Horticulture Innovation Australia

Final Report

Development of a Vegetable Education Kit

Astrid Poelman
CSIRO Food and Nutrition Flagship

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Development of a vegetable education resource

Final report (VG13089)

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Summary

Children's consumption of vegetables is below the daily recommendations in Australia and in many countries worldwide. As many nutrition intervention approaches have been found to be ineffective, new approaches are needed. Low acceptance of vegetables is a critical barrier in children's consumption. As most food preferences are learned, increasing enjoyment of vegetables is a sustainable way to increase demand, and schools provide a good setting for development of a new education intervention program.

The aim of the current project was to develop a Vegetable Education Resource for use by teachers in Australian schools, to scientifically investigate its effectiveness, to seek teacher input, and to develop a technical implementation plan.

The Vegetable Education Resource needed to meet two main objectives: 1) to be effective in achieving change amongst children, in the sense that students become more aware of vegetables, learn to enjoy them, and are more willing to taste them when they are offered them. These factors have been shown to be positively associated with vegetable consumption. Seen in this way, the resource is a behavioural intervention; 2) to align to the Australian curriculum, and be in a form that teachers can use in their classroom. This second objective was important to ensure that teachers are willing to use the resource, as classroom time is limited and the curriculum is already very crowded.

This unique combination of objectives was tackled by a multi-disciplinary team. Sensory scientists from CSIRO Food and Nutrition were responsible for the development of the theoretical framework of the vegetable education resource. A literature review was undertaken to review selected relevant, primarily overseas, classroom-based educational programs with similar goals to determine best-practice approaches. Scientific research on the development of food preferences of children was also taken into account. Educators from CSIRO Education reviewed curriculum alignment and used their expertise in developing and implementing educational programs to structure the resource.

The resulting Vegetable Education Resource was a comprehensive set of work modules targeting all stages of primary school, providing long term education. It consisted of 5 lessons in each Stage, and focused on hands-on learning; exposing children to the taste and texture of vegetables, and teaching them to actively use their senses when eating foods. It also taught children about the development of their own food preferences, and focused on regionality and seasonality, cultural diversity, and aspects of vegetable growing. It is a cross-curricular resource, most closely aligned to Science and to Personal Development of Health and Physical Education in the Australian curriculum. The resource contains written lesson plans, supporting slide sets for use in the classroom, as well as an Implementation manual for schools and teachers.

Version 1 (VER 1.0) was piloted at a primary school in Sydney, and teacher feedback was incorporated into the revised resource. The second version of the vegetable educational resource (VER 2.0) was then tested in a validation study and teacher feedback was sought.

The validation study of VER2.0 was conducted in two different socio-economic status areas in metropolitan Sydney. Students from year 2 to 6 participated in an online survey that measured factors associated with vegetable consumption. By comparing the responses of the students of two schools before and after the vegetable education program VER2.0 was taught, and comparing with students responses from two matched control schools that continued to follow their regular curriculum, the effectiveness of the vegetable education resource was determined. A total of 320 students completed the pre- and post-test. The Vegetable Education Resource was effective in achieving behavioural change amongst students: significantly increasing the students' knowledge of vegetables and of their senses, increasing their ability to objectively verbalise sensations when eating vegetables, and their willingness to try vegetables. The vegetable education program also tended to increase vegetable acceptance, and increase intentions to consume vegetables and eat a wider variety of foods.

Teacher feedback was collected through surveys and interviews, and was largely positive. The program was enjoyed by teachers and students, and the hands-on aspects were evaluated as the most enjoyable, whilst providing deep learning opportunities. The program was engaging, aligned well to the curriculum, and activities were age-appropriate. Teachers found the program challenging to prepare, but felt that these hands-on aspects were most valuable in the program. As this aspect is also important for the behaviour change amongst students, barriers to sourcing and preparing the materials need to be addressed, and several opportunities in the resource itself have been identified.

A technical implementation plan was scoped, which included recommending a dedicated online website to make materials available to teachers, with the advantage of tracking uptake, and providing further support to develop the program. It is also recommended that the program would benefit from having a teacher training module and developing a collaborative framework (having a sustainable financial model) with a range of stakeholders (including vegetable industry representatives) to grow and extend the network of schools to a nationwide distribution.

This study showed that teaching the Vegetable Education Resource led to increased awareness, acceptance and willingness of children to consume vegetables, all of which are known to positively influence vegetable consumption. The resource indirectly also promoted positive awareness of the Australian vegetable industry. Ultimately, the Vegetable Education Resource is expected to influence positively 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, potentially increasing future demand for vegetables even further.

Keywords

Vegetables; Children; Consumption; Schools; Education resource; Acceptance; Exposure; Primary school; Teacher; Students

1 Introduction

Australian children's consumption of vegetables is below recommendations (CSIRO, 2012) as well as other western countries (Casagrande, Wang, Anderson, & Gary, 2007; Kim et al., 2014). The recommended vegetable intake for Australian children aged between 4-8 years is 4.5 serves / day (NHMRC, 2013), whereas on average they report consuming 1.2 serves per day ((Organisation, 2012).

Several settings present potential opportunities to improve children's vegetable consumption, including home, community, pre-school and school settings. Internationally there has been an emphasis on school settings in nutritional interventions (Evans, Christian, Cleghorn, Greenwood, & Cade, 2012), particularly in Europe and North America as school meal provision provides a far reaching and controlled setting. However, a recent meta-review of European and North American school interventions found almost no effect of these nutrition intervention programs on vegetable consumption (Evans et al., 2012). Additionally there is no school meal provision in Australia and nutritional guidelines for lunches brought from home and canteen policy remain only optional guidelines which are not always implemented (Commonwealth of Australia, 2010).

This means new approaches are needed for interventions in Australian schools, which remain a potential opportunity for improving children's vegetable consumption.

A key barrier to children's vegetable consumption is their low acceptance of vegetables (Krolner et al., 2011; Rasmussen et al., 2006). Vegetables are the category of food least liked by children (Caporale, Policastro, Tuorila, & Monteleone, 2009). Humans are born with an innate like for sweet, an innate dislike for bitter, and, within the first few months of life, adopt a preference for salty and energy dense foods (Mennella, 2014; Steiner, 1979). As most vegetables are not sweet, salty or energy dense, and some of them are bitter, this means that acceptance of vegetables needs to be learned. Childhood is a key critical period in the formation of food preferences (Birch, 1999). It has been shown that both food preferences and dietary patterns tend to track from childhood into adulthood (Craigie, Lake, Kelly, Adamson, & Mathers, 2011), and therefore increasing acceptance for vegetables amongst children provides opportunities to set life-long healthy eating habits whilst sustaining demand for vegetables.

Many interventions to increase children's acceptance of vegetables have focused either on the home environment, through programs focusing on the parent, or with children in child care settings (Dauchet, Amouyel, Hercberg, & Dallongeville, 2006; Knai, Pomerleau, Lock, & McKee, 2006), and these environments have proven to be successful to modify acceptance. The school environment provides another good opportunity to teach children about healthy eating habits and increasing enjoyment of vegetables. There are several school programs in various European countries that have aimed at behavioural change towards healthier eating through either 'sensory education' or 'taste lessons'. The emphasis of these programs has been to increase enjoyment and willingness to eat healthy foods in order to increase consumption of those foods. These programs have been implemented in schools, some already for more than 10 years, with measured effectiveness.

In France, a 'Lessons du gout' program was developed by Jacques Puisais and his team to help children make better food choices (Puisais & Pierre, 1999). The idea of their sensory education program was that children would gain awareness of their senses, would learn to verbalise the sensations they perceive while consuming foods, and learn that food is not only a source of nutrients, but also a source of pleasure. The origins of this work stem from the 1970s, but it has more recently been implemented and evaluated more widely in French schools. This program consists of 10 lessons aimed at 9-year olds, and focuses on increasing children's food preferences, verbalisation and perceptual description skills, and increasing willingness to try new foods (Reverdy, Chesnel, Schlich, Köster, & Lange, 2008; Reverdy, Schlich, Köster, Ginon, & Lange, 2010). This program was tested in three environments (school, canteen and home) and the school environment was the most successful in achieving change (Schlich et al., 2010).

A Finnish taste education program, similar in design to the French program, found similar results: 'educated' children improved their ability to identify tastes and odours, were able to provide more objective descriptors for the food items they tasted, compared to the control group (Mustonen, Rantanen, & Tuorila, 2009b). The effect was stronger in younger children (7-9 years old) than in older children.

The sensory education program also showed an impact on reducing food neophobia (a personality trait relating to a fear of eating novel foods) and an increasing willingness to try unfamiliar foods (Mustonen & Tuorila, 2010).

In the Netherlands, an educational program aimed at increasing healthy and informed eating behaviour found moderate increases in knowledge, perceived positive influence from teachers, and willingness to taste novel foods (Battjes-Fries, Haveman-Nies, Renes, Meester, & van 't Veer, 2014). This program consisted of 10 lessons for three age groups in primary school, and was built around the pillars "taste", "health" and "production". Analysis of the data found that the latter pillar was ineffective in achieving change, whereas the taste component was most effective and also perceived as the most enjoyable by the students.

None of the above sensory education programs focussed on a specific food category such as vegetables, but rather were aimed at increasing healthy eating behaviour in general, however they showed consistent improvement in behaviours known to be related to increasing vegetable intake. Therefore, this framework seems a promising approach to positively change factors known to promote vegetable intake in children.

