positively predispose children to consuming vegetables, VERTICAL (Vegetable Education Resource to Increase Children’s Acceptance and Liking). An initial version of the vegetable education program was developed and evaluated in a pilot study (Poelman, Broch, Cox, & Vogrig, 2016)(VG13089). It is an experiential learning program dedicated to vegetables, combining elements from sensory education with scientific insights on children’s development of vegetable acceptance, such as taste exposure and role modelling (DeCosta, Møller, Frøst, & Olsen, 2017; Laureati, Bergamaschi, & Pagliarini, 2014; Nekitsing, Hetherington, & Blundell-Birtill, 2018). The program is teacher led and consists of five, 1hr lessons for each of the three stages of primary school. The resource is closely aligned to the curriculum, in particular: Key Learning areas of Science, English, Mathematics, Health and Physical Education as well as generic capabilities and cross-curricular themes.

The program focuses on enjoyment and acceptance of vegetables because there is strong evidence that children’s rejection of vegetables is based upon disliking the taste. Vegetable liking can be learned, as children are malleable in their food preferences (Birch, 1999; DeCosta et al., 2017; Nekitsing et al., 2018), and increasing acceptance for vegetables has important short and long term benefits, as food preferences and dietary behaviours tend to track from childhood into adulthood (Nicklaus, Boggio, Chabanet, & Issanchou, 2004, 2005).

The program incorporates elements from successful European sensory education programs focusing on healthy eating behaviours. These experiential learning programs focus on the role the senses play in eating, and have positively influenced behavioural factors associated with healthy eating, including decreased food neophobia (fear of new foods) and increased willingness to try new foods, knowledge, ability to describe foods and odours using a sensory vocabulary, and intentions to eat healthily (Battjes-Fries, Haveman-Nies, Renes, Meester, & van ’t Veer, 2014; Mustonen, Rantanen, & Tuorila, 2009; Mustonen & Tuorila, 2010; Reverdy, Chesnel, Schlich, Köster, & Lange, 2008).

The prototype version of VERTICAL (Poelman, Cochet-Broch, Cox, & Vogrig, 2017, 2019) showed positive changes in mediating factors associated with children’s vegetable consumption in a matched-control schools pilot study. These changes included: increases in knowledge about vegetables and the senses, students’ verbalisation skills around vegetable sensory properties, vegetable acceptance and willingness to try (Poelman et al., 2019). The program was also evaluated favourably by teachers (Poelman et al., 2017).

The positive results of the pilot project led to Hort Innovation commissioning a second stage of the project. This project had the following objectives:

- Revise and optimise the vegetable education program based on feedback and results from the teacher and student survey
- Identify alignment of the vegetable education program with the Australian curriculum
- Develop an online teacher training module to support the program
- Develop a web-based platform for distribution of the resource
- Evaluate the effectiveness of the vegetable education program on student outcomes in a large-scale trial in two states

- Undertake a teacher evaluation of the training module and program
- Develop a business plan for national roll out
- Initiate stakeholder engagement and partnering options for larger scale roll out.

This project aligns with the Australian Vegetable Industry Strategic Investment Plan (2017-2021). It particularly aligns to the strategy to increase growth in the domestic market, which aims for “increased demand and value of the domestic vegetable industry through improved grower knowledge of the market, product differentiation, increased food service revenue, improved food safety and increased consumer knowledge”. This project will increase consumer knowledge and education (in particularly of children and their teachers) and will generate new consumer data on the effectiveness of a new education program on increasing consumer preferences for vegetables.

2. Methodology

This project used a mix of activities and methodologies to achieve the objectives:

- Technology development by a multidisciplinary team of sensory and behavioural nutrition scientists and educators to:
 - Optimise the pilot vegetable education program (content and lesson materials)
 - Develop an online teacher training module and face-to-face teacher training
 - Develop a web-based platform to provide access to the education materials.
- Review of alignment of the vegetable education program with the Australian curriculum by an independent education expert.
- A quantitative online teacher survey to evaluate the training module and the vegetable education program on key parameters, including appreciation, content quality, ease of use and curriculum alignment. This method was selected over qualitative methods in order to be able to collect quantitative information to support the roll out and be able to statistically compare data across states. It also allows for comparison with teacher data collected during the pilot vegetable education program (VG13089).
- A randomised clustered controlled trial was undertaken to evaluate the effectiveness of the vegetable education program on student outcomes. This intervention method is the gold standard for interventions where participants are randomly allocated either to an intervention arm (in this case students were taught the vegetable education program) or a control (students continue their regular curriculum level). The intervention was a *clustered* controlled trial as the intervention was allocated at a school level, and all classes and students participating from the same school were in the same intervention group. This was done for practical reasons and to avoid cross-contamination of information (teachers or students in different groups influencing each other). The study included baseline measures in order to be able to compare the groups. To measure the effect of the program a post-test was undertaken to assess the immediate effect of the program and a three-month-follow up test was undertaken to assess a sustained effect of the program.
- Stakeholder engagement with nutrition and public health experts and educators was undertaken using semi-structured interviews to seek input for the best business model and dissemination strategy for national roll out.
- A business model with a commercialisation and dissemination strategy was developed to support the commercialisation of the program to achieve national roll out and maximise impact, uptake and adoption by schools. This involved collaboration of the project team members with relevant members of the funding body, communication, branding, legal and business development experts.

Details of methodology and results are described in the following chapters.

3. Refinement of vegetable education program

The vegetable education program in a nutshell

- An education program for use by Australian primary school teachers
- The program aims for behavioural change in students to enjoy vegetables more and increase willingness to try vegetables
- Unit of work (5 lessons) across three stages of primary school (F-2, 3-4 and 5-6)
- Online training module and written materials for teachers, with supporting in-class slide sets
- Tastings, development of the senses and hands-on learning are the essential components
- Vegetables are tasted in each lesson, with more than ten different vegetables tasted in each unit
- Aligned to the Australian curriculum, cross-curricular but most strongly embedded in Science and English.

The vegetable education program is designed around several key criteria:

- Allows behavioural change in factors known to be positively associated with vegetable intake. It considers the scientific insights on increasing children’s acceptance and intake for vegetables and is based upon insights from several overseas educational programs with similar goals.
- Aligned to the Australian curriculum
- Designed and structured around Australian schools and teacher needs.

The vegetable education program was developed by a multi-disciplinary project team consisting of sensory and consumer scientists from CSIRO Agriculture and Food, and educational officers from CSIRO Education.

3.1 Expert review of resource

The vegetable education program (v2), developed as part of the previous project (VG13089), was reviewed by an independent expert. The expert reviewed the resource against the Australian curriculum (v8.2, 2016), and found good alignment across different key learning areas, notably Science and English, but also Mathematics, Physical Health and Education, Technologies and The Arts (Table 1). The resource also aligned with a range of general capabilities, i.e. literacy, numeracy, Information and Communication Technology (ICT) capability, critical and creative thinking, personal and social capability and intercultural understanding. The full expert reviewer report is available as appendix to the Milestone 102 report.

Table 1 Alignment of the vegetable education program (v2) with the key learning areas (number represents the number of content descriptions addressed) and general capabilities (yes/no) of the Australian curriculum

Learning area/ capability	Foundation	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Science	6	9	8	3	3	6	6
English	16	10	10	5	3	2	1
Mathematics	6	2	3	1	1	1	
The Arts	1	1	1				
Technologies	2	2	2	1	1	1	1
Health and Physical Education	1	1	1	1	1	1	1
Literacy	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Numeracy	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ICT capability	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Critical and creative thinking	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Personal and social capability	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intercultural understanding	Yes	Yes	Yes	Yes	Yes	Yes	Yes

3.2 Optimised vegetable education program

The vegetable education program developed as part of the previous project (v2) was revised using input from the expert review, feedback from the teacher survey, the outcomes of the student survey and classroom observations from the previous project (VG13089).

Key feedback for improvement from the teacher evaluation was that the resource was too content dense, and that preparation was challenging (although the experiential learnings from the tastings were critical to its success).

Key changes in version 3 of the resource (compared to v2) were:

- The content density was reduced whilst keeping both curriculum alignment as well as the behavioural objectives
- The pedagogic framework of 5E (Engage, Explore, Explain, Elaborate, Evaluate) was shifted from 5 E's in each lesson to 5 E's across the five lessons. This helped communicate the objectives and flow on of the program more strongly, as well as reducing content.
- Every lesson now contains vegetable tastings and the vegetable suggestions for the lessons have been given more emphasis.

If teachers follow recommended suggestions, students will taste a minimum of 10 different vegetables in each unit, and more than 20 different vegetables across all three units.

- Practical experiments not involving vegetables were kept to an absolute minimum
- Barriers of practical implementation were lessened by providing more detailed information on quantities for one classroom
- An online teacher training program was developed to better prepare teachers for teaching the program (see Chapter 4).

3.2.1. Conceptual framework

The conceptual framework of the vegetable education program has the following characteristics:

1. Vegetable education program across the entire primary school career

There is evidence that children are most susceptible to change their behaviour when they are young. Furthermore, continuity in program activities across the student's primary school career as indicated in overseas initiatives (Battjes-Fries et al., 2014) was found to be a critical success factor to achieve permanent positive change.

2. Classroom based program, delivered by the teacher

The program is designed as a low-cost program to maximise uptake on a national scale, including in socio-economically disadvantaged areas. The program is used by teachers themselves, without in-class support from specialised staff; teachers are provided with training on the program.

3. Written resource, with full lesson plans and electronic whiteboard support

The physical form of the resource is written manuals. For each unit, it contains two resources for the teachers: a teacher manual, which includes all lesson plans, student worksheets and answer sheets, and an Electronic whiteboard support (set of PowerPoint slides). It includes an implementation manual for teachers/schools, with general information about the program, background information on preference development, a note on allergies and the safety of preparing foods, and curriculum alignment.

4. Three units of work for the different stages in primary school

The structure of primary schools allows for a unit of work on a single topic (here: vegetables). A unit consists of activities that span different learning areas. Three units were developed that align to different stages of the Australian schooling system: Foundation – year 2 (children aged 5-8 years), year 3-4 (children aged 8-10 years), year 5-6 (children aged 10-12 years). The lessons from each unit build on each other to provide students with a "food education" tailored around vegetables throughout primary school.

5. Each unit for work consists of five structured lessons of approximately one hour each

The number of lessons provides opportunity to build up knowledge, awareness and attitudes, whilst taking a crowded curriculum into consideration. Each lesson is fully described consisting of objectives, a lesson outline, materials needed, preparation activities and time, teacher background notes, suggested activities / lesson steps and extension activities. The pedagogic framework is the 5Es instructional model (Bybee, 1997); Engage, Explore, Explain, Elaborate and Evaluate.

6. Fun, enjoyment and hands-on experiences are critical elements of the program.

Increasing enjoyment in eating vegetables is a key goal of the program.

A specific health focus was avoided as this has been shown to negatively impact upon acceptance of foods labelled 'healthy' amongst children and adolescents (Maimaran & Fishbach, 2014; Wardle & Huon, 2000). The focus is on practical elements and fun, providing tasting exposure opportunities in the classroom, which have been shown to positively influence taste acceptance.

There is also a lot of emphasis on being able to describe sensations when eating vegetables, i.e. being able to describe broccoli as crunchy and a bit bitter, rather than in hedonic (yucky, yummy) terms.

7. The vegetable education program is closely aligned to the Australian curriculum

The resource is cross-curricular with close alignment to the Australian curriculum, particularly Science and English. It also contains elements from other learning areas as well as cross-curricular objectives. Information about curriculum alignment is included in the teacher toolkit, to maximise chances of uptake, and provide teachers with information about the objectives they have 'ticked off'.

3.2.2. Objectives

The overall objectives of the vegetable education program are for students to:

- Increase their knowledge, awareness and familiarity with vegetables and vegetable products
- Increase their knowledge about the senses
- Increase their understanding of how food and vegetable preferences differ between individuals and how they can change
- Increase their ability to describe experiences of eating vegetables
- Increase their acceptance, enjoyment and willingness to try vegetables.

All objectives are covered in each of the units, and the recurring themes increase in content complexity throughout the units. They are designed to align to curriculum objectives in each year level. Vegetables are tasted in each of the lessons in a fun and enjoyable way, built around specific lesson objectives and science investigations. For example, in unit 1, students learn about basic tastes, then taste vegetables representing specific basic tastes. A wide range of vegetable varieties are presented across each age-level with more focus on uncommon vegetables from unit 2 onwards. The program encourages trying vegetables and teaches students that liking develops as a result of repeated eating (exposure). In the last lesson of each unit, students create and consume a simple vegetable dish together, highlighting and promoting the social and pleasurable aspects of sharing meals with vegetables.

3.2.3. Materials

The vegetable education program consists of an overall implementation manual, an online teacher training module (see Chapter 4), and for each unit a teacher manual with lessons and electronic whiteboard support in the form of PowerPoint slides.

Overall implementation manual

The implementation manual is generic across all units. It provides general information and support for the school to implement the program.

It contains:

- Information about the objectives of the program
- Structure and lesson plans for each unit
- Theoretical background information for teachers on the functioning of the senses and development of food preferences

- Safety considerations for implementing the program (example note for parents that addresses allergies and cultural/religious perspectives on eating foods; worksheet on safe preparation of vegetables)
- Information about curriculum alignment, with specific curriculum objectives met within each of the units.

Unit materials

Each unit has two resources: a teacher manual that describes the lessons in detail, and a supporting PowerPoint resource to use in the classroom via the interactive whiteboard. The lessons all follow the same format:

- Lesson number and title
- Lesson outlines
- Materials and vegetables needed, preparation activities and preparation time
- Teacher background information
- Suggested activities with details on activities, time required and suggested work form (e.g. groups, pairs, individual)
- Extension activities
- Worksheets if related to activities in the lesson
- Teacher answers sheets related to worksheets.

Some sample material of a lesson plan is provided in Appendix A.

Unit 1 objectives and lesson plan

The lesson content in each of the units is provided in Figure 1 to Figure 3.

The objectives of Unit 1 (Foundation – Year 2) are for students to:

- Increase knowledge and familiarity with common vegetables
- Describe vegetables in terms of the five senses
- Learn that liking/disliking of specific foods can change by repeated trying
- Become more open to tasting a wide variety of vegetables.

LESSON	TITLE	LESSON OUTLINE
1	The five senses	Students: <ul style="list-style-type: none"> • Learn about the senses involved in eating. • Experience the five senses through tasting vegetables. • Taste and describe three vegetables with different colours, tastes and textures.
	Homework	Students create a vegetable tasting record with their parents.
	Extension	Students draw vegetables they would serve at a vegetable tasting party.
2	From seed to vegetable	Students: <ul style="list-style-type: none"> • Can recognise and name different types of common vegetables. • Understand what plants need to grow. • Understand which parts of plants are eaten as vegetables. • Taste vegetables from three different plants parts.
	Extension	Students grow a bean plant.
3	The basic tastes	Students: <ul style="list-style-type: none"> • Learn that we taste foods using the taste buds on the tongue. • Can recognise the four key basic tastes (sweet, sour, salty and bitter). • Give examples of foods for each of the basic tastes. • Taste two vegetables and can identify their dominant taste (sweet and bitter).
	Extension	Students categorise foods according to their basic taste.
4	Becoming a food adventurer	Students: <ul style="list-style-type: none"> • Learn that liking/disliking of foods can change by repeated trying. • Learn about the role of variety in the diet (included colour in vegetables). • Try foods they have not tasted before.
	Extension	Students discover colour variety in vegetables.
5	Picnic in class: sandwich	Students: <ul style="list-style-type: none"> • Prepare a tasty sandwich with vegetables and other ingredients. • Enjoy eating a sandwich together. • Discuss their experiences of eating a sandwich that includes vegetables.
	Extension	Students know at least ten vegetables that can be consumed on a sandwich.

Figure 1 Lesson plan unit 1

Unit 2 objectives and lesson plan

The objectives of unit 2 (Year 3-4) are for students to:

- Increase knowledge and familiarity with less common vegetables
- Increase knowledge about growing and preparing vegetables
- Develop their awareness of cultural diversity in food and vegetable preferences
- Build on their vocabulary concerning how food preparation affects vegetable sensory characteristics
- Understand how appearance influences food choices
- Become more open to try culturally diverse vegetables.

LESSON	TITLE	LESSON OUTLINE
1	Discover vegetables through the senses	<p>Students:</p> <ul style="list-style-type: none"> • Enrich their knowledge of vegetables. • Develop their awareness of cultural diversity in vegetable preferences. • Taste and describe two vegetables, plain and with two different condiments, and become aware of individual preferences. <p>Extension</p> <p>Students identify the vegetable in a dish from a particular country Students complete Find a Word "I know my vegetables".</p>
2	Vegetables grow in different climates	<p>Students:</p> <ul style="list-style-type: none"> • Grow their own micro herbs. • Develop their understanding of plant lifecycles, climates and seasons. • Taste and describe vegetables from two different climates. • Understand the difference between descriptive and evaluative words for describing vegetables. <p>Extension</p> <p>Students imagine their own vegetable garden. Students explore the role of agricultural sciences through imagining their own vegetable hybrid.</p>
3	Preparing vegetables – a science experiment	<p>Students:</p> <ul style="list-style-type: none"> • Understand what cooking techniques are used to prepare vegetables. • Investigate the relationship between cooking/preparation and the taste/texture of vegetables through a simple scientific experiment. <p>Extension</p> <p>Students complete crossword "I know even more about vegetables". Students use Veggycation website to find out how to cook two non-preferred vegetables.</p>
4	Perfectly imperfect vegetables	<p>Students:</p> <ul style="list-style-type: none"> • Understand how expectations and visual cues can affect our food choices and willingness to try different foods. • Become aware of food wastage and its relation to food appearance. • Write persuasive dot points to convince someone to try an imperfect vegetable. <p>Extension</p> <p>Students can differentiate between poor quality and odd appearance.</p>
5	MasterChef® in class: the salad	<p>Students:</p> <ul style="list-style-type: none"> • Prepare a mixed salad that is appealing and nutritious. • Critically appraise the food they eat. • Enjoy eating a meal together. <p>Extension</p> <p>Students compile and graph a class record on number and type of vegetables consumed.</p>

Figure 2 Lesson plan unit 2

Unit 3 Objectives and lesson plan

The objectives of unit 3 (year 5-6) are for students to:

- Increase knowledge and familiarity with vegetable products and processing
- Understand how the senses interact in the perception of vegetables
- Learn how cultural background and exposure shape food preferences
- Build a vocabulary about how processing affects vegetable sensory characteristics
- Conduct an experiment about vegetables using a scientific approach
- Become more open to experiencing a broad variety of vegetable forms.

LESSON	TITLE	LESSON OUTLINE
1	How our senses interact	Students: <ul style="list-style-type: none"> • Discover how our senses interact when we eat foods. • Investigate how appearance influences perception and consumption.
	Extension	Students explore colour variety in vegetables and graph results.
2	A science experiment on taste of vegetables	Students: <ul style="list-style-type: none"> • Learn to identify, plan and apply the elements of scientific investigations such as hypothesis, variables, constant. • Conduct a scientific experiment about the taste of vegetables. • Plan a scientific experiment about the taste of vegetables.
	Homework	Students observe, measure and record data for a scientific investigation about the taste of vegetables.
	Extension	Students suggest improvements to the scientific methods used in their experiment.
3	Vegetables from farm to plate	Students: <ul style="list-style-type: none"> • Investigate the role of food technology in producing vegetable products available all year round. • Compare the taste and texture of two fresh vegetables and their processed variant.
	Extension	Students describe how a vegetable gets from farm to plate.
4	Vegetables and cultural diversity	Students: <ul style="list-style-type: none"> • Understand how cultural background shapes food preferences from an early age by evaluating culturally diverse vegetables and preparation. • Compare data from the students' investigations about the taste of vegetables.
	Extension	Students enhance understanding of multicultural diversity by exploring dishes and vegetables from their chosen culture.
5	The vegetable dip challenge	Students: <ul style="list-style-type: none"> • Create a recipe for a dip that is tasty and looks good. • Taste and evaluate different vegetable dips. • Realise that dips can be a fun way to add vegetables in your diet.
	Extension	Students 'pitch' their dip to other students.

Figure 3 Lesson plan unit 3

3.3 Breaking down barrier of logistics/preparation

Teacher evaluation showed that current logistics /preparation were found challenging (Poelman et al, 2016, 2017). Vegetable tasting is the pillar of the behavioural change and teachers recognised its critical importance. To facilitate uptake by schools, options to make preparation/logistics easier were considered.

The supply of vegetables to schools in a format that would minimise preparation by teachers/parents (e.g. cut vegetables) was considered but was deemed unfeasible after stakeholder consultation. Whilst there are suppliers that deliver cut vegetables, the low volume per location and high distribution costs make it very difficult to economically sustain at scale up and school budgets do not allow for large operating expenses. Moreover, even if a viable distribution system could be developed, such a system would require all schools to conduct all lessons at the exact same weeks, which does not meet with school requirements of having some flexibility in conducting their lessons. This system would also risk increasing inequity when not all schools would have equal access to such delivery systems (e.g. rural/remote areas).

The following changes were made to facilitate logistics/preparation:

- Changes were made to the lesson content. The number of experiments in nearly all lessons was reduced to one. Practical experiments not involving vegetables were also kept to an absolute minimum.
- Variety in the last lesson was reduced. This lesson generated the largest amount of wastage (second and third helpings) and the number of suggested options for the foods was reduced whilst still maintaining variety so that each student/group could create their own meal/dish.
- The lesson content of one lesson (unit 3, lesson 5) was changed from a juice to a dip to make the lesson easier to organise and without requiring specific equipment (like a juicer or blender)
- Stronger emphasis on the use of specific vegetables which were recommended for each lesson. At each occasion, alternative vegetables were also provided.
- Vegetable preparation videos were made for each lesson, clearly demonstrating all steps and size of portions needed
- Quantities needed were determined and communicated in a more specific way. The previous version of the resource had shopping lists which stated, for example: “1 cauliflower floret per student”. In the current version, the amount of produce to source per class was calculated (“1/2 cauliflower head based on average sized cauliflower”) so the guesswork was removed for teachers.
- The online training manual gave specific information on how to implement the program in schools and to seek parental input.

It was further ensured that all consumables needed could be purchased at a supermarket to provide easy accessibility. The only non-vegetable item that needs to be purchased elsewhere are micro-herb seeds and potting mix.

3.4 Web portal

For the validation study, a web portal within the CSIRO website was created which provided:

- Information about the program objectives
- An introduction video about the program
- Contact information
- A link through which schools can access the materials.

Unique registration and password detail were sent to teachers by email to access the teacher training module which was integrated in an Learning Management System (LMS) . The module also provided access to the resources which have all been integrated in the module. In the version that will be made available for national roll out, an existing LMS system could not be found. Therefore, modifications were made to the web access and webpage to allow for teachers to get direct access to the materials (after registration on the webpage), see chapter 6.2.

3.5 Professional learning module

The objective of the professional learning module is to prepare the teachers to achieve the objectives of the VERTICAL program (i.e. increasing food and vegetable enjoyment), to prepare them for the practical implementation and to motivate them to teach the program. Different forms of training provision were explored, including video, webinar and face-to-face. Considering costs versus benefits, two versions of teacher training were developed differing in their level of intensity:

- Low intensity: training provided to the teacher as written documentation and an online training module (20 min), with no face-to-face training or support
- High intensity: training provided using the same materials as in the low intensity arm, but with additional personal support in the form of a face-to-face training preceding implementation of the program. In addition, school staff could ask questions and request support throughout the program.

The two training forms differ in their costing structure (one-off versus ongoing costs), which is of relevance for implementation of the resource outside of the research context.

3.5.1. Online training module

A teacher training module was developed in the form of an online training module which can be accessed via a web portal. The training module is designed to function as a stand-alone tool to prepare teachers for teaching the vegetable education program. The module takes around 20 minutes to complete after which teachers gain access to the educational resources.

The module consists of approximately 20 main slides, many of which have a layered build up. It has been built by a third party using Articulate® Storyline software around content developed by CSIRO.

The module consists of 5 main blocks:

1. Information about the program and resources available
2. Theoretical information Part 1 – Verbalisation and tasting methodology
3. Theoretical information Part 2 – Food preference development and teaching enjoyment
4. Implementation of practical aspects of the program
5. Downloadable vegetable education materials.

Sections are introduced through examples in which teachers can relate their own experiences eating vegetables in order to engage them and increase relevance. The module is provided through written, at times dynamic content, and professionally narrated by a female voice. Details about each of the five sections is provided below. For sample screenshots, see Appendix B.

Details of training and resources module

1. Information about the program and its structure

This section provides an overview of:

- The objectives of the training module
- Background and rationale of the vegetable education program. This is provided through a video message from the CSIRO Education Program Development Manager.
- Program structure and overview of content.

2. Theoretical information Part 1 – Verbalisation and tasting methodology

This section provides teachers with the theoretical background to systematically build their students' knowledge on how the five senses are involved in tasting vegetables and how they increase their ability to describe what they taste. Specifically, it explains:

- The five senses involved in tasting vegetables, with examples
- The difference between hedonic words that describe acceptance, and descriptive words that objectively describe vegetable properties
- A systematic tasting protocol used in the lessons for all vegetable tastings.

3. Theoretical information Part 2 – Food preference development and teaching enjoyment

This section provides the teacher with the theory and background to be able to teach children about vegetable enjoyment and increase children’s willingness to consume vegetables. It addresses 6 key concepts important to develop an acceptance for vegetables:

- Vegetable preferences are learned
- Repeated trying builds acceptance of vegetables
- Encouraging fussy eaters to try vegetables
- Cultural differences in vegetable preferences
- Avoid a focus on health
- Teachers are important role models.

4. Implementation of practical aspects of the program

This section provides practical information on implementation of the program in schools, including:

- The rationale of vegetables selected for the lessons
- Allergies and cultural sensitivities
- Sourcing and preparing materials
- Seeking help in running the program.

5. Downloadable vegetable education materials

For the validation study, the module was designed to function as part of a professional Learning Management System (LMS), which can track who has undertaken the training. Schools were required to login with secure details which gave them access to the module and integrated resources. The LMS system was hosted by an external provider.

3.5.2. Face-to-face training

A face-to-face training for teachers was developed that facilitates preparation for the theoretical and practical implementation of the program. The face-to-face training took around 45 minutes and provided information around the following sections:

- Information about the program, its structure and objectives
- Theoretical information about the senses and food preference development
- Practical information on how to implement the program in the school and classroom.

As such, the sections followed a similar structure to that used in the online teacher training module. Key differences were:

- More in-depth provision of information (including use of more examples and anecdotes)

- Discussion of practical implementation opportunities and barriers for the particular school. This allowed for tailored advice to the specific school situation.
- Opportunity for teachers to ask questions
- Experiential learning (an actual tasting experiment) to demonstrate the tasting protocol and to illustrate how the senses interact with each other in perception. This experience was designed to deepen the understanding of core concepts and heighten teacher engagement.

The evaluation of the online training module and face-to-face training is described in Chapter 4.

4. Evaluation of the vegetable education program by teachers

Key findings of teacher survey in a nutshell

- A total of 65 teachers evaluated various aspects of the program and online training module
- The program and online training module were well received by teachers on all aspects measured. Teachers would re-use and recommend the program
- Teachers felt the program had good alignment with the curriculum and materials were easy to use, both of which are important for uptake and reach
- Teachers had mostly used the vegetables recommended in the lesson plans
- Evaluation of preparation effort has improved as a result of changes to the program
- Additional face-to-face training offered some benefits over on-line training alone, in percentage of teachers being trained and perceived program workload
- Thus, some form of teacher support may improve reach in schools.

A teacher survey was conducted to gain insight into the experiences of the teachers working with the resources in order to support its national roll out and identify areas for further development.

4.1 Methodology

Quantitative data was collected from teachers who implemented the vegetable education program in their classroom (low and high intensity intervention). Questions related to the online training module and face-to-face staff training, as well as the vegetable education lessons/resources themselves. Data was collected through an online survey (Survey Gizmo) and teacher participants provided online consent.

4.1.1. Online training module

Teachers were asked to indicate whether they had used the online training module (Yes, fully; Yes, partially; No). If they used the online training module, they were asked to evaluate specific items of the module.

The items included in the evaluation of the online training module were based on 6 of 9 key dimensions of the Learning Object Review Instrument (LORI), a framework for evaluating the quality of multimedia learning resources (Leacock & Nesbit, 2007). The dimensions included were: content quality, learning goal alignment, motivation, presentation design, interaction usability and reusability. Every dimension was described with several items pertaining to that dimension (Table 2) and rated on a 5-point scale, ranging from 'strongly disagree' (=1) to 'strongly agree' (=5). The other dimensions of the LORI framework were deemed as not applicable (feedback and adaptation) or not relevant (accessibility and standards compliance) to the module. In addition, the questionnaire contained an open question to add any comments (positive or negative) about the online training module.

Table 2 Items included in the evaluation of the online training module and their classification according to the dimensions from the LORI framework

DIMENSION	ITEM
Content quality	The content of the online training module was relevant to teaching the vegetable education program
	The level of detail in the module was appropriate
Learning goals	The module enhanced my knowledge about how to teach enjoyment of vegetables
	The module enhanced my knowledge to teach students about the senses and how to verbalise their sensations when eating vegetables
	The module helped me with the practical implementation of the lessons
Motivation	The information provided prepared me well to teach the program to my students
	I found the module interesting
	The module motivated me to teach the program to my students
Interaction usability	The training module was easy to navigate
	It was easy to download the resources (lessons plans, shopping lists) from the module
Presentation design	The training module was appealing (visually and auditory)
	The presentation design (graphics, text, voice-over etc.) supported the content well
Re-usability	The online training module is suitable for teachers at different levels
	The online training module is suitable for teachers working in different school environments
Other	The duration of the module was appropriate

4.1.2. Face-to-face training

Face-to-face (F2F) training was provided to teachers in the high intensity intervention arm only. Although the LORI framework was specifically designed for multi-media resources, several dimensions were also deemed suitable for the F2F training and items were included to cover those (Table 3).