An increased vegetable acceptance and willingness to eat vegetables (through school education programs) can lead to increased intake in the home environment if vegetables are being offered by parents. It also provides opportunities for exposure to vegetables for children who do not get this opportunity in their own home environment. School based education programs are likely to be most effective in increasing actual intake when incorporated into multi-component interventions (Blanchette & Brug, 2005; Knai et al., 2006).

The objectives of the current project were as follows:

- To undertake a feasibility study to determine the opportunities to develop a vegetable education resource for schools aligned to the Australian curriculum (Chapter 2)
- To develop a vegetable education resource for use in Australian primary schools that aims to increase vegetable acceptance and willingness to consume vegetables (Chapter 3)

- To determine whether the vegetable education resource is effective in achieving behavioural change positively associated with vegetable intake, through a validation study amongst students (Chapter 4)
- To determine whether the vegetable education resource is perceived by teachers as a valuable resource that helps achieve curriculum objectives (Chapter 5)
- To develop an implementation strategy that outlines how larger scale uptake of the vegetable education resource may be achieved (Chapter 6).

2 Feasibility study

2.1 Methodology

A feasibility study was first undertaken to determine the opportunities to develop a vegetable education resource for Australian schools aligned to the Australian curriculum. A Go/ No Go point was built into the project after this stage, to review feasibility and to re-scope activities where necessary.

A literature review was undertaken on relevant overseas and national classroom based initiatives. The Australian Curriculum was also reviewed to identify whether a Vegetable Education Kit could be developed that aligned to the curriculum, and consultation with educators was initiated and the activities of various potential dissemination partners was examined.

2.2 Results

The literature review showed that there were several well developed overseas programs in place that used a classroom based approach and were relevant for this project aiming to increase children's vegetable consumption. The most relevant programs were in The Netherlands (Smaaklessen), France (Lessons du Gout), several other European countries, and the USA (Veggiecation). An Australian program, the Stephanie Alexander Kitchen Garden Program, that aimed to increase vegetable consumption by setting up a garden and kitchen in schools, was also included in the literature review. Enjoyment, fun and tasting of products to increase appreciation were common elements across the programs. Evaluation of effectiveness of these programs showed that the aim to positively change children's behaviour was achieved. Measures of effectiveness included increase in knowledge, attitude and willingness to taste new foods. Most programs were focused on primary school children, with strongest effects found among the younger age groups. A wider review of classroom based educational programs to increase vegetable consumption around the world also found that most programs targeted children at primary schools. The reasons were that primary school-age children were more likely to be malleable, and that a long term approach facilitated by starting at a young age supported also establishing acceptance at a young age and was likely to carry through as children got older. In contrast, teenagers have already determined preferences in food and are much less likely to change, especially as they tend to choose their food independently and are often swayed by many other factors, suggesting it would be 'too late' for the intervention to have a large influence. A need therefore was identified to establish a 'cohort' of young primary school aged children. Furthermore the implementation of such a program was deemed to be better facilitated by having more flexibility in the classrooms afforded by primary level curriculum.

The feasibility study showed that there was good potential to develop a Vegetable Education resource in Australian schools. There were good opportunities to align materials to fit the Australian Curriculum, in particular in Science, Design and Technologies, Health and Physical Education, and Geography, but also aligned with cross-curriculum objectives and general

capabilities. Stakeholder consultation showed that primary school teachers appreciated ready-made/available resources that use a more holistic approach across different key learning areas.

The recommendation from this feasibility study was to develop an in-depth unit of work across different Stages in primary school education. A conceptual outline of the vegetable education resource was proposed, and is presented in the next chapter.

The full detail of this feasibility study is reported in Milestone report 102.

3 Development of a Vegetable Education Resource

3.1 Methodology

A vegetable education resource was developed around several key criteria:

1. Allowed behavioural change in factors known to be positively associated with vegetable intake. It takes into account 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.
2. Aligned to the Australian curriculum
3. Designed and structured around Australian schools and teacher needs

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

A Conceptual Framework was developed and approved by the steering committee. A first version of the vegetable education resource was then developed, and piloted at one primary school in the Sydney metropolitan area. Feedback and learnings were incorporated into a revised resource (VER 2.0). This second version was then used for a validation study on student's responses and qualitative and quantitative data was collected from teachers on the use of the resource (see Chapter 4 and 5).

3.2 Results

3.2.1 Conceptual development of a Vegetable Education Resource

The Conceptual Framework for the vegetable education resource was based upon a feasibility study, and was informed by scientific insights on increasing children's acceptance and intake of vegetables, insights from several educational programs with similar goals (see Milestone report 102) as well as information on alignment to the Australian curriculum.

The Conceptual Framework which formed the basis for the development of the Vegetable Education Kit had the following characteristics:

1. **Vegetable education resource 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 core program was designed as a low-cost program to maximise uptake on a national scale, including in socio-economically disadvantaged areas. The program is therefore intended to be used by teachers themselves, without in-class support from specialised staff; teachers are provided with detailed instructions about the program as part of the resource. Longer term, this program may benefit from providing specialised training to teachers.

3. **Written resource, with full lesson plans and electronic whiteboard support**
   The physical form of the resource is written manuals. For each stage, it contains 2 resources for the teachers: a Teacher manual, which includes all lesson plans, student worksheets and answer sheets, and an Electronic whiteboard support (set of Power point 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), which taps into different learning areas. Materials focus around three stages aligned to the Australian schooling system; Early Stage 1 / Stage 1 (F-2) children aged 5-8 yrs, Stage 2 (yr 3-4), children aged 8-10 yrs, and Stage 3 (yr 5-6), children aged 10-12 yrs. The lessons from each Stage build on each other with the view to provide students with a “food education” tailored around vegetables throughout primary school.

5. **Each Unit for Work consists of 5 structured lessons of approximately 1 hr 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 of the 5Es instructional model (Bybee, 1997); Engage, Explore, Explain, Elaborate and Evaluate, can be used to structure each lesson.

6. **Fun, enjoyment and hands-on experiences are critical elements of the program.**
   Scientific insights show that increasing enjoyment in eating vegetables should be a key goal of the program. A specific health focus should be avoided as this has been shown to negatively impact upon acceptance of foods labelled ‘healthy’ amongst children and adolescents (Maimaran & Fishbach, 2014; Rolls, Ello-Martin, & Tohill, 2004; 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.

   The Vegetable Education resource covers the following areas:
   - Taste and taste development
   - Knowledge of vegetables, including their taste properties
   - The role that vegetables play in a healthy and varied diet
   - Regionality / seasonality of vegetables and vegetable production

- Cultural diversity in eating vegetables
- Aspects related to vegetable growing and the production chain.

Elements in the program are covered in all stages, but there is a stronger focus on the senses involved in eating (e.g. appearance, smell, taste, mouthfeel and hearing) and on taste in Stage 1, and on production / cultural diversity in later stages. The focus in each of the stages is closely aligned to achieving Australian curriculum objectives.

7. **The Vegetable Education Kit is closely aligned to the Australian curriculum**
   There is a close alignment to the Australian curriculum, in particular the Science and Health and Physical Education strand. 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 First prototype of the Vegetable Education Resource

A first prototype (VER 1.0) was developed and piloted at a school in the Sydney metropolitan area (North Shore). The pilot testing involved a teacher-led implementation of the full program in all school classes (13 classes in total).

Informal feedback from all teachers and the principal was obtained. Materials were also reviewed in detail by three teachers, one each representing early Stage 1/ Stage 1, Stage 2 and Stage 3 respectively. Overall feedback was positive. Specific feedback and suggestions to improve the materials were incorporated in a second prototype.

Feedback related to the **overall program**:

- Overall very positive, students got a lot out of it and really enjoyed it
- Hands-on tasting really appreciated; opportunities to taste vegetables in class
- Novel approach: "In all my 20+ years of teaching I have never come across anything like this"
- Some children had little experience with eating some raw vegetables, since they were more used to eating cooked vegetables. A mix of raw and cooked vegetables to taste would be good
- The last lesson in each stage, the "creating and eating together" lesson (Sandwich, salad, juice in Stage 1,2 and 3 respectively), were extremely valuable and enjoyable, and certainly worth "the fuss"

Feedback related to the **Structure** of the resource:

- 5 lessons is good; duration of lessons (1hr each) is good; Kindergarten children have short attention span therefore mix of hands-on activities and opportunities to break the lesson in separate activities is good

- Culmination of hands-on / conviviality at the end is great
- Do not feel too limited by the 5E framework – do not have to have all the five E's in each lesson, Evaluation typically can be very short

Feedback in relation to the **Materials** was:

- Overall framework of the lesson plans is good; an overview of the lessons at the start of the manual would be valuable
- Having a clear overview of what is expected in each lesson is really important starting point. This is now in Outcomes but could at times be strengthened to focus on the main points.
- There is a lot of material in the lesson; define core of what is expected, other activities optional (tie in with Literacy/Maths/Art etc..).
- The Power Point slides as a supplement to the Lessons are good; would be good to have more of this information to guide the teacher through the lesson (then no need to look to the lesson plan as much)
- OneNote as form for the lesson plans would be good (Smart Notebook is not accessible to all schools).
- Teachers like visuals / flowcharts / tables/ pictures
- The Explain part should be bullet points or questions for the teacher to ask the kids. The information will come from the children. The teacher background part can contain the detailed information about what the good answers might be.
- Keep worksheets to minimum, use of some worksheets are ok; activities via interactive whiteboard are preferred
- No coloured worksheets for students (too expensive, colour copying restricted); development of coloured posters or laminated pictures to put in the kit could be done, so they can be displayed in the classroom.
- All students have a journal in which they can write/glue things -> can make reference to those
- Have activities available for the fast workers or if there is waiting time between activities

Feedback in relation to the **Curriculum** was:

- Good alignment with the Curriculum
- The program has the best fit with Science and Physical Education and Health; both have objectives as two-year strands so this fits well with having a Unit for one stage
- Longer term, incorporating an assessment task with an assessment rubric in the Unit would be valuable. This provides information for report, and can be the last lesson, quiz, rich task... Assessment possibilities could also be literacy based (text types purpose of writing, visual literacy) or numeracy (charts, data, measuring)

Feedback in relation to the **Logistics and Costs** of the program, including recommendations for running of the program in other schools, was:

- Provide a shopping list for each lesson, similar to the Juicing lesson shopping list.
- Same stage could run the lesson at the same time (same day/time): vegetables could be bought fresh, with one person responsible for sourcing. Vegetables could then be prepared at the same time
- Can include suggestion that some classes could be run as buddy class (one teacher explaining, one doing practical preparations)
- To facilitate logistics in longer term roll out (when part of regular Scope and Sequence): could stagger the Units across Stages (e.g. Stage 1 first 5 weeks of a term, Stage 2 last 5 weeks of a term). This way mix-up of vegetables between stages can be avoided, and can cope with limited refrigerated storage
- Best time to run the program is either just before lunch or just after lunch
- Involve parents or year 6 students to assist with vegetable preparations
- Use parent's info news or newsletters to let parents know about the project and maybe manage to get them involved.
- School has science budget of $2000 for year. This cost about $150 per stage of 80-100 students ($450 for the school, is 1/4 of the year's budget). Teachers were happy with this.

Teachers also provided specific detailed feedback in relation to the materials and activities for each stage, which were used to develop the second prototype.

3.2.3 Second prototype of the Vegetable Education resource (VER 2.0)

A second prototype of the vegetable education resource (VER 2.0) was developed, and this prototype was used in the validation study (see Chapter 4) and for seeking quantitative teacher feedback (see Chapter 5).

The second prototype followed essentially the same framework as the first but with refinements based upon feedback from experience of using VER 1.0.

The Vegetable education program consisted of the following materials:

1. Overall Implementation Manual
2. Early Stage 1 / Stage 1: Teacher Manual and PowerPoint support
3. Stage 2: Teacher Manual and PowerPoint support
4. Stage 3: Teacher Manual and PowerPoint support

Overall Implementation Manual

The Overall Implementation Manual is generic across all Stages. It provides general information and support for the school to implement the program.

It contains:

- Information about the objectives of the Program

- Example note to inform parents about the program which also addresses allergy and concerns regarding food tastings by their child. Recommendations to the school are also included to be mindful of allergenicity and eating of foods that may be sensitive from a cultural or religious perspective
- An overview of the lessons in each Stage
- Theoretical background information for teachers on development of food preferences, and the functioning of the senses.
- Information about Curriculum alignment, with specific Curriculum objectives met within each of the Stages
- Detailed shopping lists for each of the Stages, broken down by lesson
- Worksheet on safe preparation of vegetables (one A4 sheet with pictures, intended to use as a stand-alone material for those preparing vegetables), as well as links to two websites for further information on safe preparation of foods

Contents of the Stage Materials

In all stages the content of the vegetable education resource was aligned to the curriculum. It involved hands-on activities in each of the lessons, focused on experiential learning and vegetable tastings. The last lesson in each Stage was the preparation of vegetables in a dish (a sandwich in Stage 1, a salad in Stage 2, and a juice in Stage 3) and the meal/dish was enjoyed together by the students.

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

Lesson	Title	Objectives
1	The Five Senses	Students: - learn about the senses involved in eating and drinking - experience the five senses through tasting vegetables - can describe vegetables in terms of the five senses - create a class record showing liking for vegetables
	Extension	**Students draw their favourite vegetable**
2	From Seed to Vegetable	Students: - can recognise and name different types of common vegetables - discover and eat different parts of vegetable plants (leaves, root, pods) - know what plants need to grow
	Extension	**Students grow a bean plant**
3	The Basic Tastes	Students: - learn that we taste foods using the taste buds on the tongue - can recognise the four basic tastes (sweet, sour, salty and bitter) - can identify the dominant taste in different vegetables
	Extension	**Students categorise foods according to their basic taste**
4	Becoming a Food Adventurer	Students: - learn that liking of foods can change by trying - become more open to taste novel foods - learn about the role of variety in the diet - learn about colour variety in vegetables
	Extension	**Students create a rainbow artwork of fruit and vegetables**
5	Picnic in class: sandwich	Students: - prepare a tasty and balanced sandwich with vegetables - understand food hygiene rules that apply to eating communal foods - enjoy eating a sandwich together - discuss their experiences of eating a sandwich with vegetables
	Extension	**Students know at least 10 vegetables which can be consumed in a sandwich**

Figure 1 Overview of the Unit consisting of 5 lessons for Early Stage 1 / Stage 1

Lesson	Title	Objectives
1	The Five Senses: Taste and Olfaction	Students: - explore the five senses involved in eating and drinking - understand the differences between odour, taste and flavour - become aware of individual food preferences and cultural diversity through vegetable tastings
	Extension	**Students complete a Word clue "I know my vegetables"**
2	Discovering a variety of vegetables	Students: - Enrich their knowledge of vegetables while expanding their ability to describe it's flavour and texture properties - Are exposed to more complex and less common vegetables - Explore the relationships between cooking/preparation methods and the taste and flavours of vegetables through a simple scientific experiment
	Extension	**Students complete a cross word "I know even more vegetables"**
3	Vegetable lifecycle and environment	Students: - understand how a plant grows - discover the relationship between plant lifecycle, climates and seasons - explore the role of agricultural sciences
	Extension	**Students prepare a Show and Tell for a vegetable**
4	Cultural differences and food wastage	Students: - Investigate how vegetable practices differ between families and cultural groups - Understand how expectations and visual cues can affect our food choices and willingness to try different foods - Become aware of food wastage and it's relation to food appearance
	Extension	**Students associate vegetables with the corresponding dish and country of origin**
5	Masterchef in class: The Salad	Students: - Prepare a mixed salad that is appealing and nutritious - Learn to critically appraise the food they eat - Learn basic hygiene rules when preparing food - Enjoy eating a meal together
	Extension	**Students compile and graph a class record on number and type of vegetables consumed**

Figure 2 Overview of the Stage 2 Unit consisting of 5 lessons

Lesson	Title	Objectives
1	How our senses interact	Students: - explore in detail the five senses involved in eating and drinking - learn how the senses interact with each other - learn and apply a systematic method for tasting foods
	Extension	Students explore colour variety in vegetables and graph results
2	Investigating taste - Part 1	Students: - learn to identify and determine the basic elements in a scientific experiment such as hypothesis, variables, constant - discuss how to best present the results of a scientific experiment - plan a small scientific experiment about the taste of vegetables - conduct a scientific experiment about the taste of vegetables - discover that simple changes can have a large effect on taste and texture
3	Vegetables from farm to plate	Students: - are aware of the many ways to purchase and eat vegetables - investigate the vegetable supply chain - investigate the role of food technology in producing vegetable products available all year-round - compare the taste and texture of a fresh vegetable and a processed variant
	Extension	Students compare the taste and texture of more fresh vegetables and their
4	Investigating the taste of vegetables - Part 2	Students: - plan, rehearse and deliver a presentation of scientific findings - understand the effect of cooking on taste and texture of vegetables - broaden their descriptive vocabulary relevant to tasting foods - suggest improvements for the scientific methods used in their experiment
5	The Ultimate Vegetable Juice Challenge	Students: - think about vegetable combinations to create a recipe for a beverage of vegetables that is tasty and looks good. - recognise that each vegetable contains different nutrients and has different health benefits, and to maintain good health, a variety of vegetables should be consumed - discover/retain safe food handling practices - taste a variety of vegetable juice combinations, and compare with their expectations - realise that juicing is a fun way to add vegetables in your diet

Figure 3 Overview of the Stage 3 Unit consisting of 5 lessons

Overall Structure of Stage Materials

Each stage had two resources:

1) A teacher manual that described the lessons in detail, and 2) A supporting Powerpoint resource to use in the classroom via the interactive whiteboard.

The teacher manual started with an overview of the lessons, and then had five individual lessons that all followed the same format:

1. Lesson number and title
2. Lesson outcomes at a glance (in bullet points)
3. Lesson objectives
4. Materials needed, preparation activities and preparation time
5. Teacher background information
6. Suggested activities, based around the 5E framework: Engage, Explore, Explain, Elaborate and Evaluate, with details on activities, time required and suggested work form (e.g. groups, pairs, individual).
7. Extension activities
8. Worksheets if related to particular activities in the lesson
9. Teacher Answers sheets related to Worksheets

The PowerPoint supporting material contained information specific to the lesson, and was variable in size depending on the lesson.

3.3 Discussion

The Vegetable Education resource (VER2.0) developed was used in the validation study to determine the effectiveness of vegetable education on behavioural outcomes in students, and quantitative feedback was also gathered from teachers.