Table 3 Items included in the evaluation of the Face-to-Face training and their classification according to the dimensions from the LORI framework

DIMENSION	ITEM
Content quality	The content of the face-to-face (F2F) training was relevant to teaching the vegetable education program
	The level of detail in the F2F training was appropriate
Learning goals	The F2F training had added value to the online training module
Motivation	The information provided in the F2F training prepared me well to teach the program to my students
	I found the F2F training interesting
	The F2F training motivated me to teach the program to my students
Other	The duration of the F2F training was appropriate

4.1.3. Vegetable education program

The vegetable education program itself was evaluated quantitatively as well as through some open questions. Where possible, quantitative questions were the same as those used in the pilot evaluation of the vegetable education program (Poelman et al., 2017) to allow comparability with the previous version. Some additional questions were added following the LORI framework (Table 4). All items were rated using a five-point agreement scale. In addition, teachers were asked to provide an overall score of the program out of 10.

As open questions, teachers were asked what the best features of the program were and what features could be improved.

Table 4 Items included in the evaluation of the vegetable education program (bolded questions were used in the pilot evaluation)

ITEM
The program was engaging for students (M*)
The program was educational for students (CG, LG)
The program encouraged student participation (CQ, M)
The program contained activities that allowed to gauge how much students had learned (FA)
The program was suitable for students from various backgrounds (A, R)
The program was suitable for students of all abilities (A, R)
The program related well to the curriculum (CQ, LG)
The program support materials were useful (CG)
The amount of preparation for each lesson was reasonable
There was a good mix of pictorial, text and audio materials in the teaching package (PD)
The number of lessons was appropriate
The duration of the lessons was appropriate
I used the vegetables that were suggested for the lessons
The program is likely to encourage students to enjoy vegetables more (LG)
The program helped students gain knowledge of vegetables (LG)
The program is likely to have a lasting positive impact on the students (LG)
I would use this program again (R)
I would recommend this program to other teachers (R)

* Relates to the dimensions of the LORI instrument: CG = Content Quality, LG = Learning goals, FA= Feedback and Adaption, M=Motivation, IU = Interaction Usability, PD = Presentation Design, R = Reusability, A=Accessibility.

4.1.4. Data analysis

Data analysis was conducted with SPSS (IBM Corporation, v25, 2017). A value of $P < 0.05$ was adopted as the measure for statistical significance.

For the online training module, first internal consistency of the items pertaining to the same construct (e.g. learning goals, content quality) were calculated using Cronbach's alpha. An average score was calculated for constructs with sufficient internal consistency (Cronbach's alpha > 0.70). Where internal consistency was lower, the individual items were retained. In addition, an average score across all items was calculated.

To determine if there were differences in responses between teachers from different intervention arms and states

for the online module, two-way analysis of variance (ANOVA) was conducted with the dimension ratings as dependent variables, and the variables Intervention (Low/High) and State (NSW/SA) as independent factors in a full-factorial model. SES and Unit taught were not included in the model as the numbers per subgroup were too low.

Cronbach's alpha ratings were also calculated for the dimensions of the face-to-face training and average rating calculated in case of sufficient internal reliability.

The questions on the vegetable education program were analysed as separate items. An ANOVA analysis on these items was conducted with Intervention and State as independent factors using full-factorial models. In addition, an independent samples t-test with teachers from NSW was conducted to compare the ratings from the pilot program to the current program.

4.2 Results

4.2.1. Participants

A total of 65 teachers (38 NSW, 27 SA) completed the survey, of which, 57% had taken part in the high intervention group and 43% in the low intervention group. Feedback from teachers from nearly all (17 out of 19) intervention schools was received, with an average of 3.8 ± 2.5 teachers per school. The teachers represented a mix of all year levels, with 23% of teachers who had taught Unit 1, 40% Unit 2, 15% Unit 3 and 22% multiple units.

4.2.2. Participation in training

A total of 78% of teachers completed the online training module (partly 14% and fully 64%). In addition, around two-thirds of the teachers in the high intervention group also received face-to-face training. In the high intervention group 95% of participants received any form of training (F2F and/or online), whereas only 75% of participants in the low intervention group received any form of training (Table 5).

Table 5 Completion rates of the online training module and face-to-face training by teachers as a function of intervention group (high vs low intensity).

Intervention arm	Completed online training	Received (additional) face-to-face training		
		No	Yes	Total
High intensity	No	5%	14%	19%
	Yes, partially	8%	5%	68%
	Yes, fully	22%	46%	14%
	Total	35%	65%	100%
Low intensity	No	25%	N/A	25%
	Yes, partially	61%	N/A	61%
	Yes, fully	14%	N/A	14%
	Total	100%	N/A	100%

4.2.3. Evaluation of online training module

A total of 51 teachers completed an evaluation of the online module. There was good internal consistency for the dimensions: Content Quality, Learning Goals, Motivation, Presentation Design and Re-usability (Table 6); for these dimensions the average ratings were calculated. The dimension Interaction Usability had a Cronbach's alpha of 0.69 and items were analysed separately.

The online training module was evaluated favourably (Table 6). The overall rating across all items was 3.9 ± 0.5 out of 5 and all individual items had similar ratings. These results indicate that the online module was favourably received by teachers in terms of: content quality, achieving the desired learning goals, motivating teachers to teach the program, suitability for teachers from different backgrounds and school environments, presentation design, ease of use and duration.

There were no statistically significant differences in ratings between teachers from different states and allocated to different intervention arms (all P values > 0.05, Table 6 and Figure 4).

Table 6 Ratings (mean and SD) for various dimensions (Cronbach's alpha) of the online training module evaluated by teachers in NSW and SA (n=51) and statistical significance as a factor of intervention (high vs low intensity training), state (NSW vs SA) and their interaction. Ratings ranged from 1-5.

DIMENSION	MEAN	SD	EFFECT (P VALUE)		
			INTERVENTION	STATE	INTERVENTION x STATE
Content quality (0.89)	4.11	0.55	0.56	0.10	0.71
Learning goals (0.89)	3.88	0.69	0.54	0.27	0.99
Motivation (0.84)	3.86	0.71	0.91	0.42	0.87
Re-usability (0.83)	3.95	0.49	0.37	0.07	0.95
Presentation design (0.82)	3.95	0.49	0.97	0.62	0.26
Easy to navigate	3.03	1.17	0.52	0.81	0.79
Easy to download resources	3.86	0.71	0.30	0.16	0.99
Duration	4.25	0.47	0.47	0.08	0.72
Overall rating	3.90	0.45	0.70	0.27	0.99

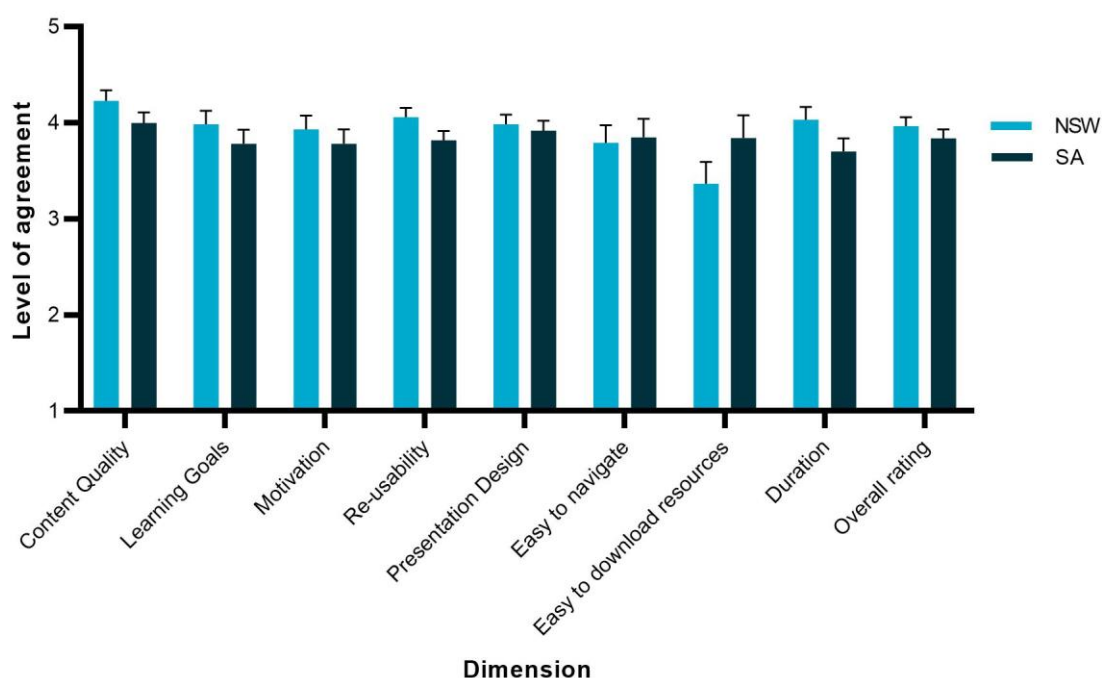


Figure 4 Ratings (mean and SE) for various dimensions of the online training module evaluated by teachers in NSW and SA (n=51), ratings ranged from 1-5. There were no statistically significant differences in the ratings between states.

Teachers were given a few opportunities to provide open comments. Open comments from NSW teachers related mostly to the difficulty in downloading materials. NSW was the first state to receive the intervention and there were some initial technical problems in accessing materials from the LMS module. The open comments from SA teachers provided some positive feedback (interesting, easy to use, informative), some comments related to accessing materials (time consuming to download and some technical difficulties, but far less than in NSW) and some comments related to the content. On the latter aspect, two teachers indicated that they wished that the module would provide more detailed training on a lesson by lesson basis, whereas one other teacher commented that the module was not needed as sufficient background information was given in the lessons themselves.

4.2.4. Evaluation of face-to-face training

The high intervention arm received face-to-face training and this training was evaluated by 24 teachers. Therefore, the numbers were too low to conduct statistical analyses on subgroups.

The dimensions of Content Quality and Motivation showed good internal consistency and items were averaged. Overall, the F2F training was well received by teachers with an average score around 4 (out of 5) for all items (Table 7).

Table 7 Ratings (mean and SD) of face-to-face training (n=24). Ratings ranged from 1-5.

DIMENSION/ITEM	MEAN	SD
Content quality (0.85)	4.15	0.58
Motivation (0.93)	3.92	0.84
Learning goals	4.00	1.02
Duration	4.17	0.56

4.2.5. Evaluation of vegetable education program

The vegetable education program was evaluated quite positively, with most items scoring an average score around 4 out of 5 (Table 8). Notably, teachers felt that the resource aligned well with the curriculum, used the vegetables suggested for the lessons, felt the program would have a long-lasting impact on students and were positive about re-use and recommending it to other teachers. The rating for *amount of preparation* was 3.0, indicating a neutral level of agreement. The overall rating of the program (out of 10) was 7.3.

Table 8 Ratings (mean and SD) for various elements of the vegetable education program evaluated by teachers in NSW and SA (n=65) and statistical significance as a factor of intervention (high vs low intensity training), state (NSW vs SA) and the interaction of intervention level and state. Ratings ranged from 1-5.

ELEMENT	MEAN	SD	EFFECT (P VALUE)		
			INTERVENTION	STATE	INTERVENTION x STATE
The program was engaging for students	4.13	0.72	0.30	0.003	0.91
The program was educational for students	4.23	0.58	0.96	0.32	0.36
The program encouraged student participation	4.30	0.66	0.19	0.02	0.22
The program contained activities that allowed to gauge how much students had learned	3.70	0.73	0.68	0.09	0.21
The program was suitable for students from various backgrounds	4.14	0.59	0.92	0.01	0.86
The program was suitable for students of all abilities	4.09	0.66	0.67	0.01	0.11
The program related well to the curriculum	3.86	0.73	0.51	0.79	0.87
The program support materials were useful	4.02	0.85	0.97	0.07	0.61
The amount of preparation for each lesson was reasonable	3.03	1.17	0.45	0.80	0.12
There was a good mix of pictorial, text and audio materials in the teaching package	3.86	0.71	0.11	0.01	0.04
The number of lessons was appropriate	3.77	0.83	0.02	0.02	0.02
The duration of the lessons was appropriate	3.39	1.06	0.02	0.01	0.01
I used the vegetables that were suggested for the lessons	4.23	0.46	0.92	0.64	0.33
The program is likely to encourage students to enjoy vegetables more	3.95	0.74	0.16	0.74	0.28
The program helped students gain knowledge of vegetables	4.25	0.47	0.48	0.21	0.45
The program is likely to have a lasting, positive impact on students	3.83	0.79	0.44	0.66	0.66
I would use this program again	3.78	0.95	0.26	0.45	0.56
I would recommend this program to other teachers	3.80	0.91	0.12	0.54	0.48
Overall score for Program out of 10	7.33	1.94	0.69	0.40	0.85

There were a few differences as a function of intervention level and state:

- Teachers who had received face-to-face training (high intensity intervention) were more positive about the number and the duration of the lessons than teachers who conducted the online training only (low intensity intervention) (Figure 5).
- Teachers from NSW rated the vegetable education program higher than teachers from SA on 7 elements: engaging, encouraging student participation, suitable from student of various backgrounds and abilities, good mix of materials and number and duration of lessons. They did not differ in other aspects, including how well the program related to the curriculum, their evaluation of preparation effort and the overall score (Figure 6).

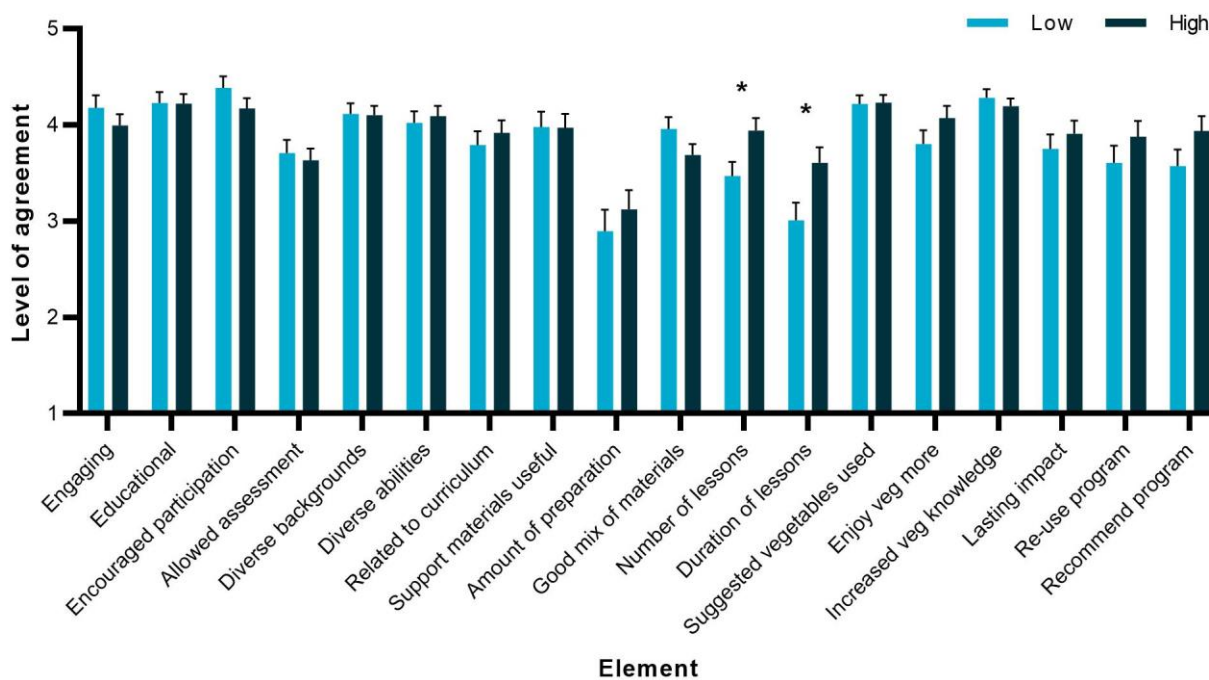


Figure 5 Ratings (mean and SE) for various elements of the vegetable education program evaluated by teachers (n=65) split by low and high intensity intervention, ratings ranged from 1-5. * indicates a statistically significant difference in the ratings between low and high intensity interventions ($p < 0.05$).