The Technology Readiness Level (TRL) framework provided a useful framework to discuss the maturity of the newly developed technology (i.e. vegetable education resource) in terms of its readiness for market (Figure 4).

The current Technology Readiness Level of the Vegetable Education Resource (VER2.0) is TRL5. The concept has been defined (TLR1), and a conceptual framework has been developed (TRL2-3). A first version ("ugly" prototype VER1.0) has been developed, and has been piloted in one school (TRL4). A second version was developed and tested in an actual environment, i.e. two schools (TRL5).

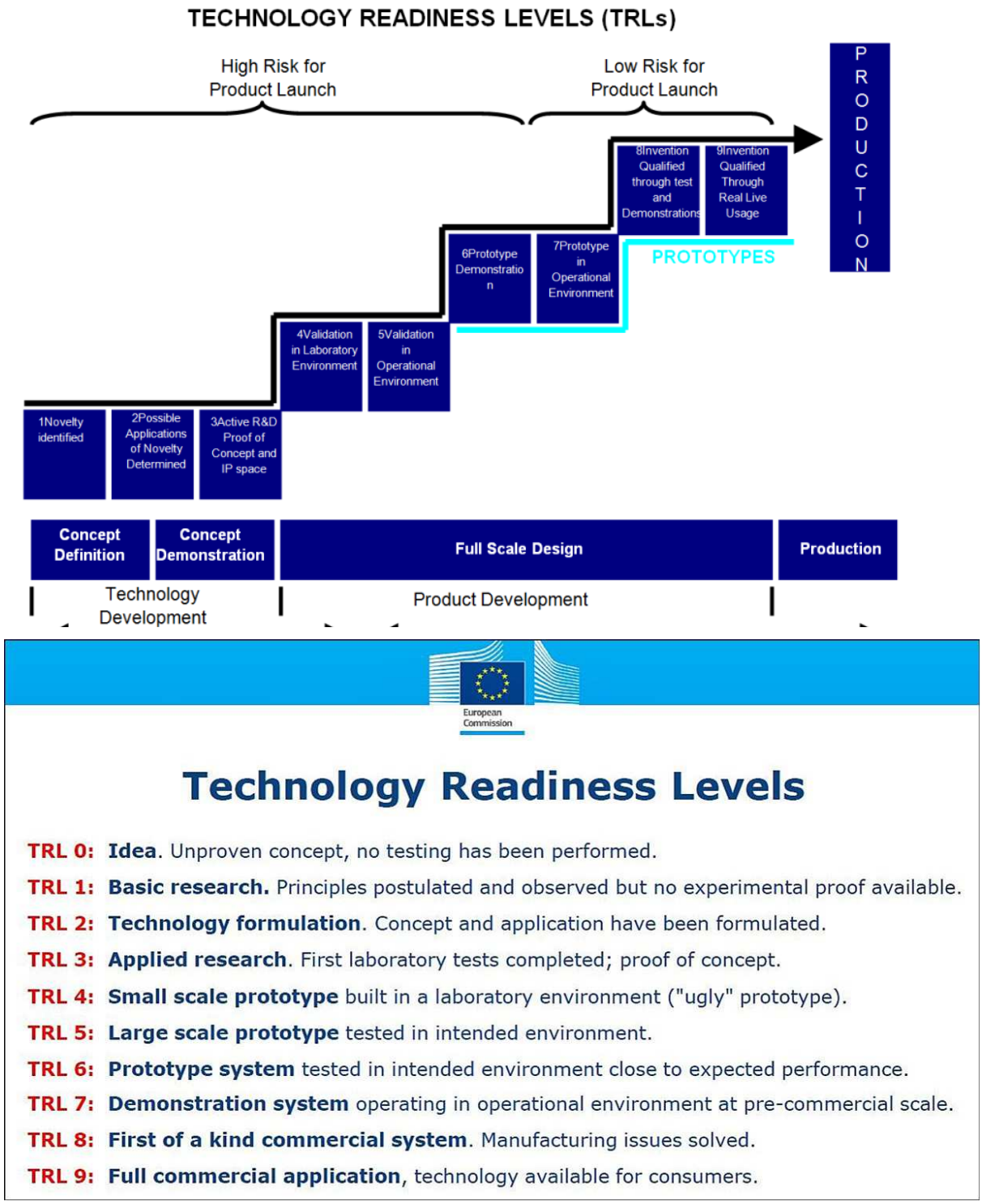

Figure 4 Technology Readiness Levels (Source: European Commission)

The Vegetable education program (VER2.0) was evaluated in two ways:

1. A scientific validation study to determine the effectiveness of the vegetable education resource in achieving positive change amongst students in factors associated with vegetable intake (Chapter 4)
2. A teacher survey and teacher interviews to evaluate the teachers experiences working with the materials, determine alignment to the Australian curriculum, seek input for improvement of the resource, and seek input to increase its uptake amongst schools in later stages (Chapter 5)

The results from the student and teacher survey provided input for further development and maturation of the technology.

The Vegetable Education Resource in a nutshell

- An education resource for use by 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)
- Written materials for teachers, with supporting in-class slide sets
- Tastings, development of the senses, and hands-on learning are the essential components
- Aligned to the Australian curriculum, cross-curricular but most strongly embedded in Science, and Personal Development, Health and Physical Education
- VER 2.0 of the resource was tested in two schools through a student and teacher survey

4 Validation study

4.1 Methodology

4.1.1 Overview

The validation study was designed to determine the effectiveness of the vegetable educational program in achieving positive change in behavioural factors known to promote vegetable intake through a survey amongst children. Changes in behavioural factors of children from two schools that implemented the newly developed vegetable educational resource were measured. These changes were compared with those children from two control schools that had followed their regular curriculum.

Three measurements were conducted with eligible students in Year 2 to Year 6: a baseline measurement, a post-test measurement and a three-month follow up. The vegetable education resource was taught between the baseline measurement and the post-test measurement, whilst the control schools followed their regular curriculum during that time. The follow up measurement was conducted to determine whether any positive effect was sustained over the longer term. This measurement falls outside the scope of the current contract (CSIRO investment) and is not reported in the current document.

4.1.2 Questionnaire

Children self-completed a questionnaire that addressed various factors known to be associated with vegetable intake. The questionnaire was administered online, using Survey Monkey software. Three different versions of the questionnaire were developed, one for year 2 students, one for year 3-4 students, and one for year 5-6 students.

The knowledge component of the questionnaire, as well as the food and vegetable pictures were slightly different in the three questionnaires, to match with the content taught in the Unit of Work for the particular age group.

The year 2 questionnaire was slightly shorter than the Year 3-4 and the Year 5-6 questionnaire, to take into account the children's shorter attention span. Although the vegetable education resource was also taught on Foundation level (Kindergarten) and Year 1, comprehension and reading skills, and the attention span of these young children was limited, and therefore it was deemed not possible to conduct this survey with the students of those classes.

The following various factors associated with intake of vegetables were investigated.

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 was used. One point was given for every correct response. Questions were slightly different for different age categories to match with the content used in the vegetable education resource, although there were also questions in common. The knowledge component consisted of 8 items in the year 2 questionnaire, and of 12 items in the year 3-4 and year 5-6 questionnaire.

Acceptance

Acceptance for commonly consumed vegetables was measured using a 5-point hedonic facial scale(Guinard, 2000), which is an age-appropriate scale commonly used to measure vegetable acceptance (e.g. (Poelman, Delahunty, & de Graaf, 2013). Examples to ensure correct understanding of the scale were given. Acceptance of 8 (year 2) to 10 (year 3-6) types of vegetables was measured.

Skills

Ability to verbalise sensory perceptions was tested. Students were asked for two (year 2) or three (year 3-6) foods to provide descriptive words for each of the foods. The number of descriptive words (e.g. crunchy, sweet) was counted. Hedonic (liking-disliking) words (e.g. delicious, yummy) were excluded.

Attitudes

The attitude of the child was measured, using the Theory of Planned Behaviour Framework (Fishbein & Ajzen, 1975). Attitudes related to eating a variety of foods and vegetables, and of trying new foods and vegetables, and were measured using statements, with response scales consisting of a 5-point scale of agreement. Perceived attitudes by teachers and peers were measured using the same statements and response categories, for children in year 3-6.

Emotions

Positive and negative emotions towards eating new foods and towards eating vegetables were measured using validated scales (Desmet & Schifferstein, 2008). The child responded with their level of agreement to eight statements.

Neophobia

Neophobia was measured and analysed using the validated neophobia scale (Rubio, Rigal, Boireau-Ducept, Mallet, & Meyer, 2008). This scale consists of 13 items that measures aspects of willingness to try new foods, including specific situations in which children are asked to indicate to which degree they would be willing to consume if they were offered to them (5 point scales).

Intention and willingness to eat

Behavioural intentions for trying, and for eating a variety of foods and vegetables was measured using 4 statements and formatted according to the validated scales of behavioural intent of the Theory of Planned Behaviour(Fishbein & Ajzen, 1975). In addition, experience with and willingness to try four specific (less commonly consumed) vegetables was measured using pictures of the vegetable and dichotomous responses.