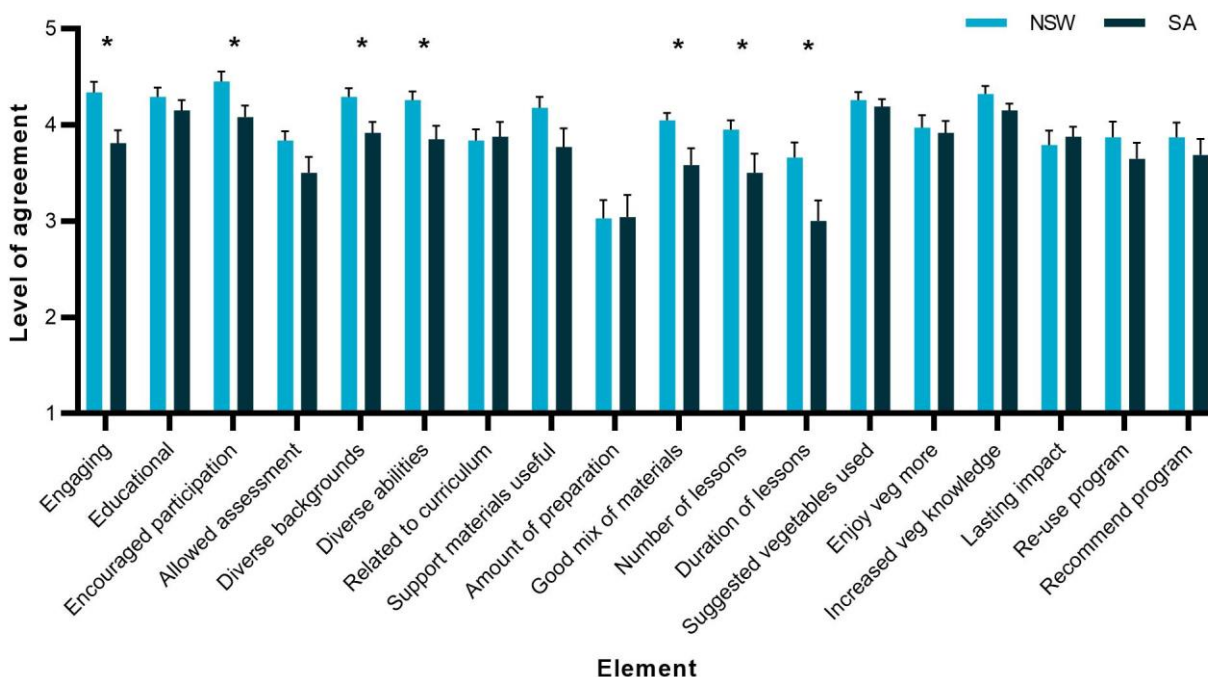


Figure 6 Ratings (mean and SE) for various elements of the vegetable education program evaluated by teachers (n=65) split by state (NSW vs SA), ratings ranged from 1-5. * indicates a statistically significant difference in the ratings between states (p<0.05).

A significant interaction between intervention level and state was found for three variables: mix of materials, duration of lessons and number of lessons. Figure 7 shows that teachers in NSW rated these items similarly regardless of the intervention arm, but there were differences amongst SA teachers depending on whether they had received F2F training or not. SA teachers who received F2F training scored comparably to the NSW teachers in their assessment on the number and duration of lessons, but SA teachers in the low intensity arm rated these aspects lower. These results likely indicate that for SA teachers the F2F training prior to starting the lessons helped to create a more positive attitude towards the appropriate number and duration of the lessons. SA teachers in the high intervention arm rated the mix of materials lower than the other three groups, and we cannot offer a suitable explanation for this result.

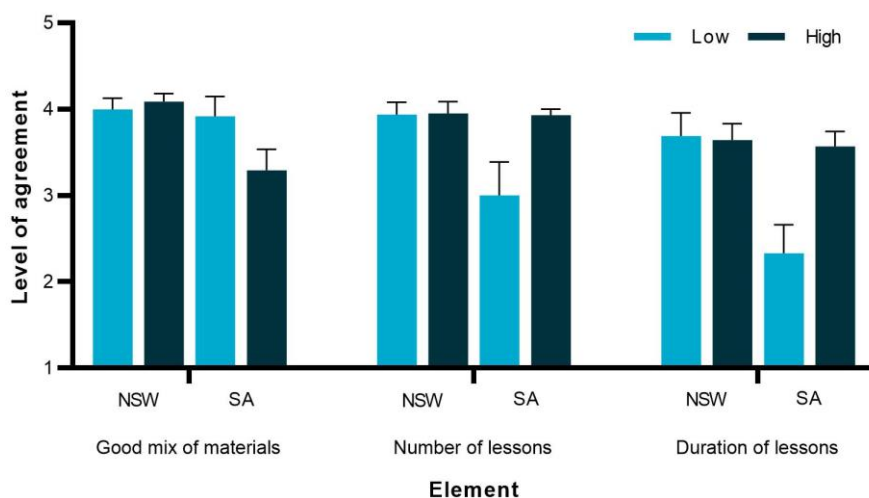


Figure 7 Ratings (mean and SE) for three elements of the vegetable education program evaluated by teachers (n=65) as results of interaction between state and intervention level split (low vs high intensity) by state (NSW vs SA), ratings ranged from 1-5.

Open comment on best features of the program and development opportunities

In an open comment, the teachers were asked about the best features of the program. The most commonly mentioned included: the vegetable tastings and students trying new foods/vegetables, the high student engagement through the hands-on learning aspect and the good resources of the program overall (lesson plan, PowerPoint). Comments were also made about specific program aspects, particularly the last lesson (where students eat and prepare a dish together) which was very well received, the concept of food adventurer and the information that the program provided about vegetables. Several teachers also mentioned that the program was important in challenging pre-conceived ideas and allowed students to take some risks, which they liked.

Teachers were also asked to describe how they feel the program could be improved. Some comments related to the time/duration of the lessons in relation to content density, with some teachers suggesting breaking up material in smaller lessons or reduce the amount of material. Preparation time involved for the practical aspects was also mentioned, and involvement of others suggested (e.g. teacher aid, parents, students). Some teachers also suggested to add a recording element for the students (journal/workbook/scrap book). There were two teachers who commented that the Kindergarten students found it difficult to come up with describing words and suggested buddy-classes with older students.

Comparison with pilot program

Several questions in the teacher survey were the same in the VERTICAL pilot program (Poelman et al., 2017) and the current program and responses of the NSW teachers were compared. Compared to the pilot program, the current program rated higher on the usefulness of the support materials ($P=0.052$) and the preparation effort needed for the program ($P=0.005$) (Figure 8).

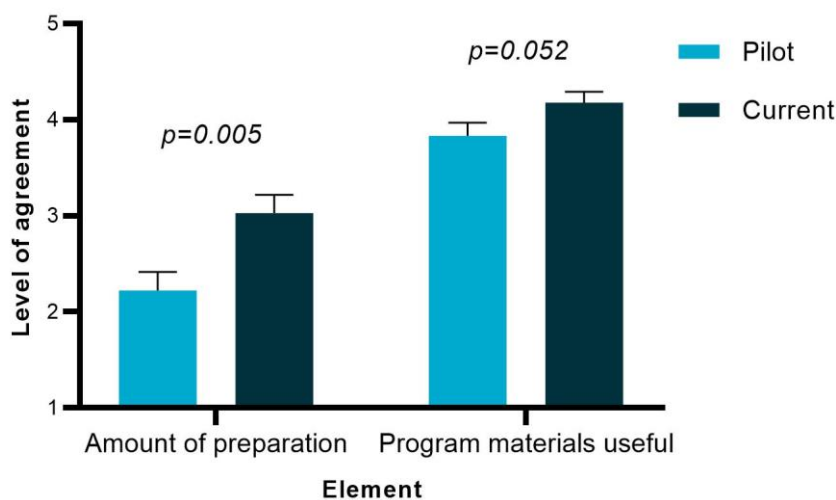


Figure 8 Comparison between pilot and current VERTICAL programs for amount of preparation and usefulness of program materials (mean and SE) on a scale of 1 - 5.

5. Effect of vegetable education program on student outcomes

Key findings of student survey in a nutshell

- A randomised controlled trial was conducted with 1639 students from 25 schools
- The vegetable education program was effective in changing mediating factors associated with vegetable consumption among primary school students
- The program increased student’s vegetable knowledge, ability to verbalise sensations when eating vegetables, vegetable acceptance, willingness to try them, as well as the number of new vegetables consumed
- The effect of the vegetable education program was sustained at three-month follow-up for knowledge
- Online and written training of teachers alone was just as effective on student outcomes as teachers receiving additional face-to-face training
- Results demonstrate that there is a strong evidence base for efficacy of the program, regardless of student’s backgrounds in terms of gender, school size, socio-economic status and state of residence.

The aim of this study was to test the effectiveness of the vegetable education program to positively change mediating factors associated with vegetable consumption in primary school children.

5.1 Methods and materials

5.1.1. Design

A cluster randomised controlled trial was conducted amongst schools, each allocated to one of three conditions:

1. Control
2. Intervention low: sensory and vegetable education intervention with low intensity teacher training (online training and written materials)
3. Intervention high: sensory and vegetable education intervention with high intensity teacher training (as for ‘intervention low’ but with face-to-face training and personal support).

Data was collected from students at three time points:

1. At baseline (pre-test)
2. Immediately after the intervention (post-test)
3. At three-month follow up (follow-up).

A pre- and post-test with students was conducted to determine differences in behavioural determinants of vegetable intake between children in the three groups. The intervention arms were the same teacher led school-based vegetable education program, though preceded by differing teacher training intensity, and hence, implementation costs. The control arm continued to follow their regular education. A three-month follow up was collected to determine whether any effects of the interventions were sustainable.

Hypotheses:

- Both the low and high intensity education program will lead to:
 - Increased knowledge of the child about vegetables and the senses involved when eating them
 - Increased awareness of vegetable sensory properties
 - Increased acceptance of vegetables
 - Increased willingness of the child to try vegetables.
- The high intensity intervention is more effective than the low intensity intervention

- Changes in outcome measures are sustained at three-month follow up.

5.1.2. Participants

Participants were students from primary schools in NSW and SA whose parents provided consent. Students were eligible to take part in the student survey if they were in year 2 to year 6 from primary school, their school and classroom teacher were taking part in the study, and their parent had provided written consent.

Participating schools needed to meet the following criteria:

Inclusion criteria:

- Government primary school
- School located in one of ten selected areas in Greater Sydney or Greater Adelaide.

Exclusion criteria:

- Schools that could not accommodate computerised data collection
- Schools that were previously involved in trialling the vegetable education program.

5.1.3. Recruitment protocol

Recruitment was a staged approach, whereby schools were first approached to take part in the study, and then consent was sought from (parents of) participants to take part in the validation study.

A stratified approach was followed to select schools based on socio-economic status. SEIFA (Socio-Economic Indexes for Areas) scores for Index of Relative Socio-Economic Advantage and Disadvantage (IRSEAD) were obtained from the Statistical Local Areas (SLA) of Greater Sydney and Greater Local Areas (GLA) in Greater Adelaide (Australian Bureau of Statistics Census data, 2011). A tertile split was conducted within each state to divide SLA's and GLA's in low (IRSEAD deciles 1-5), medium (IRSEAD deciles 6-8) and high (IRSEAD 9-10) socio-economic status. SLA's and GLA's with fewer than 6 schools were excluded. A total of 4, 3 and 3 SLA's (NSW) and 3, 3 and 4 GLA's (SA) were randomly selected from the low, medium and high SES area, respectively. A list of government primary schools from each selected SLA/GLA was compiled using information from the Department of Education and all schools in the selected area were invited to take part. Once schools were recruited into the study, schools within each SES level were randomly allocated to one of the three treatments (2 intervention or control).

Ethical approval for this study was provided by the CSIRO Human Research Ethics Committee (HREC24/2016), the NSW Department of Education and Communities (SERAP 2017036) and the SA Department for Education (2008-0032). Written informed consent was collected from parents and via classroom teachers. The parent provided consent on behalf of their child. All children at the intervention schools/classes received the vegetable education program, however, only children whose parents had signed the consent form took part in this validation study.

5.1.4. Sample size calculation / power

- The study was a cluster randomised controlled trial, using a stratified design, whereby schools were randomly allocated to a treatment, and all individuals within that school were subjected to the same treatment. As there is dependence between individuals sampled from the same school and classroom, the clustered nature was accounted for in the power analysis.
- The number of student participants needed was calculated based on a change in attitudinal outcomes. We estimated a small effect size of 0.15 based upon findings from another study with similar objectives (Battjes-Fries et al, 2015, Poelman et al 2018). With a power of 0.95, alpha = 0.05 and using a repeated exposure ANOVA with 3 treatment groups, an overall sample size of 531 students was needed (GPower 3.1.9.2).
- This sample size was multiplied by a correction factor of $1 + (m-1) \rho$, called the design effect (where m is the average cluster size and ρ is the intra-class correlation coefficient), to take the clustered nature of the data into account (Campbell, Piaggio, Elbourne, & Altman, 2012).

Assuming an m of 25 students per class and estimating a small degree of correlation ($\rho = 0.05$), the correction factor is 2.2. Thus, a sample of 1168 students was needed ($531 \times 2.2 = 1168$).

- On a school level, we sought to obtain data from 30 schools (10 schools in each of the three treatment arms, 6 classes per school) covering a wide geographic and socio-economic spread across metropolitan Sydney and greater Adelaide.
- With an estimated response rate in classes of around 30% and a participation of 6 classes per school, based on response rates in our pilot study, we expected to receive data from a minimum of 1350 students (30 schools \times 6 classes \times 25 students/class \times 30% response rate), which allowed for a further 13% drop-out rate at three-month follow up.

5.1.5. Intervention

The vegetable education program consists of written resource materials and an online teacher training module.

The vegetable education program consists of three integrated lesson plans (Units of Work) aligned to the different Stages in which the primary school curriculum is divided: Early Stage 1 / Stage 1 (lowest three years; 5-8 year old children), Stage 2 (middle two years; 8-10 year old children) and Stage 3 (highest two years; 10-12 year old children). Each unit of work consists of five lessons of approximately 1hr each, aimed at increasing food and vegetable knowledge, awareness and enjoyment. The program is taught by the teacher in their own classroom. Fun, enjoyment and hands-on experiences are critical elements of the program. Children are taught about vegetables, including their taste properties and receive taste development training to increase their vegetable acceptance. They are also taught about cultural diversity, regionality and seasonality of vegetables, about growing vegetables, and about Australian vegetable production. A specific health focus is avoided, but the role that vegetables play in a healthy and varied diet is included. Materials consist of fully written lesson plans with worksheets and background information. The resource is closely aligned to the curriculum, in particular, Key Learning areas of Science, English, Mathematics, Health and Physical Education as well a generic capabilities and cross curricular themes.

The teacher training module consists of an online module that takes about 20 minutes to complete. It contains information on the objectives and structure of the program, background theory about the senses and food preference development, the objectives and structure of the program and practical information on the implementation of the program.

Two interventions were evaluated: 1) Low intensity intervention (teacher training using written resources and online training module followed by vegetable education program in class); 2) High intensity intervention (as 1, with additional interactive – face to face – support). Intervention schools in the two treatment arms received their allocated training and subsequently undertook the teaching of the vegetable education program over a period of 5 weeks. During that time, control schools continued to teach their regular curriculum. The waitlisted control schools were offered the vegetable education program materials after completion of the validation study. Baseline measures for children in the intervention and control schools were collected at commencement of the school term (week 1 or 2) and post-test data towards the end of the same term (week 8 or 9). A follow up measurement was conducted three months after completion of the intervention (including children in the control arm of the study).

5.1.6. Measures

An online survey (Survey Gizmo) was completed by children (whose parents provided consent) in the classroom. Students self-completed the questionnaire addressing their knowledge, verbalisation skills, vegetable acceptance, behavioural intent and their willingness to try foods, including vegetables, and the number of new vegetables consumed.

There were three different versions of the survey for students in different year levels (lower, middle, upper). The outcome measures were the same in all three groups, but the questions were slightly different to correspond with the resource content:

1. Lower: year 2 students
2. Middle: year 3 and year 4 students
3. Upper: year 5 and year 6 students.

The differences between year levels related to the knowledge component of the questionnaire as well as the specific vegetables used in the verbalisation, acceptance and willingness to try questions. Unlike the other questionnaires, the lower or year 2 questionnaire had no open questions in the knowledge component to take the more limited writing capabilities and shorter attention span of this younger age group into account.

The outcome measures are summarised in Table 9 and described below.

Table 9 Outcome variables, number and example of question format and answer category measured during the randomised controlled trial amongst students.

DETERMINANT	# OF QUESTIONS	EXAMPLE OF QUESTION	ANSWER CATEGORY
Knowledge	11	<i>Which 5 senses are involved in eating vegetables?</i>	True/False, Multiple Choice, Open question
Verbalization	2	<i>How does this [vegetable] taste and feel in our mouth? Write as many describing words as you can.</i>	Open question
Vegetable acceptance	7	<i>How much do you like [vegetable]?</i>	Really dislike (=1) – Really like (=7)
Behavioural intention	4	<i>I will eat a variety of vegetables</i>	No, definitely not (=1) – Yes, definitely (=5)
Vegetables willing to try	4	<i>Would you try [vegetable] if someone offered it to you?</i>	Yes / No
New vegetables consumed	1	<i>How many new vegetables have you consumed in the last month?</i>	Number

- **Knowledge:** Knowledge was tested in relation to vegetables and the senses involved in eating and drinking. A combination of true/false statements, multiple choice questions and open questions were used. A total of 11 points for knowledge could be scored within each year level. For all questions, a correct response provided a score of 1 point, with exception of the open question about listing vegetables, where up to 2 points could be scored (year 3-4: 0 correct = 0 points, 1-3 correct = 1 points, 4 or more correct is 2 points; year 5-6: 0 correct = 0 points, 1 correct = 1 point, 2 or more correct is 2 points). Cut-offs were determined based on the results from the pilot study.
- **Verbalisation:** Ability to verbalise sensory perceptions was tested. Children were asked to provide descriptive words for two vegetables. The number of descriptive (e.g. crunchy, sweet) words was counted. Hedonic words (e.g. delicious, yummy) were excluded. One point was allocated for each correct answer. The number of descriptive terms summed across the two vegetables was calculated.
- **Behavioural intention:** Behavioural intentions for eating a variety of foods and vegetables was measured using 4 statements. Format was according to the validated scales of behavioural intent of the Theory of Planned Behaviour (Fishbein & Ajzen, 1975). Cronbach's alpha was calculated within each year level to determine internal consistency of individual items for the overall concept and was satisfactory (~0.8). The mean of these items was calculated.
- **Willingness to try:** Willingness to try four specific (less commonly consumed) vegetables was measured using pictures of the vegetable. One point was allocated for each vegetable the child was willing to try.
- **Acceptance:** Acceptance for vegetables was measured using a single item 7-point hedonic facial scale. In addition, acceptance for six specific vegetables, which varied between year levels, was measured using the same scale. Examples to ensure correct understanding of the scale were given.
- **Number of new vegetables tried:** Students were asked to record the number of new vegetables they had tried in the previous month.

To assist with comprehension and task requirements, teachers explained the task of completing the survey questionnaire to the children. Year 2 students completed the questionnaire through class-guided support from the teacher (the teacher read out the questions and/or showed on the interactive white board). Students from year 3 onwards self-completed the questionnaire, and the teacher was present to answer any questions. The survey questionnaires took a maximum of 15 minutes to complete.

As the questionnaire was a shorter version of the previously used questionnaire (Poelman et al, 2018), no pilot testing with students was undertaken.

The following background information was collected:

- Student questionnaire: gender, age and school class of the child
- Parent questionnaire: cultural background (using categories of the Australian Bureau of Statistics), usual vegetable intake and food neophobia of the child. Questions were embedded in the consent form.

Parents were asked if they consented to being contacted for follow up about this study. To determine whether the school educational program has had any (noticeable) flow-on effects in the home environment of the child, the following information was collected from consenting parents:

- Parental perception of whether the child is more open to trying new foods (food neophobia, 6-item scale), and more open to eating vegetables when they are offered to the child, by agreeing to the statement with level of agreement/disagreement using a 7-point scale.
- Vegetable consumption of the child.

These measures were the same as the ones collected at baseline from the parent.

5.1.7. Data analysis

Descriptive statistics were analysed using SPSS (IBM Corporation, v25, 2017) and mixed linear modelling (MLM) was conducted using Stata v15 (www.stata.com). A value of $P < 0.05$ was adopted as the measure for statistical significance. Descriptive statistics were used to characterise the participants. Participants were only included in the final analysis when they had completed baseline and at least one of the two post-intervention surveys. All other participants were considered to be drop-outs and participant characteristics of the drop-outs were compared with the participants used for analysis to determine if there was systematic bias in the final sample.

To analyse whether there were differences between the high intensity and low intensity training preceding the vegetable education intervention, mixed linear modelling (MLM) was conducted. Analyses were conducted on outcome measures with time point (baseline, post-test, follow-up), treatment condition (intensity low, intensity high and control), year level (lower, middle, upper) plus the 2- and 3-way interactions between time point, treatment condition and year levels as fixed factors. The low intensity intervention arm was set as the contrast category, and it was determined whether the high intensity intervention significantly differed from the low intensity. This multi-level analyses took the interdependency of measures into account (i.e., students over time, students in the same class, classes in the same school). Gender, school size, socio-economic status of the school's area and state were included in the models as covariates.

Where there was no statistically significant difference between the two different intensity levels of training preceding the vegetable education intervention at post-test, these two groups were combined to analyse the effect of the vegetable education program using mixed linear modelling (MLM). Analyses were conducted on outcome measures with time point (baseline, post-test, follow-up), treatment condition (both intervention groups combined and control group), year level (lower, middle, upper) plus the 2- and 3-way interactions between time point, treatment condition and year levels as fixed factors. The 2-way interaction effect between treatment condition and time point was used to interpret the effects of teaching the vegetable education program over time, and the 3-way interaction to see if this varied by year level. Multi-level interdependency and covariates were defined as described in the first step of the analyses.

5.2 Results

5.2.1. Participant flowchart and participant characteristics

The participant flowchart is provided in Figure 9. A total of 25 schools took part in the intervention study. There were 1639 students from 116 classes who completed baseline data plus the post-test and/or the three-month follow-up test. There were a larger number of schools from the control arm who withdrew after they were allocated (3 out of 9).

From their responses this seemed due to disappointment that they could not take part in the intervention.

A total of 2215 students completed the baseline test, though 576 students (26%) did not complete further assessments. These drop-outs were largely (64% of participants) due to whole classes not continuing, particularly in one school in the low intensity intervention arm who initially intended to take part with the whole school but decided to continue with a selected number of classes after the baseline survey due to time constraints.

Students who did not continue after baseline measurements (“drop-outs”) differed from students who remained in the trial in SES of the suburb in which their school was located, the state they live in and school size (Table 10). Drop-outs were likely to come from schools located in medium SES areas, schools located in South Australia and from medium-sized schools. However, drop-outs were not significantly different on gender and year level.

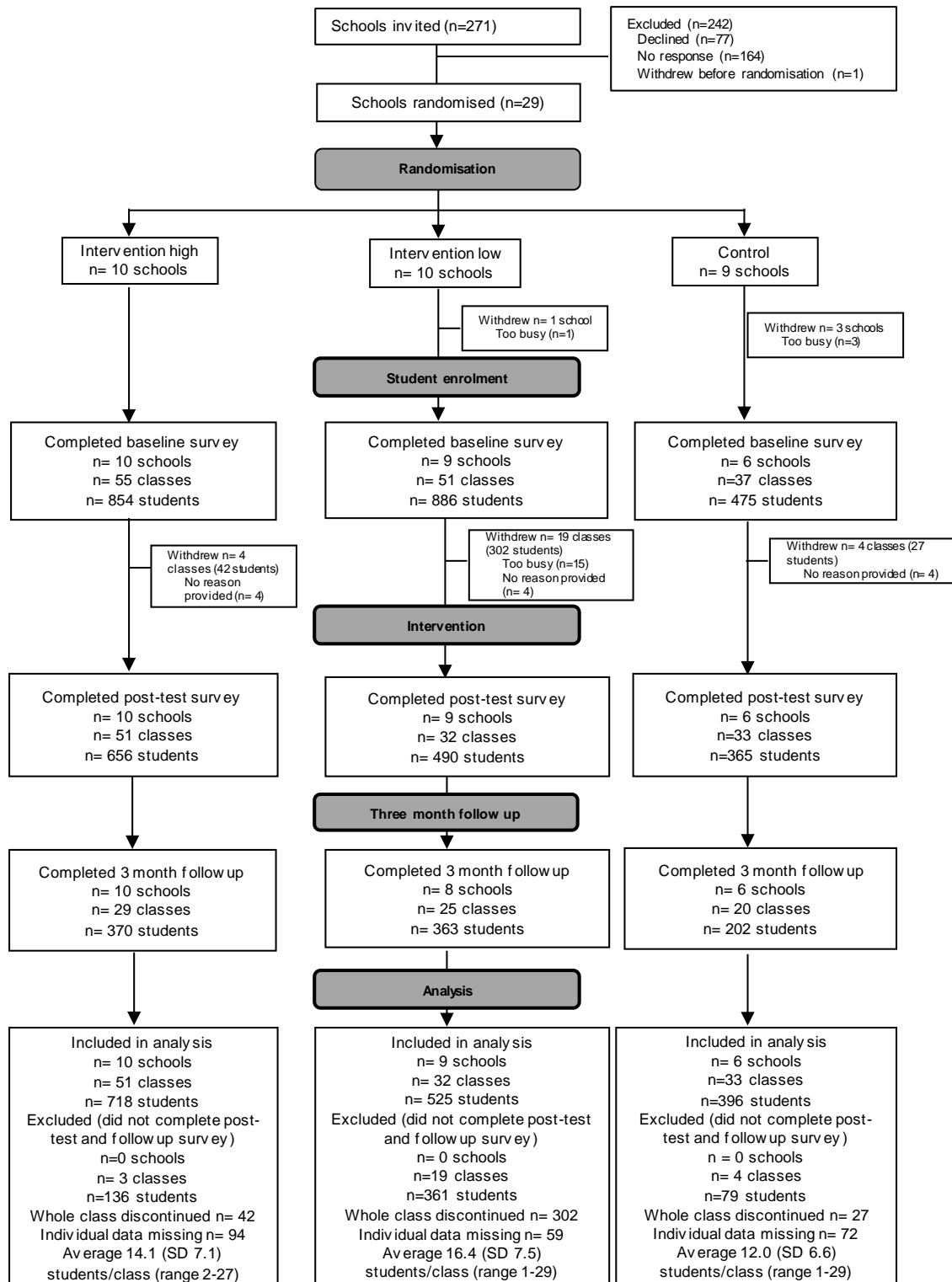


Figure 9 Participation flowchart of schools, classes and students in NSW and SA.

Table 10 Characteristics of study participants in the total sample, the students who remained in the trial and drop-out after baseline.

VARIABLE	LEVEL	TOTAL AT BASELINE (N=2215)	STUDENTS IN ANALYSIS (N=1639)	DROP-OUTS (N=576)	P VALUE ¹
Year level²	Lower	22.3%	21.8%	24.0%	0.538
	Middle	44.1%	44.2%	43.6%	
	Upper	33.6%	34.0%	32.5%	
Gender	Boy	48.7%	48.5%	49.3%	0.741
	Girl	51.3%	51.5%	50.7%	
SES³	Low	28.9%	30.3%	25.0%	<0.0001
	Medium	44.8%	38.9%	61.8%	
	High	26.3%	30.9%	13.2%	
State	NSW	36.4%	38.3%	31.1%	0.002
	SA	63.6%	61.7%	68.9%	
School size	<400 students	50.9%	58.4%	29.5%	<0.0001
	401-600 students	38.1%	27.6%	67.9%	
	>600 students	11.0%	14.0%	2.6%	

¹ P value based on Pearson Chi-Square analysis

² Year level: lower = year 2, medium = year 3 and 4, upper = Year 5 and 6

³ Based on Index of Relative Socio-Economic Advantage and Disadvantage (IRSEAD) scores from Australian Bureau of Statistics, Low = IRSEAD deciles 1-5, medium = IRSEAD deciles 6-8, high = IRSEAD deciles 9-10.

Table 11 shows that the random allocation resulted in participants in the three different arms being similar in most characteristics, but there was an imbalance in SES of the suburb in which their school was located and school size. A relatively larger proportion of students in the control group were from schools located in high SES areas. Further, more schools in the high intensity intervention arm were relatively smaller (<400 students) than the other two arms. These factors were co-variates in the MLM analysis thereby controlling for any effect they may have on outcome measures.

The comparisons between the low and high intensity intervention groups did not yield any significant differences on any of the outcomes at post-test (all P values > 0.05), meaning the low and high intensity interventions had similar effects on students' outcomes. Therefore, results from both low and high intensity intervention were combined for all measures.

Table 11 Characteristics of participants included in the analysis in the control (usual school education), intervention low (low intensity teacher training followed by vegetable education) and intervention high (high intensity teacher training followed by vegetable education) arm of the study.

VARIABLE	LEVEL	CONTROL (N=396)	INTERVENTION LOW (N=526)	INTERVENTION HIGH (N=718)
Year level ²	Lower	22.0%	14.7%	26.9%
	Middle	38.4%	52.0%	41.8%
	Upper	39.6%	33.3%	31.3%
Gender	Boy	51.8%	49.1%	46.2%
	Girl	48.2%	50.9%	53.8%
SES ³	Low	13.1%	44.4%	29.4%
	Medium	24.7%	33.0%	51.0%
	High	62.1%	22.7%	19.6%
State	NSW	41.9%	36.0%	38.0%
	SA	58.1%	64.0%	62.0%
School size	<400 students	22.7%	61.3%	75.9%
	401-600 students	49.5%	16.0%	24.1%
	>600 students	27.8%	22.7%	

Characteristics of participants who completed baseline data and at least one of either post-test or three-month follow up data

¹ P value based on Pearson Chi-Square analysis

² Year level: lower = year 2, medium = year 3 and 4, upper = Year 5 and 6

³ Based on Index of Relative Socio-Economic Advantage and Disadvantage (IRSEAD) scores from Australian Bureau of Statistics, Low = IRSEAD deciles 1-5, medium = IRSEAD deciles 6-8, high = IRSEAD deciles 9-10.