	Number of questions				
Determinant	Year 2	Year 3-4	Year 5-6	Example of question	Answer category
Knowledge	8	12	12	You can eat eggplant raw.	True/False, Multiple Choice, Open question
Verbalisation	2	3	3	How does this [food/vegetable] taste and feel in our mouth? Write as many describing words as you can.	Open question
Vegetable acceptance	8	10	10	How much do you like [vegetable]	Really dislike (=1) – really like (=5)
Neophobia	13	13	13	When you see a food for the first time you are afraid to taste it	Strongly disagree (=1) – Strongly agree (=4)
Attitude		4	4	It is good to eat a variety of vegetables	Yes, definitely (=1) – No, definitely not (=5)
Subjective norm teacher		4	4	My teacher would like me to eat a variety of vegetables	Yes, definitely (=1) – No, definitely not (=5)
Subjective norm peers		4	4	My friends would like me to eat a variety of vegetables	Yes, definitely (=1) – No, definitely not (=5)
Emotions	8	8	8	I often find vegetables fun	Yes, definitely (=1) – No, definitely not (=5)
Intentions	4	4	4	I will eat a variety of vegetables	Yes, definitely (=1) – No, definitely not (=5)
Vegetables tried	4	4	4	Have you ever tried [vegetable]?	Yes / No
Vegetables willing to try	4	4	4	Would you try [vegetable] if someone offered it to you?	Yes / No

Table 1 Content of the survey questionnaire

Suitability of language, complexity and duration of the questionnaires for children was ensured by the use of dedicated readability software (https://readability-score.com) and by expert review from 4 qualified primary school teachers.

An overview of the questions is provided in Table 1. As an example, the questionnaire for Stage 3 has been provided in Appendix A.

As background information, the following data was collected from the parents. These questions were embedded in the Consent Form.

Vegetable consumption

The child's usual vegetable intake (excluding potatoes) in serves per day was measured at baseline using an adaptation of a validated scale (Ball, Crawford, & Mishra, 2006). As response categories, 0, ½, 1, 1 ½, 2, 3-4 and 5 serves were used. In this validated questionnaire, a serve is identified as ½ cup (75g) of cooked vegetables, or 1 cup of salad vegetables. Since this question is conceptually difficult for children to respond to (and has not been validated amongst children), the parent was asked to complete this question.

Background information

Background information collected from the child were gender, age and school class. The parent was asked to provide an estimation of their own usual vegetable consumption using the validated questionnaire (Ball et al., 2006), as well as provide information on the cultural background of the child.

4.1.3 Participants

Participants in the study were students in year 2-6 whose parents had provided consent. Recruitment was stratified through schools and classes.

Power calculations estimated a sample size of 436 students were required. This was based on an effect size of .15, which was slightly lower than the effect size obtained in a similar study where the intervention was slightly more intense in the number of lessons offered (Battjes-Fries et al, 2015). With a power of 0.95 and alpha = 0.05, and using a repeated exposure ANOVA with between-group factor, an overall sample size of 436 students was needed. It was estimated that the target sample could be achieved by recruiting four schools (2 intervention and 2 control schools) with an average school size of approximately 400 children. With an estimated 1000 eligible children in years 2-6, it means a participation rate of 45% was needed. This was deemed to be an achievable target, as a similar study (Battjes-Fries et al, 2015) had a participation rate of 50% through to the second follow up measurement.

Two areas of different socio-economic conditions were selected from the Sydney metropolitan area: Merrylands and Ryde (see Table 2).

Ethical approval was required for the validation study, but not for pilot testing the vegetable resource. Due to time needed for planning the study, the first schools were approached to pilot the vegetable education study. The first school that agreed was selected.

Human Research Ethics Approval for the Validation Study was obtained from the CSIRO Human Research Ethics Committee (HREC01-2015) on 28 April 2015. The Validation Study also required prior approval from the NSW Department of Education and Communities by applying through the NSW State Education Research Applications Process (SERAP). This SERAP application process required approval by a relevant HREC prior to granting permission. SERAP approval (2015286) was significantly delayed due to unknown administrative delays within the NSW Department of Education, and was granted without requiring any revision on the 31st of July 2015.

After HREC and SERAP permission were obtained, schools were recruited for the validation study. For intervention schools, schools were approached that had already agreed to implement the Vegetable Education Resource. In line with the SERAP requirements, letters were sent to principals to seek their schools participation in the validation study. Thus, it is theoretically possible that schools agree to trial the vegetable education resource but they do not agree to the validation study. However, in our case the two schools that agreed to implement the resource also agreed to the validation study. In addition to the intervention schools, schools were approached that matched the intervention schools in terms of geographic area and socio-educational status. These schools followed their regular curriculum and thereby functioned as controls. These Control schools were offered the vegetable education resource materials after completion of the validation study.

By design, intervention and control schools were matched for geographic area and SEIFA (Socio-Economic Indexes for Areas) status. Table 2 summarises the characteristics of the schools that took part in the validation study (from www.myschool.edu.au).

The two schools, intervention and control, in one location (the Ryde area) were similar to each other in number of students, whereas in the other location (Merrylands) numbers of students in each school differed. All schools were simultaneously taking part in the NSW Crunch & Sip® program, which is a set break during the school day when students can eat fruit or salad vegetables, and drink water in the classroom. Participation in Crunch & Sip® is very common across schools in NSW.

All schools were culturally diverse, as is common in the Sydney metropolitan area and across Australia.

Area	SEIFA	Type	Student enrolments	Index of Community Socio-Educational Advantage (ICSEA)	Language background other than English
Merrylands	3	Intervention	721	975	69%
Merrylands	3	Control	308	1016	64%
Ryde	8	Intervention	481	1106	56%
Ryde	8	Control	504	1090	79%

Table 2 Overview of the schools that took part in the validation study

4.1.4 Procedure

Information sheets and consent forms for parents from students in year 2 to 6 were distributed to parents via the schools that had agreed to take part in the validation study. Only children whose parents provided written consent took part in the study. This process was managed by the schools.

Pre-test measurements were collected in all schools in Term 3 of 2015, between mid August and mid September. The intervention schools then started teaching the vegetable education resource over a period of 4-5 weeks. Post-test data were collected at the beginning of Term 4. The control schools collected the post-test data with a similar amount of time between pre-and post-test measurements as their matched intervention school.

Survey questionnaires were completed online, in the computer lab of the school. 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 and upwards self-completed the questionnaire, with the teacher available to provide guidance. The survey questionnaires took a maximum of 30 minutes to complete.

4.1.5 Analysis

Data were analysed using SPSS (v20.0.0) and a criterion of $P<0.05$ was used for statistical significance.

- Sum scores were calculated for knowledge, verbalisation skills, and for willingness to try vegetables, allocating 1 point for each correct answer, and for each vegetable the child was willing to try.
- For scales consisting of several items (attitudes, emotions, neophobia) Cronbach's alpha were calculated within each scale/ subscale to determine adequate consistency of individual items to the overall concept. Mean ratings were calculated for each scale.
- Repeated measures ANOVA was conducted on outcome measures (knowledge score, verbalisation score, vegetable acceptance, mean attitude score, subjective norm, behavioural intent, neophobia, number of foods willing to taste) with time point as repeated measure, and using treatment condition (intervention or control) as between-subject factor.

4.2 Results

4.2.1 Participants in the validation study

The flowchart describing class and student participation throughout the study is shown in Figure 5. A similar number of classes took part across the intervention and control schools, although the number of students that were in the intervention part of the study was higher than in the control arm. This is partly related to the higher number of eligible participants in the intervention arm due to school size, but also because of a higher response rate in intervention schools, likely because parents were aware that a new program would occur at their school, and they were therefore more agreeable to their child taking part in the validation study. The total number of students that took part in either the pre-test or the post-test was 493 in the intervention schools, and 162 students in the control schools. At the same time, there were 213 students in the intervention schools that completed both the pre-test and the post-test, and 107 students in the control schools.

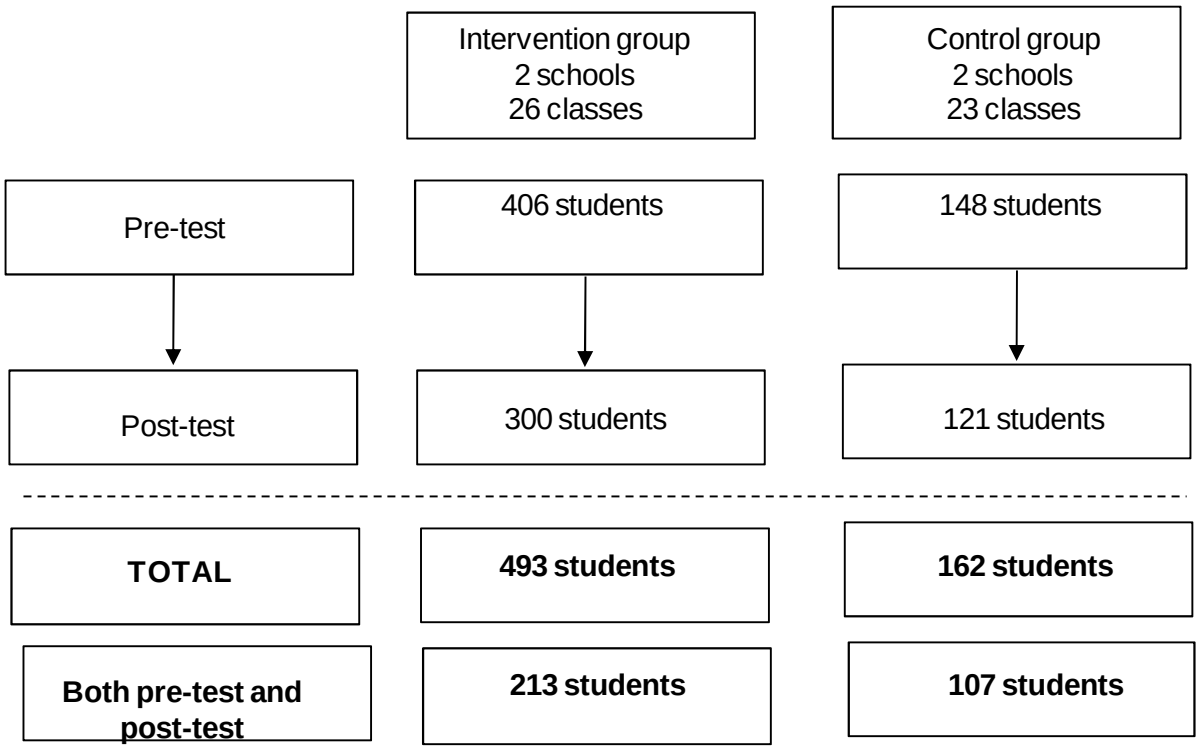

Figure 5 Flow diagram of recruitment and participation of students

The breakdown per Stage is provided in Table 3. The students that took part in the study were largely either from Stage 2 or Stage 3, with only 12% of students that participated being from Stage 1 (please note that only year 2 students were eligible in Stage 1).

TIMEPOINT	GROUP	YEAR			TOTAL
		Year 2	Year 3-4	Year 5-6	
Pre-test	Control	28	34	86	148
	Intervention	63	163	180	406
	Total	91	197	266	554

	Control	15	32	74	121
Post-test	Intervention	9	131	160	300
	Total	24	163	234	421

Table 3 Breakdown of number of participants per stage

There was an equal amount of boys and girls that participated in the study; and this distribution was even across the control and intervention schools, as well as in the different stages (Table 4).

		YEAR			
GROUP	**Gender**	**Year 2**	**Year 3-4**	**Year 5-6**	**TOTAL**
Control	Boys	50%	44%	51%	49%
	Girls	50%	56%	49%	51%
Intervention	Boys	41%	46%	49%	47%
	Girls	59%	54%	51%	53%

Table 4 Breakdown of gender of participants per stage (baseline data)

The average age was 7.32 year (SD 0.47 year) for students in Year 2, 8.93 year (SD 0.80 year) for students in Stage 2 (Year 3-4) and 10.86 year (SD 0.73 year) for students in Stage 3 (Year 5-6). There was no difference in age between students in the intervention and the control schools.

Reported vegetable consumption of children at baseline was well below the recommendations of 4.5 serves per day in all stages. Consumption also did not differ between intervention and control schools (Table 5).

GROUP	**YEAR**		
	Year 2	**Year 3-4**	**Year 5-6**
Control	1.37 ± 1.01	1.52 ± 1.15	1.89 ± 1.36
Intervention	1.84 ± 1.18	1.67 ± 1.18	1.84 ± 1.20

Table 5 Vegetable intake ± SD (in serves/per day) by children per stage as reported by parents (based on all students, measured at baseline)

Similarly, reported vegetable consumption by the parents at baseline was well below recommended intake of 5 serves per day. There was no difference of vegetable intake by parents from the intervention and control schools (Table 6).

GROUP	**YEAR**

	Year 2	Year 3-4	Year 5-6
Control	2.08 ± 0.98	1.98 ± 0.98	2.71 ± 1.19
Intervention	2.45 ± 1.11	2.32 ± 1.14	2.23 ± 1.15

Table 6 Vegetable intake ± SD (in serves/per day) by parents per stage (measured at baseline)

Parents reported the cultural background of their child, and could provide more than one response. Twenty-five percent of parents provided more than one response. Students were from mixed cultural backgrounds, as Table 7 shows.

Cultural identity	Control	Intervention
Aboriginal / Torres Strait Islander	2%	3%
Australian / New Zealander	46%	53%
British / English / Scottish / Welsh	1%	5%
Chinese	23%	10%
German	0%	1%
Greek	2%	0%
Indian	9%	5%
Irish	0%	0%
Italian	4%	1%
Lebanese	2%	18%
Vietnamese	3%	1%
Other	40%	32%

Table 7 Cultural background of students, reported by the parent

4.2.2 Effect of vegetable education program on student outcomes

The outcomes of the validation study were analysed on an overall level, across the three stages. The results are shown in Table 8.

		Mean score		P value		
Outcome measure	**Group**	**Pre-test**	**Post-test**	**Time**	**Time x group**	**Stage**
Knowledge	Intervention group Control group	9.27 10.37	12.53 10.91	<0.001	<0.001	<0.001
Verbalisation	Intervention group Control group	3.40 4.69	4.77 4.96	n.s.	0.002	<0.0001
Acceptance	Intervention group Control group	3.45 3.59	3.60 3.59	n.s.	0.06	n.s.
Neophobia	Intervention group Control group	2.12 2.22	2.19 2.24	n.s.	n.s.	0.002
Attitude	Intervention group Control group	1.77 1.74	1.70 1.73	n.s.	n.s.	n.s.
Subjective norm teacher	Intervention group Control group	1.93 1.82	1.92 1.89	n.s.	n.s.	n.s.
Subjective norm peers	Intervention group Control group	2.38 2.54	2.40 2.67	n.s.	n.s.	n.s.
Emotions	Intervention group Control group	2.35 2.23	2.33 2.22	n.s.	n.s.	n.s.
Intentions to eat	Intervention group Control group	2.08 1.96	1.95 2.01	n.s.	0.06	n.s.
Vegetables tried	Intervention group Control group	1.44 1.84	1.39 1.88	n.s.	n.s.	n.s.
Vegetables willing to try	Intervention group Control group	1.94 2.48	2.10 2.44	n.s.	0.05	n.s.

Table 8 Mean scores at pre-test and post-test of the outcome measures for students in the intervention school (n=213) and in the control school (n=107).

The statistical analyses showed that the vegetable education resource was effective in achieving positive change in several outcome areas across all years.

The vegetable education program:

- Significantly increased students' **knowledge** about vegetables and the senses

- Significantly increased student's **verbalisation skills**, i.e. their ability to describe the sensory properties of foods they were eating.
- Significantly increased student's **willingness to try** vegetables when they were offered to them
- Showed a tendency to increase student's **vegetable acceptance**
- Showed a tendency to increase student's **intentions** to eat more vegetables and a wider variety of foods

There was no statistically significant effect of the vegetable education program on the student's behavioural neophobia, attitude, how they perceived their teacher or friends expectations of their behaviour, their emotions, or in specific vegetables tried.

One variable that showed an effect of time was knowledge, which increased across both the intervention and the control group. These results point to a learning effect. However, there was also a significant time by group interaction for this variable, which indicates that the effect was not the same in both groups. Indeed, the increase in knowledge was much larger in the intervention group of students that had received the vegetable education compared to the control students that continued to follow their regular curriculum.

There were also several outcome measures that showed a difference across stages (a general age effect). These were knowledge, verbalisation skills and neophobia.

Knowledge: The three stages all differed significantly from each other. Stage 1 overall scored lowest in knowledge; this was in part inherent to the questionnaire, as fewer questions were asked. Stage 2 also had a lower score than Stage 3.

Verbalisation: Stage 3 students had a higher verbalisation score than students in Stage 2 and 1.

Neophobia: Stage 1 students were more neophobic than Stage 2 and 3 students.

4.3 Discussion

The validation study showed that the vegetable education resource was effective in achieving some behavioural changes amongst students which are known to be positively associated with vegetable intake.

Our study showed effects in line with what other scientific studies on sensory education programs have found. Our study found an increase in knowledge about the vegetables and the senses, which were the two specific knowledge areas of our vegetable education resource. Increases in knowledge were also observed in the Dutch Taste Lesson program (Battjes-Fries et al., 2014), which related to taste and health as these were the areas that their resource focused on. We also found an increase in verbalisation skills which were similar to the effects found in the French (Schlich et al., 2010) and Finnish (Mustonen, Rantanen, & Tuorila, 2009a) sensory education programs. The difference between the two studies is that the verbalisation in our research related primarily to vegetables, whereas a general food approach was followed in the overseas program Our data showed a tendency to increase vegetable acceptance, and a change in food preferences which was also observed in the French sensory education program (Reverdy et al., 2010). We saw

a tendency for increased intentions to eat vegetables and a variety of foods, similar to the increased behavioural intentions found in the Dutch education program (Battjes-Fries et al., 2014). An increase in willingness to try new foods was found in several programs (Battjes-Fries et al., 2014; Mustonen & Tuorila, 2010; Reverdy et al., 2008); we found an increased willingness to try vegetables but not an overall increased willingness to try new foods. Our program was specifically designed around vegetables, whereas the other sensory education programs had a broader focus on healthy eating, and the resulting difference in willingness to taste foods is reflective of the difference in scope.

The number of students that participated in both surveys was lower than we originally anticipated. Whereas more than 650 students completed at least one of the surveys, only about half of those (320 students) completed both the pre-test and the post-test, and these were the students on which our analysis was based. The lower number of participants than originally intended (i.e. 466) meant that some effects (vegetable acceptance and intentions) pointed in the right direction, but unfortunately just failed to achieve statistical significance.