Looking at the change from baseline to post-test (Figure 10), the MLM analyses showed significant positive effects of the intervention compared to the control group on all six outcomes: knowledge ($P<0.001$), verbalisation skills ($P<0.001$), behavioural intention ($P=0.011$), willingness to try ($P=0.013$), vegetable acceptance ($P=0.021$), and new vegetables consumed ($P<0.001$). At the three-month follow up, this was only sustained for knowledge ($P<0.001$).

The flow-on effects for food neophobia and vegetable consumption were reported by the parents and unfortunately, only 205 parents completed this survey at post-test, which means that the test was underpowered for these variables. As a result of the sample size being too small, the MLM analyses did not find any significant interaction effects for food neophobia and vegetable consumption.

The trial was undertaken in different states and incorporated areas of low, medium and high socio-economic status. Therefore, the results of this study have a high external validity.

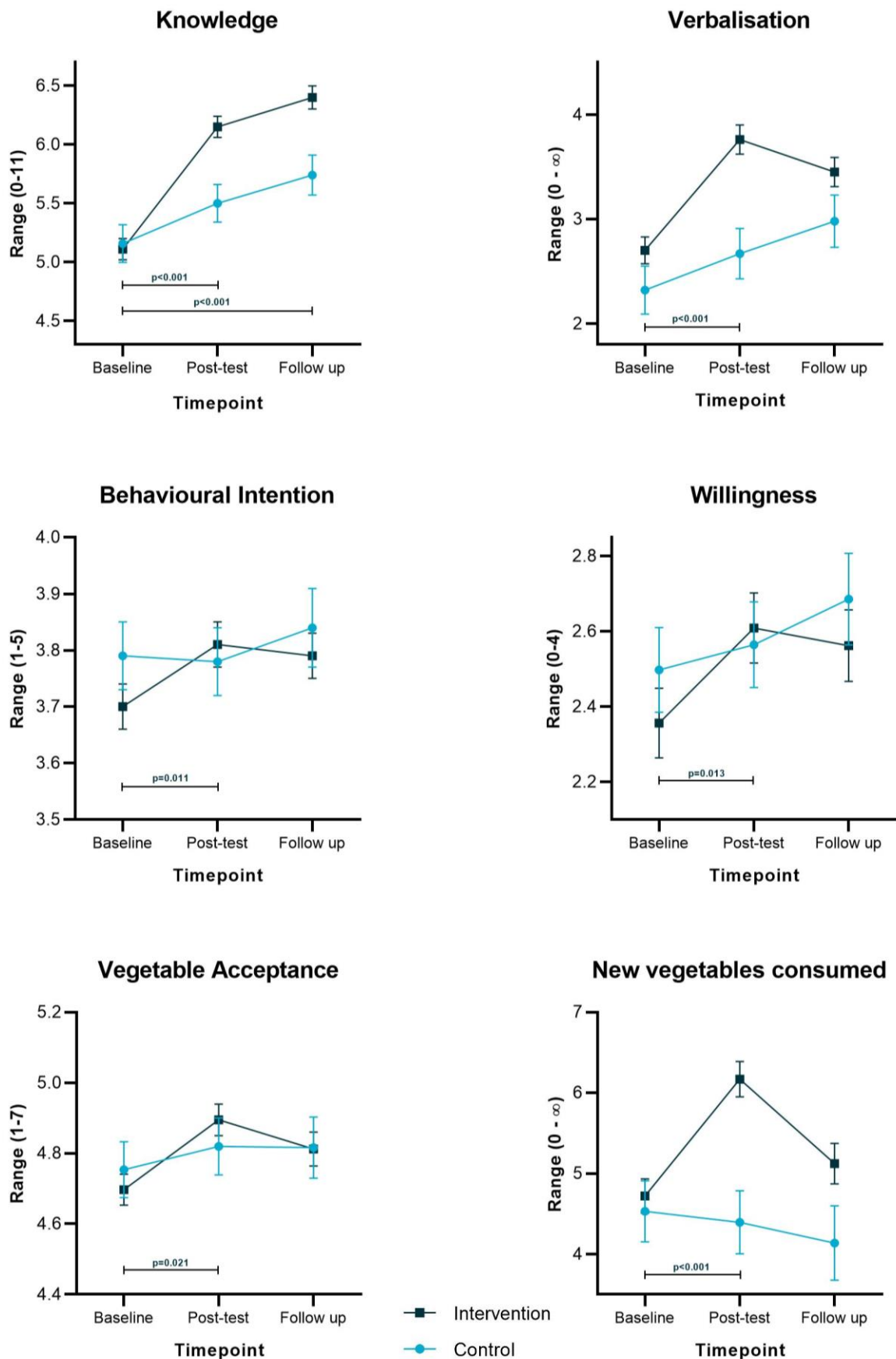


Figure 10 Changes in outcomes over time for students who received vegetable education (intervention) compared with students who received their usual education (control). P value on the difference in intervention*time point interaction effect between the intervention and control

6. Business plan and national roll out

Stakeholder engagement was undertaken to inform the development of a business plan for roll out. This was combined with information from desktop research on nutrition school programs and educational settings in states, as well as relevant national nutrition policy documentation. In addition, resource materials were prepared to allow to move from trial validation to a commercial phase.

6.1 Stakeholder engagement

Stakeholder engagement in the form of semi-structured interviews was undertaken. Stakeholders included a total of 13 participants. There were ten participants from the public health and nutrition sector (academic, NGO and state government) who were responsible for developing, evaluating and/or implementing nutrition education programs and three educators who were responsible for developing and evaluating programs for teachers (several with teaching experience). Participants included representatives from each state and territory, except for the Northern Territories.

The following main topics were discussed with all stakeholders:

- This program aims to have a nation-wide roll out. To what extent should a national versus a state-by-state approach be followed?
- What are important aspects to get good uptake of the program?
- How can we gain government support?
- Is there benefit of delivering a high intensity (additional face-to-face training of teachers) version of the program over a low intensity version?
- Could industry involvement/sponsoring finance parts of roll out?
- What do you think of suggested name for the program: Taste & Learn?
- What funding opportunities for further evaluation and delivery could be pursued to support roll out?

The following questions were additionally discussed with stakeholders with education expertise:

- How important is it to align to the state curriculum?
- How can we ensure 'bottom up' uptake of resources from teachers and schools?
- Should we aim to get resources on Scootle (a national education portal with resources aligned to the Australia curriculum)?
- What personal development activities do teachers in your state have to undertake?

In addition, state-based information was gathered from participants on nutrition programs in schools and cross-collaboration/promotion opportunities.

The main outcomes of the stakeholder engagement were as follows:

National vs state by state approach

- Some opportunities exist at a national level, however, there is no current relevant federal framework. The Council of Australian Governments (COAG) Education and COAG Health (representatives from state departments) have prepared a draft policy document entitled "Good practice guide: supporting healthy eating and drinking at schools", which describes a whole of school approach in order to increase health and wellbeing. As part of this policy, the Student Wellbeing Hub (www.studentwellbeinghub.edu.au) is available which is a website with resources for educators aligned to the Australian Curriculum and the Australian Student Wellbeing Framework to promote wellbeing in schools.

- The draft Good Practice Guide contains several recommendations for action that the vegetable education program might help achieve. Having a national program, i.e. a program not driven from a single state, to support national priorities might be seen as beneficial.
- A state-by-state approach would work best to achieve a national roll out, so that alignment and adoption can be tailored to each state: how it fits with educational goals and priorities, how it fits with and can be integrated in other (existing) programs and initiatives
- Multiple states have or are working towards an integrated health package following a whole-of-school approach (including canteen policy, classroom resources etc.). These programs provide a good opportunity to tie in the vegetable education program. Examples of states with a whole-of-school framework are:
 - Victoria: Healthy Eating Advisory Service (delivered by Nutrition Australia VIC)
 - NSW: Live Life Well (delivered by NSW Health in partnership with NSW Education)
 - ACT: Healthy Living Schools Program (delivered by Nutrition Australia ACT)
 - SA: Right Bite (delivered by SA Education).

Important aspects to get good uptake of the program

- At government level:
 - Having an evidence-based program
 - Taking a state by state approach. It is important to define the specific opportunities in each state
 - Departments of education want to see curriculum relevance and benefits for teachers and students
 - Value for money is important: efficacy of the program versus the costs of the program versus the number of students reached for the costs
- At school / teacher level:
 - Having good and fun resources, such as easy to use lesson plans, attractive visuals, editable PowerPoint materials
 - Teachers while guided by the curriculum are still very independent in their selection of classroom activities and selection of classroom resources. Therefore a ‘bottom up’ (teacher/school) implementation focus will be critical to successful take up of the program
 - Good communication to inform teachers about the program is important. There are many ways of doing this, including getting the program integrated or available through teacher resource hubs and professional development channels, present at teacher education conferences, and sending a direct mailing to schools
 - Provide professional learning opportunities for teachers
 - The program needs to be affordable to use fresh produce. Local sponsoring can offer opportunities to financially lower costs
- Overall:
 - Good communication at all levels, including with government, stakeholders, schools and parents
 - Media releases to create awareness and support for the program
 - Ensuring peer reviewed publications are available for work undertaken. These publications demonstrate that it is an evidence-based program and can show that the program works from a student and teacher perspective
 - It would be beneficial if the program tied in to important initiatives/goals in schools, for example student wellbeing or sustainability
 - Can look at complementary programs who can support/promote the program to achieve cross-promotion of activities
 - Emphasizing the novel sensory approach of the program, rather than traditional nutrition programs, which provides a new, fresh approach.

Government support

- Support from government can come at different levels of involvement:
 - Endorsement

- Government allowing or making resources available via educator portals (e.g. national Student Wellbeing Hub, www.studentwellbeinghub.edu.au; ACT Healthy Children’s Learning Hub <https://learning.health.act.gov.au/>)
- In-kind support, whereby government actively promotes or implements the program through their own resources
- Funding from the government to deliver the program
- Government support requires individual discussions to identify opportunities on national and state level.

Low versus high intensity delivery of the intervention

- It was generally seen as good that the low intensity intervention was effective as governments do not like to have large ongoing costs for programs
- Without any further support, it will be hard to continue to get attention for the program
- To maximise reach, efficacy and cost, webinars (live with recordings made available thereafter) are a good option. F2F will deepen engagement with schools, but is only a cost-effective option if the infrastructure is already in place
- Even if no further individual engagement with schools was continued, there would need to be some sort of support for the program in order to operate it. Ideas include partnering up with or embedding the program in other programs, pitching it as a complimentary program for existing programs, newsletters and/or a service desk for questions.

Industry involvement/sponsoring to finance parts of roll out

- Commercial involvement might affect the government’s views on it. Some governments do not endorse, support or fund programs with commercial involvement. Equity seems to be a key driver in the government policy on commercial involvement
- Stakeholders generally acknowledged there was no conflict of interest between commercial and health goals to increasing vegetable consumption
- From a school perspective, industry involvement does not have to be viewed as negative, as long as:
 - The type of sponsor will be critically looked at in the classroom, so ensure it aligns closely with the aims of the program and the commercial partner has a good reputation. There should be no conflict of interest
 - It is important that the commercial partner is not involved in the content of the program, but has a pure sponsoring role
 - Equity would be important. It would be important that not one partner seems to benefit. This would mean offering the opportunity for sponsorship not to just one party
 - Sponsorship can occur at a local level to lower the costs of produce. This sponsorship would then happen at the local school level and be the school’s responsibility to seek sponsorship in their own community.

Name for the program: Taste & Learn

The name was viewed positive by all stakeholders.

Funding opportunities for further research and delivery to support roll out

Most grants have specific eligibility criteria and would require forming partnerships with e.g. universities or state-based organisations in order to provide a benefit to that state. Opportunities may include:

- In-kind or direct financial support from government
- Partnership type grants, e.g. NHRMC, ARC-linkage
- ACT Healthy Canberra grant
- WA Healthway health promotion grant

Alignment to state curriculum

Some states have fully adopted the Australian curriculum, whereas other states have their own syllabus based on the Australian curriculum. Where states have their own curriculum (e.g. in NSW and VIC), written links to the specific curriculum alignment will be beneficial to get uptake by teachers. In general, time spent on literacy and numeracy is much bigger than time spent on science, so it is beneficial to emphasize the literacy impact the program has.

Secure ‘bottom up’ uptake of the resources by schools and teachers

Teachers get their classroom resources from many different sources, including through internet search, via education resource portals, attending teacher conferences, reading teacher journals, word of mouth from colleagues, accessing Scootle. When publishing on Scootle, it would be recommended to get the whole unit published together rather than the individual lesson plans, as the lessons are all integrated.

Professional development

All teachers need to undertake professional development (typically 20 hours per year) and preparation for the program could be counted. Only a few states have an accreditation system (NSW, ACT) which is difficult to obtain and requires ongoing efforts to register teacher participation.

6.2 Technology-readiness and preparing materials for national roll out

The Technology Readiness Level (TRL) framework provides a useful framework to discuss the maturity of the newly developed technology (i.e.: vegetable education program) in terms of its readiness for market (Figure 11).

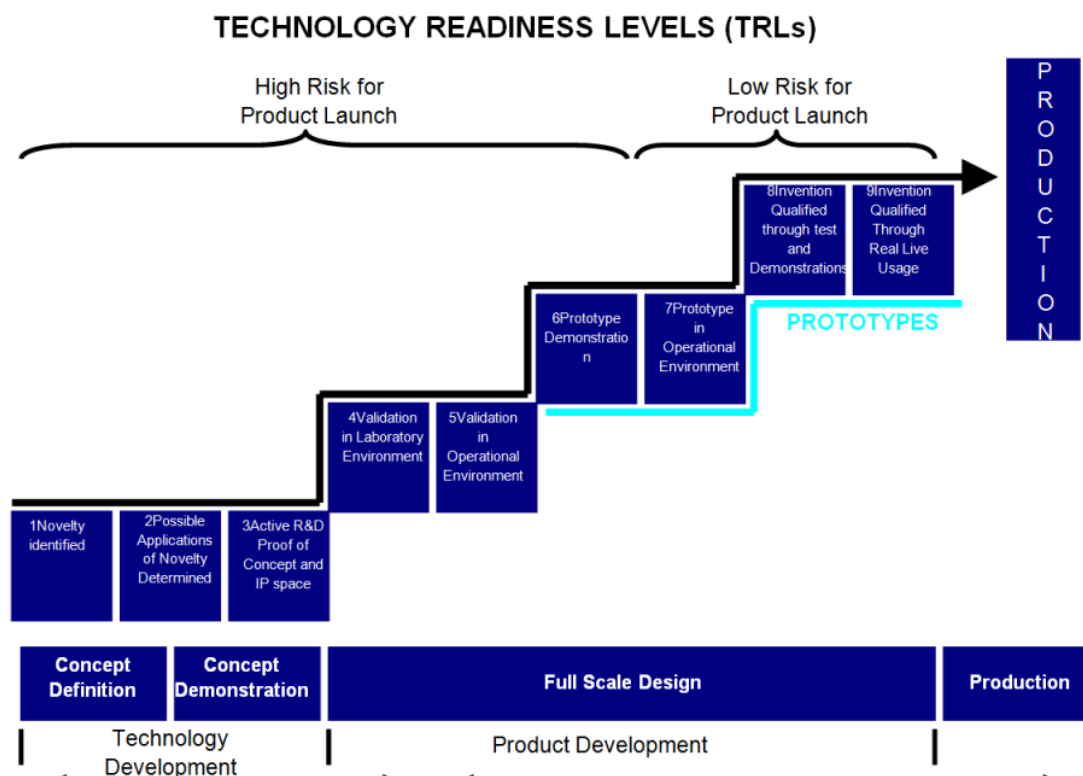




Figure 11 Technology Readiness Levels (Source: European Commission)

The TRL of the vegetable education program (VER2.0) at the start of the project was TRL5, a prototype tested in an actual pilot environment. The current project developed a prototype system based on input from the student and teacher survey, informal teacher feedback and observations and curriculum review, which was tested and evaluated in a large-scale evaluation (TRL6). Further preparation of the program materials was undertaken to bring the program to the TRL7-8 level. This means that this project has brought the program from a high risk of product launch to a low risk for product launch.