There were also a number of outcome measures where no effect of the vegetable education resource was found. These were emotions, attitudes and the social norm perceived from the teacher and peers. The Dutch sensory education program found no effect on attitude and social norms of peers either (Battjes-Fries et al., 2014). Whereas it is possible that the program does not impact on these variables, it is also possible that the duration of the program is not sufficient to obtain measurable changes. It is also possible that better measures are needed in order to quantify these variables, in particular as the teacher feedback seemed to indicate some positive changes at least in peer influence (see Chapter5).

Surprisingly, the Dutch program found a negative effect on emotions, which they attributed to the health component of the program. In our program health was de-emphasized; however no positive effect on emotions was found either. The Dutch program increased students perceptions that their teacher wanted them to eat a variety of foods, whereas no such effect was found in our study. The difference in outcome is not fully understood. Teachers are important role models for students, and this would have been the case in both the Dutch and the Australian situation. It would be useful to understand whether the teachers were displaying the desired social modelling role to a lesser degree, or whether students did not perceive their behaviour in this way. Knowledge on food preference development amongst adults is generally low; for example parents often stop offering foods that their children dislike after a few times (Carruth, Ziegler, Gordon, & Barr, 2004), and may not be aware that repeated exposure over much longer times is often needed to change acceptance. Teacher development training may help to provide teachers with a stronger understanding of the principles of food preference development, and better prepare them to teach the program.

The low response rate in year 2, combined with teacher feedback on this survey, indicated that this questionnaire was too long for students. The low number of participants from this stage meant that this group was not well represented in the overall survey. For further research, it would be recommended to develop a shorter questionnaire for this age group, and the results of the current study can be used to develop such a questionnaire. It would also be preferable to

develop an instrument that can be used to measure the effect of the vegetable education resource amongst younger students. Due to their limited reading, writing, comprehension and attention skills a written questionnaire was deemed unsuitable for the first two year levels (5-7 year olds), and therefore they were not included in the validation study. Other approaches, such as experimental research, may well be more suitable for these younger students.

This validation study demonstrated that the vegetable education resource is effective in achieving behavioural change amongst students. The resource was a sensory education program tailored around vegetables, and the behavioural factors most closely associated with actual consumption, such as willingness to try, were vegetable specific. Research was undertaken in two schools in different socio-economic areas, and with students from various cultural backgrounds. Thus, there is some generalisability of findings. However, the number of schools was quite limited, and both schools were in metropolitan Sydney. It would be recommended to test the effectiveness of the vegetable education resource amongst a wider range of schools in different states across Australia.

The validation study in a nutshell

- Two intervention schools and two control schools took part in the validation study
- Two areas were selected in Sydney-metropolitan area that differed in their socio-economic status: relatively low (Merrylands) and medium (Ryde) status.
- One intervention school in each area implemented the vegetable education program, whereas a control school in the same area followed their regular curriculum.
- Data from 4 schools' students were collected via online questionnaires before and after the VER 2.0 intervention (and at similar time intervals at the control schools).
- Originally, we aimed for 466 students completing both pre- and post-test. More than 650 students participated either in the pre-test or in the post-test; however, a total of 320 students completed both the pre-test and the post-test. Data from these 320 students were used for statistical analysis of the outcomes.
- Overall, the vegetable education program increased students' knowledge of vegetables and the senses, their ability to verbalise their sensations when tasting foods, and their willingness to try vegetables when offered to them. The vegetable education program also tended to increase acceptance for vegetables and intentions to eat more vegetables and a larger variety of foods, although these results approached significance only.

5 Teacher feedback and survey

5.1 Methodology

Qualitative and quantitative data from teachers were collected from the schools that implemented the vegetable education resource.

Quantitative data was collected by survey from teachers that used the VER 2.0 vegetable education resource in their class. Teachers responded to the degree of agreement with 12 statements that covered general aspects of the program, as well as an overall score out of 10 for the program. The questionnaire is provided in Appendix B.

Qualitative data was collected in several ways:

- As part of the survey, written feedback was collected for each lesson on the appropriateness of the activities for the age group, the duration of the lesson and whether this was a reasonable time, as well as capturing any other comments/suggestions for the lesson.
- Teachers were also asked for suggestions on how to promote this program to other schools and for specific training suggestions for if a Professional Learning module would be developed for the program
- Semi-structured interviews were undertaken with 7 teachers, one from each year level, which were selected by the school. Interviews focused around student participation and enjoyment, changes amongst students observed, implementation and logistics of the program in their classrooms, structure, set up and duration of the program, and feedback on specific activities and the written resource materials.
- Informal feedback was also gathered from other staff involved in the implementation and logistics of the program, e.g. principal, deputy principal etc.
- Several lessons were observed by team staff whilst they were being taught at the school. Personal observation as well as informal discussion with the teacher enhanced understanding of the implementation of the program

There was some overlap in these methods, in part due to different implementation of the feedback in different schools. In one school interviews were primarily held for qualitative data gathering, whereas teachers at the second school responded primarily to the written survey part of the specific lessons.

5.2 Results

5.2.1 Logistical implementation of the program

In both schools all teachers took part in the vegetable education program. Although the schools were given the same advice regarding implementation of the program in terms of logistics of buying and preparing the materials, they each followed a slightly different approach.

The school in the Merrylands area appointed one person who was responsible for sourcing and buying all materials needed for all classes. Every class taught the lesson on the same day. A bag with all materials for each class was put in the staff room in the morning, which the teacher collected. Each teacher was responsible for preparing the vegetables themselves, which was done either in the staff room or in the class room. This school chose this approach as they were a large school with only a small refrigeration capacity (fridges are intended for teachers use, not in relation to educational activities) and as a consequence could not refrigerate fresh vegetables for all classes simultaneously. They also wished to trial the preparation without outside support from parents, to know whether this would be achievable from a school perspective.

The school in the Ryde area organised the logistics per Stage. In every stage either one teacher was responsible for all the lessons, or they rotated this responsibility amongst the teachers for the different lessons. Preparation was done as a collective, and the school had sought some parent support for this part. In practice this meant that perishable items (like the cut vegetables) were available for the teacher in the fridge in labelled bags with the materials required for the lesson.

Teachers could generally source all materials required for the lessons. One school bought herbs seeds rather than micro-herb seeds in the stage 2 lesson. Although students enjoyed the process of watching them grow, the plants had not grown enough to be consumed as part of their salad in the last lesson as intended.

Blenders were used for the juicing lesson, as juicers were deemed too difficult to source. In one of the schools this lesson was not done for all classes of the stage, as they lacked the time. Teachers reported some difficulty in sourcing the equipment, and only one blender was available for the lesson. The issue of insurance was also raised, in case the (borrowed) equipment would be damaged.

5.2.2 Quantitative survey results

Quantitative feedback on key aspects of the vegetable education resource was obtained from teachers that had taught this program in their class (Figure 6). Overall both schools were positive in their evaluation of the resource, and were similar in their response. An exception was the response to the preparation required. Both schools evaluated this aspect rather negatively, indicating that the amount of preparation required was too high. One school was less negative about this part than the other school, which reflected on the overall evaluation.

Teachers found that the program was engaging for the students, and it encouraged students to participate. They also felt that the program related well to the Australian curriculum, and was educational. These aspects will be very important for uptake, as it means teachers feel they can

achieve curriculum outcomes when teaching the program. The information as well as support materials provided were found to be useful.

Teachers also thought that the program encouraged students to learn more about and enjoy vegetables, and was likely to have a lasting impact on the students.

Teachers did not agree with the statement that the amount of preparation was reasonable. They felt that the preparation was too onerous. There was a slight difference between the two schools, where the Ryde school was slightly less negative than the Merrylands school on preparation. The Ryde school organised the logistics per Stage and with some input from parents (which is what we recommended), whereas the Merrylands school organised the logistics as a whole with teachers being responsible for all the preparation. It was clear from the results that more onus on the teachers negatively affected their evaluation of the preparation.

The difference in evaluation of preparation also affected their evaluation about using the program again, and about recommending it to other teachers. Whereas both these aspects were evaluated overall quite favourably (between neutral and slightly agree), it seemed that the amount of preparation was impacting on their evaluation to re-use and recommend, and as a consequence the school that had help with preparation was more agreeable to re-use and recommend than the school where teachers had to conduct all preparations themselves.

Teachers were also asked to give an overall rating out of 10 for the program, and it was rated 6.9 by the school that had no help in preparation, and 8.0 by the school that had some parent input.