The following activities were undertaken to prepare the vegetable education program materials for national roll out:

- Professional design of the materials by CSIRO Branding
- Exclusive photo images developed for illustration and promotion purposes (see Figure 12)
- Legal terms developed of use for the resource materials
- Ensured all images and artworks in the resource were either copy-right of CSIRO or approvals were obtained from third party to use the material
- Program name (Taste & Learn) identified and road-tested in stakeholder engagement
- New section developed in the implementation manual addressing accessibility and availability of vegetables. This provides information to schools in areas of low availability and accessibility of vegetables, and thus, allows for better implementation and uptake in rural and remote areas
- Curriculum alignment undertaken of the final version of the resource ready for roll out against the current version of the Australian curriculum (see Figure 12 One of the exclusive photo images developed for this program)

- Table 12)
- Content and format of the online training module adapted to a digital training module to function outside an LMS environment
- New webpage designed to allow for direct access to resource materials rather than via existing LMS platform.

The latter two activities were undertaken to accommodate a different form of distribution. In the validation study all resources were integrated in the online training module, which was part of an LMS system. At the time, it seemed likely that this could be tied to an existing LMS when the program would be ready for national roll out (hence not requiring on-going costs). However, this was not the case. As it would not be cost-efficient to set up and maintain a separate LMS for the current program for the national rollout, an alternative approach was proposed for the business plan and the tools were developed.

This consisted of making the training module a digital tool (rather than an online tool) and making both module and lesson materials available directly via a website after registration. For details on monitoring and evaluation data that can be gathered, see chapter 9.

The curriculum alignment demonstrates that the program is cross-curricular. The strongest alignment of the program is with English and Science. In comparison with the previous version of the program, the curriculum alignment has become stronger, particularly in English and Science in units 2 and 3 (year 3-6).



Figure 12 One of the exclusive photo images developed for this program

Table 12 Alignment of the final vegetable education program with the key learning areas (number represents the number of content descriptions addressed) and general capabilities and cross-curricular priorities(yes/no) of the Australian curriculum

Learning area/ capability	Foundation	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Science	6	9	8	3	3	7	7
English	16	10	10	5	6	10	9
Mathematics	5	2	3	1	1	3	1
The Arts	1	1	1				
Technologies	2	2	2	1	1	1	1
Health and Physical Education	1	1	1	3	3	1	1
Literacy	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Numeracy	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ICT capability	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Critical and creative thinking	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Personal and social capability	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intercultural understanding	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Asia and Australia's engagement with Asia				Yes	Yes	Yes	Yes
Sustainability				Yes	Yes	Yes	Yes

6.3 Learnings from Dutch Taste lesson program

The Dutch Taste lesson program “Smaaklessen” (<https://www.smaaklessen.nl/>) commenced with taste lessons in Dutch primary schools in 2006. The aim of the program is to educate students on taste development and healthy and sustainable eating. To date, over 65% schools in the Netherlands have taken part in the program (Haveman-Nies, Fries, van Wijhe, & Snel, 2017). The lesson program is evidence-based (Battjes-Fries et al., 2014; Battjes-Fries et al., 2016; Battjes-Fries et al., 2017). The longevity, reach and impact of the program make it a valuable case study for the current program. Some key characteristics of the way this program operates are:

- The program focuses on healthy eating and is not tailored to one specific food category
- The program originally started with a taste lesson program in the classroom. The program content was changed from 10 lessons in a unit (one for every two year-levels) to 5 lessons in a unit (one for each year-level).
- Over time, the program evolved to include more in-depth activities. ‘Taste missions’ are in-depth learning activities (around 5 hours each) focusing on a specific food category. They consist of interactive learning materials and have an excursion element (e.g. visit to farmer or supermarket). There is also opportunity for incursions on various topics.
- The program also ties with an EU-funded program to support school provision of fruit and vegetables
- The program has ongoing support to engage with schools. It provides information sessions for new schools and sends out monthly newsletters.
- The continuous evolution of the program is seen as a critical factor to success (Haveman-Nies et al., 2017)
- The program started as a government funded model. The activities expanded after several years and allowed industry involvement. Several industries now financially support the program; this is managed through a separate governing body.

6.4 Business model and commercialisation strategy

Based on stakeholder engagement, results from the validation study with students and teachers and desk-based research, the following business-model is proposed:

- Program materials are made available for free to teachers
- Access will require registration to collect monitoring and evaluation data
- Taste & Learn will be used as the name for the program
- The program will commence with a low intensity model that requires no ongoing costs
- Commercial sponsorship or a public/private partnership will not be pursued at this stage in order not to jeopardise potential government endorsement or sponsorship
- Government endorsement and support will be sought
- A state-by-state approach will be followed for government support to ensure the program is aligned to and integrated in state priorities; this approach will thus likely be slightly different for each state, whilst still delivering the same program
- Strengthening the strong evidence-base of the program by publishing results in scientific journals
- A phased model for national roll-out is proposed to progressively increase adoption rates, in line with potential funding available to deliver the outcomes
- The different phases are described in Table 13
- Phases 2-5 for commercialisation, adoption and expansion are beyond the contract scope. They are partly contingent on funding being available and/or in-kind resources from CSIRO, Hort Innovation, AUSVEG and/or other delivery partners.
- Phases do not have to follow a linear pathway. For example, a phase 4 roll out may be achieved early in a particular state if the state government adopts the program. Engagement with state governments has already commenced as part of the current project.
- It is proposed that the planned communication and dissemination component of the plan is developed in further detail with Hort Innovation, including specific actions and dates.

Table 13 Proposed phases for the national rollout of the vegetable education program to gradually increase adoption rates.

Phase	Description	Rationale	Timing
Phase 1	<p>Having a program with low intensity teacher training available</p> <ul style="list-style-type: none"> - A website with downloadable materials - Teachers access the resources through general registration 	<p>The model requires no ongoing costs</p> <p>Monitoring and evaluation data are generated</p> <p>Builds a Customer Relationship Management database for continuing engagement with schools for communication and evaluation</p>	As part of contract
PHASES BELOW ARE BEYOND THE SCOPE OF THE CURRENT PROJECT			
Phase 2 (in-kind support from CSIRO)	<p>Scientific dissemination: conference presentations and submit peer-reviewed papers on validation study (teachers and students)</p> <p>Creating references to the website via organisations with aligned goals that provide access to teacher resources (e.g. PIEFA, Healthy Kids Association, VegKIT registry)</p> <p>Seek national and state government endorsement by referring to program on government education portals (e.g. Student Wellbeing Hub)</p> <p>Prepare and submit publication to professional magazine (teachers – together with CSIRO Education, growers for example through Vegetable Australia magazine)</p> <p>Targeted promotion to schools to advise them of new school program which will be available in new calendar year</p> <p>Government engagement (continuation of existing engagement with states)</p> <p>Launch / media release (by CSIRO and Hort Innovation)(around April/May 2020)</p>	<p>Strengthen the evidence base to increase credibility which is important for government support</p> <p>Making resources available at places where teachers access information (pull strategy)</p> <p>Endorsement from government will improve adoption rates through increased credibility</p> <p>Making resources available at places where teachers access information (pull strategy)</p> <p>Increase awareness of program for primary and secondary audience</p> <p>Allow schools to allocate time in their allocation of activities in the new school year ahead of official launch</p> <p>Seek endorsement, in-kind or funding support</p> <p>Increase awareness and visibility of the program in general population</p>	Nov 19 – May 20

Phase	Description	Rationale	Timing
<p>Phase 3 (in-kind support from CSIRO)</p>	<p>Two information session webinars, co-hosted by CSIRO Education and A&F research team</p> <p>Promotion through the CSIRO Education national teacher email newsletter</p> <p>Targeted promotion to all CSIRO Education Sustainable Futures primary schools</p> <p>Two presentations at relevant education conferences by CSIRO Education (and A&F research team if available) (e.g. for primary teachers)</p> <p>Explore opportunities for national roll out through different delivery partners</p> <p>Government engagement (develop engagement with other states)</p> <p>Seek to apply for grants to further roll out, evaluate and implement the program</p> <p>Promotion of the program at agricultural trade shows (by Hort Innovation’s Events team)</p> <p>Targeted promotion to growers (by Hort Innovation)</p>	<p>Raise awareness and encourage school registration to the program</p> <p>Raise awareness and encourage school registration to the program</p> <p>Raise awareness and encourage school registration to the program</p> <p>Increase awareness of program for primary audience</p> <p>Increase impact through use of different channels</p> <p>Seek endorsement, in-kind or funding support</p> <p>Seek a funding base to increase adoption and/or move to a medium intensity delivery model</p> <p>Increase awareness of program for general population and local governments; demonstrate joint endorsement from agricultural sectors</p> <p>Engagement of growers; opportunity for growers to influence local schools to adopt the program</p>	<p>Apr – Dec 20 (some activities may take place earlier, e.g. grant applications)</p>
<p>Phase 4 (contingent/ dependent on funding)</p>	<p>Roll out of a medium-intensity model (on state-by-state level)</p> <ul style="list-style-type: none"> - general information session for schools through webinars - newsletters - teacher training through webinars 	<p>This model requires ongoing financial or in-kind support from grants or delivery partner.</p> <p>Information sessions and newsletters continue to create momentum for new schools to engage and for existing schools to continue to be engaged</p> <p>Slightly better teacher engagement was shown in validation study when using direct training of teachers</p>	<p>Dependent on funding being available to undertake the activities (through grants or in-kind contributions of delivery partners)</p>

Phase	Description	Rationale	Timing
<p>Phase 5 (contingent/ dependent on funding)</p>	<p>Program evaluation – survey amongst teachers using the program</p> <p>Further develop and evaluate program</p> <ul style="list-style-type: none"> - develop lesson materials – new activities - undertake effectiveness study of multi-year exposure on students - combine with provision of vegetables and measure effect on intake 	<p>Measuring of impact and identify opportunities to optimise the program</p> <p>Create further opportunities to increase vegetable consumption and measure program impact</p>	<p>Dependent on funding being available to undertake the activities (through grants)</p>

7. Outputs

- Two expert reviewer reports on alignment of the program with the Australian Curriculum (pilot program and final program)
- An evidence-based teacher-led vegetable education program for primary schools ready for national roll out
- Written lesson manuals for each of the three stages of primary school
- Electronic whiteboard materials to support the unit of work in each stage
- A teacher manual to support implementation of the program in schools
- A digital teacher training module to prepare teachers theoretically and practically for the program
- A name for the program, Taste & Learn, road-tested as part of the stakeholder engagement
- A website that provides information about the program and access to the learning materials (access via <https://research.csiro.au/taste-and-learn>)
- Terms and conditions of use of the lesson materials (access via <https://research.csiro.au/taste-and-learn>)
- Efficacy data demonstrating the effectiveness of the vegetable education program in priming students to consume vegetables
- Teacher survey data demonstrating the positive evaluation of the program and its materials
- A business plan and commercialisation strategy for national roll out of the program based on stakeholder engagement
- Milestone reports
- Final report.

Communication and dissemination outputs:

- Media exposure in various online platforms following media release from AUSVEG:
 - Fresh Plaza, Australia encouraging vegetables in schools, 19 December 2016; <http://www.freshplaza.com/article/168185/Australia-encouraging-vegetables-in-schools>
 - 4-Traders, HAL Horticulture Australia: Veg industry teaching kids their ABCs – Artichokes, Broccoli and Carrots, 14 December 2016 <http://www.4-traders.com/news/HAL-Horticulture-Australia-Veg-industry-teaching-kids-their-ABCs-ndash-Artichokes-Broccoli-and-23547185/>
- CSIRO Factsheet and flyer on the vegetable education resource and evaluation
- Human Research Ethics report for NSW Department of Education and SA Department for Education presenting findings of the student and teacher survey outcomes
- Oral presentation at Nutrition Society of Australia Annual conference on findings of pilot-evaluation (VG13089): Poelman AAM, Broch M, Cox DN and Vogrig D (2016). Effect of Australian school vegetable education program on factors associated with vegetable consumption in children, 40th Annual Scientific Meeting of the Nutrition Society of Australia, 29 Nov – 2 Dec 2016, Melbourne, Australia.
- Oral presentation at Hort Connections 2019: Poelman AAM, Broch M, Wiggins B, McCrea R, Heffernan J, Beelen J and DN Cox (2019). Development and validation of an education resource for Australian primary schools. Hort Connections 2019, 24-26 June 2019, Melbourne, Australia.
- Abstract accepted for oral presentation at Nutrition Society of Australia Annual conference: Poelman AAM, Broch M, Wiggins B, McCrea R, Heffernan J, Beelen J and DN Cox (2019). Effect of Australian school vegetable education program on factors associated with vegetable consumption in children: a cluster randomised controlled trial. 43th Annual Scientific Meeting of the Nutrition Society of Australia, 2-5 Dec 2016, Newcastle, Australia.

8. Outcomes

This project has generated a strong evidence-base for the efficacy of behaviour change and teacher appreciation of the vegetable education program. The efficacy study amongst students has demonstrated that children who have been taught using the vegetable education program had an increased knowledge about vegetables and the senses, an increased ability to verbalise their sensations when eating vegetables, increased vegetable acceptance, increased behavioural intentions to eat vegetables, increased willingness to taste vegetables and an increased number of new vegetables tried. These factors are all intermediary factors positively associated with vegetable consumption. These effects were statistically significant immediately after the vegetable education program was taught, with a sustained effect at three-month follow up of increased knowledge.

The increased acceptance for vegetables and willingness to consume them is expected to positively influence the child's vegetable consumption when they are offered to them, for example in the home environment. This will support an increase in domestic demand for vegetables amongst parents who are responsible for their purchase.

The vegetable education program was designed as a short (5 hour) program in order to fit into a crowded curriculum and thus enable maximum reach. Three different units were developed for different stages of primary schools, which build onto each other. Thus, each student will receive the vegetable education three times throughout their primary school years when schools implement the program in full. Behavioural change is expected to build in this case, and thus stronger and more sustained effects are anticipated, further increasing demand for vegetables.

There are also likely to be longer term benefits. Sensory preferences of children are thought to be predictive of their preferences as adults. Therefore, the future demand for vegetables as a result of the increased acceptance of vegetables amongst children, will have further economic benefit to the vegetable industry. Australian healthy eating guidelines recommend that consumers eat more vegetables, but currently these recommendations are not being followed. This education program provides the opportunity to increase awareness of the benefits of vegetable consumption and increase the demand and consumption of vegetables by consumers. This will also have flow on effects to the Australian population which include the associated health benefits (i.e. help in weight control and the prevention of cardiovascular diseases and certain cancers), reduction in health care costs, reduced waste etc. Plant-based diets also benefit sustainability of the planet.

Although the primary aim of the project was a behavioural change in students as a key mechanism to support the demand for vegetables, the project also provides secondary benefits for the Australian vegetable industry. The program provides knowledge about vegetables as well as different aspects of the vegetable supply chain (e.g.: growing, climates, processing and vegetable waste) thereby increasing awareness of the vegetable industry itself. For example, an increased acceptance and tolerance of 'imperfect vegetables' (a topic in one of the units) might benefit sustainability and economic viability of the vegetable industry.

The main target audience for the project are education sector stakeholders, specifically primary schools. The secondary target group are industry stakeholders and value chain members. This project has evaluated the resource in two states and put the infrastructure (web-based platform) in place that will allow national distribution of the resource. Teacher evaluation showed positive evaluation of the program and materials and that number and duration of the lessons were found to be reasonable. Teachers felt the program aligned well to the curriculum and were positive about re-using and recommending the resource. Thus, critical barriers for uptake in schools have been adequately addressed.

The national roll out of the vegetable education program is outside the scope of the project. A financial business model for national rollout was developed as part of the project, which included target phases to achieve uptake. The critical path to success will be the extent to which the program can be made available at a low ongoing cost, whilst ensuring uptake of the resource by new schools and continued use of the resource by the existing schools. The base model is not contingent on further funding. Further opportunities (including funding opportunities outside of Hort Innovation and the Vegetable Industry) for further delivery and evaluation of the resource in other states have been identified in order to allow for a quicker expansion of the network of schools.

Technology transfer to the vegetable industry and scientific and educational communities has commenced and further communication activities are planned, including: media communication (e.g.: trade journal such as Vegetable Australia), through presentation of results at appropriate conferences and peer-reviewed journals.

9. Monitoring and evaluation

Monitoring and evaluation occurred as outlined in the contract M&E plan.

All quality metrics initially identified were met. These were:

- 1. A vegetable education program that effectively achieves both behavioural change and curriculum alignment*

Behavioural change as a result of receiving the vegetable education was demonstrated through a scientific trial (see under 5). Curriculum alignment was assessed by an independent expert and strong alignment with the curriculum was found. A teacher survey further demonstrated that teachers felt that the program aligned well to the curriculum.
- 2. A webportal with infrastructure that records downloads of the materials school uptake of the resource and provides a database of schools that can be used for continued engagement*

In the research trial phase, the training and materials were provided through an LMS and access was provided through a unique username and password. Collected data showed that 116 users from the 19 intervention schools had completed the training. On average, users connected to the module five times. The webportal that will give access to the materials when nationally rolled out will not be tied to an LMS. Rather, teachers will register through a registration form which will provide input for a Customer Relationship Management (CRM) database for ongoing monitoring and evaluation of interest in the program, as well as opportunity to contact teachers for evaluation or promotion purposes. Further M&E information on views of web-portal content and number of downloads of materials will be collected via Google Analytics.
- 3. A teacher guide that encourages and prepares teachers for effective teaching of the resource*

A digital teacher training module was developed. A teacher evaluation survey amongst 65 teachers showed that the teacher manual was positively evaluated by teachers and they felt that the training prepared them well to teach the program. Moreover, behavioural change in students was just as effective for schools where teachers were prepared using the digital teacher training alone as compared to schools where teachers had also received additional face-to-face training.
- 4. A broadened network of 24+ schools in NSW and SA that will have utilised the resource*

Together with the pilot evaluation study, a total of 30 schools in NSW and SA have been provided with the vegetable education program. A total of 22 schools have used the resource in their classroom, with a further 8 wait-listed control schools being provided with the materials after study completion to utilize at a later stage at their own discretion.
- 5. Scientific evidence on the effectiveness of the vegetable resource on achieving behavioural change amongst students*

Scientific evidence was gathered using a clustered randomised controlled trial in two states with over 2000 students, 116 classes and 25 schools participating. This study provided evidence of a statistically significant increase of behavioural change in students on all measures collected, i.e. knowledge about vegetables and the senses, ability to verbalise their sensations when eating vegetables, vegetable acceptance, behavioural intentions to eat vegetables, willingness to taste vegetables and number of new vegetables tried.
- 6. A business model with partnering options identified that can be used for large scale roll out*

A business model was developed with input gathered through stakeholder engagement with 13 experts in public health, nutrition and education. The business model proposes nation-wide availability of the resource with a specific state-by-state approach to maximise uptake and impact.

Process and delivery performance evaluation of the project occurred as follows:

- Regular updates were scheduled with the Hort Innovation portfolio manager through a combination of videoconferencing, face-to-face meetings and email. In the initial phase of the project, meetings included the Hort Innovation relationship manager for the Vegetable Industry. Throughout the course of the project, the person occupying the role of portfolio manager changed several times, which affected continuity in communication. Where relevant, briefing papers were sent in advance and identifications of action items were recorded through minutes. Timings of the meetings coincided with important milestone phases of the project.
- Originally, it was intended to form a steering committee for the project. However, after commencement of the project, Hort Innovation indicated this was not appropriate for the current project due to its size.
- Internal project team meetings were held regularly, comprising of face-to-face and videoconferencing meetings. The composition of the team members varied to some extent on the phase and specific tasks of the project. Core project member scientists (Astrid Poelman, Maeva Broch, David Cox) were a consistent factor throughout the phases.
- Advice and input on various education aspects of the project were provided by CSIRO Education staff as well as an independent education expert, who also conducted an independent assessment of curriculum alignment at the commencement of the project.
- Formal updates of delivery and performance was provided through provision of 6-monthly Milestone reports. These reports monitored progress against milestones on time/budget. Any delays in achieving the milestone were flagged with Hort Innovation and managed through milestone variations. In particular, a delay in recruitment of sufficient number of schools to conduct the validation study was encountered.
- Progress updates to the Vegetable Industry Consumer Strategic Investment Panel were delivered through presentations at annual meetings on 22 August 2017 (Gold Coast) and 17 September 2019 (Brisbane).

10. Recommendations

The main recommendations for roll out of the program are described in the business plan in chapter 6. This business model describes a phased process of roll out, in line with the required resources becoming available; in particular to support program delivery to schools with activities that have ongoing costs. The key elements of the business model will be to commence with a low intensity model, whereby teachers can register and download materials itself. This allows to establish a base for adoption of the program. Publication of the results of the study in peer-reviewed journals will be important to strengthen the evidence-base. Then, selected promotion and communication activities as well as ensuring resources can be accessed from teacher educator resource websites will create awareness and generate traffic. Simultaneously, stakeholder engagement with different states will be recommended. A state-by-state approach that can tailored to the specific needs and opportunities in each state will be critical for uptake, and might provide opportunities for endorsement, in-kind or funding support from government. Lastly, opportunities for grants can be explored, as extra funding (e.g. via state or partnership grants) will provide opportunities to provide more direct and ongoing contact with schools, and to further develop and evaluate the program. In this way, adoption and impact will gradually continue to increase.

In the longer term, it is recommended that this program becomes part of a multi-component intervention as evidence has shown these interventions are most effective. A whole-of-school approach that also targets parents and the school canteen will create an environment where more vegetables are available which will benefit vegetable consumption.

Over time the vegetable education program can be expanded with other activities, such as incursions (guest lessons) or excursions (e.g.: visit a farm). These activities will deepen student engagement and learning as well as engagement with growers. These activities will allow for further opportunities to create awareness of the vegetable industry amongst students, including potential careers in this industry.

Lastly, it is recommended to have growers become actively involved in promoting the roll out and adoption of the program by advocating the program to schools in their local areas. In addition to the increased adoption rates, and therefore success of the program, this direct involvement will deepen grower engagement with the program as well as potentially having the opportunity to see the program *in action*.

11. Refereed scientific publications

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Poelman, A.A.M., Cochet-Broch, M., Cox, D.N. & Vogrig, D., 2017. VERTICAL: A sensory education program for Australian primary schools to promote children's vegetable consumption. *Journal of Nutrition Education and Behavior*, **49**, 527-528.

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13. Intellectual property, commercialisation and confidentiality

The IP generated as part of the previous (VG13089) and current project is co-owned by Hort Innovation and CSIRO.

This IP includes the vegetable education program lesson materials and teacher training module.

The vegetable education program and its learning materials are co-branded (Hort Innovation and CSIRO) and will be amenable to wider commercialisation.

The commercialisation plan to maximise the uptake and benefits from the investment consists of the following main elements:

- Free access to the materials will be provided for teachers for educational purposes
- Any other use will require permission from Hort Innovation and CSIRO as per Terms of Use (access via <https://research.csiro.au/taste-and-learn>)
- Maximum promotion of the program and its materials will be sought as part of the dissemination strategy, including: through endorsement, pledges, conference attendance and linking with other programs
- Uptake or delivery of the program by other delivery partners (e.g. state government) will be actively sought, supported using non-exclusive license agreements, details of which will need to be agreed upon
- Scientific dissemination of the research findings will be undertaken, at scientific conferences and in peer-reviewed publications, to support the evidence-base of the program.

Taste & Learn will be used as name for the program and its lesson materials. Registration as trademark will not be undertaken immediately, rather, wider brand awareness and use will be sought first. A trademark application (co-owned) may be considered at a later stage.

The lesson materials contain images and artworks. Image credits have been provided in the resource materials. A small number of third-party materials is used in the lesson materials and permissions for their use have been obtained.

There are no confidentiality issues to report.

14. Acknowledgements

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15. Appendices

Appendix A Sample extract of a lesson plan

1 Lesson 1: Discover vegetables through the senses

Lesson outline

STUDENTS

- Enrich their knowledge of vegetables.
- Develop their awareness of cultural diversity in vegetable preferences.
- Taste and describe two vegetables, plain and with two different condiments, and become aware of individual preferences.

EXTENSION

- Identify the vegetables in a dish from a particular country.
- Complete a Find a Word, student worksheet 1, 'I know my vegetables'.

Materials

FOR THE CLASS

- PowerPoint slides, lesson 1, slides 1–32.
- Two vegetables (three pieces for each student), see below.
- Two condiments in bowls.
- Knife, cutting board, containers with lids.
- Tongs for serving.
- Classroom record.

FOR EACH GROUP/STUDENT

- A4 paper.
- Science journal.

EXTENSION ACTIVITIES

- Student worksheet 1, 'I know my vegetables'.

VEGETABLES

Description

One common and one uncommon vegetable that can be eaten raw with different condiments (jail, mustard, soy sauce, mayonnaise, yogurt dressing etc.)

Suggestions

Common: cucumber
Uncommon: soy bean pods/edamame frozen or from sushi restaurant

Alternatives

Common: carrot, cauliflower, capsicum
Uncommon: snow peas, bean sprouts, Chinese cabbage, baby corn, broad beans



Preparation



PREPARATION OF VEGETABLES AND CONDIMENTS

- Source two vegetables that can be eaten raw with the fingers. One should be common for most students and the other one less common.
- If frozen soy bean pods are chosen, prepare as per packet instructions (microwave) and store. For fresh vegetables, wash/cut up/store the vegetables (see 5.2 How to safely prepare vegetables, Taste & Learn™, general information for teachers and schools, page 20). Prepare at least three pieces of the vegetable per student.
- Select two condiments that you think could be eaten with the vegetables you have chosen (e.g. dips, yogurt, mayonnaise, butter, soy sauce, cream cheese etc). Put an adequate amount of each condiment in a separate bowl or cup for students to pass around the class and use for dipping their vegetables.

Teacher's background notes

- This lesson is about engaging students and seeking their prior knowledge on the key concepts in this unit – vegetables, the senses and cultural and individual diversity in food preferences. They will explore these concepts through a tasting experiment.
- Vegetables: we want to expose students to vegetables to increase their knowledge about them. We want them to become more familiar with vegetables and less reluctant to try them. This lesson is about broadening students' knowledge of vegetables by introducing and exposing them to less common vegetables, i.e. vegetables that we do not think they necessarily know or consume on a regular basis. Students will experience the variety of shapes, flavours and textures among vegetables and become more familiar with them as they recognize and name more vegetables. We want them to understand that it can be fun to eat veggies and overcome the dislikes of unfamiliar vegetables.
- For information on the definition used in this program, see 4.4 Vegetables, Taste & Learn™, general information for teachers and schools, page 14.
- The senses: we would like students to use their five senses when they consume a food product. The idea is that if they pay attention to the product features, they will learn to appreciate different foods and foods with more complex characteristics. For this, they need to be able to identify the tools to detect those sensations (i.e. their senses) and they need to be able to verbalize their sensations.
- When students eat a food, they need to try to take into account all their senses, as well as taste, smell, flavour and texture, to get the full experience and decide if they like it or not.
- Cultural and individual diversity in food preferences: some people are more sensitive to tastes than others and preferences are individual. Some people may like milk chocolate. Others do not and may prefer dark chocolate. People have different ways/habits to eat food products that can depend on their previous experience with the food and their cultural background.
- What can influence the foods you like is how often you consume the product. Sometimes people do not like a food the first time they try it, but then when they have tried it several times, they may start to like it. For some foods, people may like them when they are prepared differently. It is important to try at least a small amount. We would like students to realise that food preferences are individual and that preferences often depend on habits and cultural diversity.
- For background information on the five senses, and cultural and individual diversity in preferences, see Taste & Learn™, general information for teachers and schools; 4.1 The five senses (page 11) and 4.8 Everyone is different – the role of culture (page 16).

Appendix B Screenshots of the teacher training module



Objectives

This training will prepare you to teach and implement the program in your school or classroom. By the end of the training you will . . .

<p>01</p> <p>Understand the objectives of the program and its structure.</p>	<p>02</p> <p>Apply a theoretical understanding to increase children’s knowledge about the senses and their ability to describe their vegetable eating sensations.</p>
<p>03</p> <p>Understand the theory and background to be able to teach children about the enjoyment of vegetables and encourage their willingness to try them.</p>	<p>04</p> <p>Have been provided with practical information on implementation of the program in your school.</p>

Five Senses and a Tasting Protocol

Select each image to find out about the five senses involved when eating vegetables.

TOUCH Texture can be perceived with the fingers (e.g. rough, gritty, soft) and this provides expectations about what a product may feel like in the mouth. The texture in-mouth provides information about how the product feels and responds to breaking down (e.g. hard, dense, smooth, chalky).

Teaching enjoyment and willingness to try vegetables

How do our food preferences develop and how can we train food adventurers?

Select each image to find out more.

Training tastebuds – role of repeated trying

Learning to like a wide range of flavours and textures takes time, just as learning to ride a bike does.

Repeatedly eating a small portion builds acceptance of vegetables.