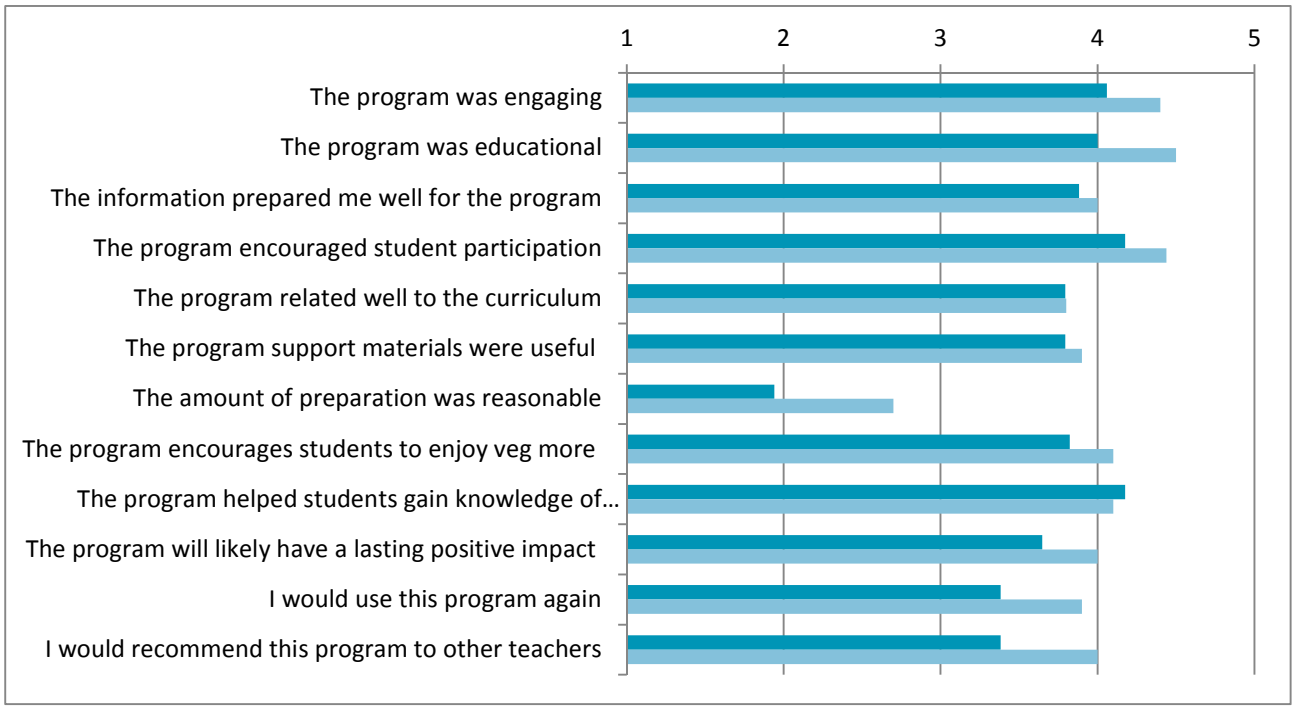

Figure 6 Quantitative feedback on the vegetable education resource from teachers from two intervention schools (dark blue = Merrylands, n=17; light blue = Ryde, n=11); 1= complete disagree, 5=completely agree

5.2.3 Qualitative feedback from interviews / survey

The qualitative feedback from interviews with teachers and the open ended questions from the survey supported and enhanced the understandings and data from the quantitative survey.

Interviews with teachers showed that overall, they felt that the students enjoyed this program. They liked in particular the hands-on aspects and the tastings. This was also reflected in the answers to the open survey questions about which aspects of the program were most appreciated (Table 9).

Teachers also noticed changes in student's behaviour, in terms of vegetable acceptance/ enjoyment, and willingness to try new foods. Especially in the youngest stage (children 5-7 years) teachers commented that they noticed changes in acceptance could occur very readily. Even the knowledge on how readily acceptance changed was useful, and teachers applied this knowledge outside of the vegetable education lessons also.

In stage 3 there was also a change in class mentality that was apparent to some teachers. Whereas the first lesson there was a tendency not to want to try new foods, and the most dominating students in the class tended to be very vocal about this. After they were taught how their preferences may change, and how preferences differ between individuals, the students were more open to trying the foods, and the collective attitude towards trying changed, and became more positive. Students were also more inclined to find out for themselves whether they liked foods or not, and not necessarily conform to a group norm.

Several teachers commented about a flow on effect on the behaviour of the children. Several children started bringing in vegetables during Crunch & Sip, which was something they had never done before. There were also several parents who had commented to teachers that their child behaved differently at home, making it easier to get them to try new foods and vegetables.

Overall the structure of the lesson material was well received. The use of specific support material to use in the class was deemed very useful, as it helped focus the lesson and made it run more smoothly. This material was provided in Power Point format. In one of the schools one stage translated the provided resource to their educational software and then added content, to allow more flexibility.

STAGE	TEACHER RESPONSE
Early Stage 1 / Stage 1	
	Getting the kids to try different things
	Engaging, content, organised well, kids were trying new things
	That it was all organised
	Opportunities to taste test vegies in a great environment
	The students were very engaged and most tried everything that was offered
	Encouraged students to eat healthy
	Clear resources - other than veg prep all ready for you
	It was engaging for students and the fact that students actually got to eat the vegetables
	The tasting of veggies that the students had never tried before
	Hands-on, eating and tasting
	The structure of the lessons
	It was engaging for students
	Variety of lessons which included different vegies
	Students trying different foods

Watching students experiment and enjoy vegetables that they hadn't tasted before and in the end bringing then in from home to eat
Stage 2
Hands-on; students enjoyed it
How it related to the Curriculum
Tasting different vegetables
The activities were overall engaging
Insights to students eating habits and encouraging them to be a part of it
Being able to discuss how students use different vegetables in their meals and culture. The powerpoint was very useful.
Do not think lessons or money should be spent on providing veg to children. Need money to be spent on scientists engaging students in science
Stage 3
The experiments
Hands-on learning and participation was fostered as students were encouraged to use their senses.
Hands-on
The hands-on activities were enjoyed by the students
Having students try new vegetables and encouraging them to have an open mind and not base their opinion on their initial perception
Students enjoyed the lessons - great content
Quick experiments

Table 9 Teacher comments to the question: "What were the best features of the program?"

The preparation was found overall quite challenging, as can also be seen from Table 10. In addition, the program was found quite dense in terms of activities per lesson.

STAGE	TEACHER RESPONSE
Early Stage 1 / Stage 1	
	Shopping; ingredients delivered
	No paperwork for children - too complicated
	Knowing how much to buy was difficult to gauge
	Worksheets were too complicated for most of Kindy
	Prep time was too much. Maybe pre-prepared materials
	Maybe too much choice in veg
	The organisational aspect, gathering all resources
	The preparation was too long
	Lots of prep, we were very lucky to have parents to cut up all of the veg. Lessons were too long
	The PPT needed more detail and information so we developed our own
	The amount of prep
	Preparation time involved
	The program

Stage 2
Less preparation time
Time it took to prepare lessons. Lessons need to be further broken up (all lessons could not be completed within the set timeframe)
Preptime, lesson content
Time was needed to effectively cover a lesson
The amount of prep
Not enough time to complete a quality lesson where everyone can contribute to the discussion
Bring back science lessons which are no longer funded
Stage 3
The preparation was too difficult on a school level
Providing optional activities for students who weren't able to eat the veg/fruit
Preparation. The amount of choices
Shorter preparation time if possible
Some lessons took longer than expected. Perhaps could have less content/activities per lesson
Preparation time was quite demanding and took much time
Content - I would get unusual veg and trial them. Make vegie people or characters. Design advertising program to sell product. Do as e-trailer on movie

Table 10 Teacher comments to the question: "What features could have been improved?"

STAGE	TEACHER RESPONSE
Early Stage 1 / Stage 1	
	Just have a few representatives from different schools. Get together. Teach them and then get them to report back to their schools
	Testimonials from kids
	Through Professional Learning
Stage 2	
	Scaffolded learning unit
	Make it simple, reduce lesson content, and make explicit links to the syllabus
	PDHPE - Healthy eating and lifestyle. Flyers, banners, emails
	Doing professional learning at schools
	Teaching children to eat and appreciate veg is the role of parents not teachers
Stage 3	
	Through Teacher Professional Learning (TPL) sessions, introducing ideas to schools
	Preparation of resources

Table 11 Teacher comments to the question: "Do you have suggestions how we could promote this program to other schools?"

Several teachers provided suggestions on how to promote this program to other schools. Different suggestions were provided (Table 11), a common suggestion was the use of Teacher Professional Learning.

5.2.4 Costs of the program

The costs of running the program mounted to $1.50 to $1.90 per student for the five lessons. A large proportion of these costs were related to the food items, mostly vegetables, and relatively little to the consumables (cups, plates, cotton buds etc). A small amount was spent on equipment that could be re-used (e.g. water jugs). These costs were similar in the school that previously piloted the vegetable education resource.

5.3 Discussion

The teacher survey and feedback confirmed the value of the vegetable education resource in a school context. Teachers reported behavioural effects they observed in the students, and these were very similar to the effects found in the scientific validation study on the effect of the program on student outcomes. Some flow-on behavioural effects on consumption and actual vegetable behaviour were also reported by the teachers. These behaviours were not included in the validation study, as we thought they fell outside the scope of what could be expected from the program. It is interesting to note this anecdotal evidence however, which seems to have been facilitated by active communication from the school to the parents about the vegetable education program the school was undertaking. It would be useful to incorporate suggestions to inform parents in the Implementation Manual, and to consider effects on the students in terms of actual behaviour (such as around Crunch & Sip time) or parental perceptions in future research.

Teacher feedback indicated that generally the resource aligned to the curriculum, and fitted with teachers needs in terms of materials. However, it was also clear that there were some challenges in terms of preparation and content-density to overcome. The next chapter provides some short and long term options to reduce the preparation burden. It would be recommended to optimise the current resource on the basis of the teacher feedback before further evaluation in other schools.

Teacher feedback in a nutshell

+ Program enjoyed by students
+ Hands-on allows deep learning
+ Well aligned to the Curriculum
+ Creates new experiences for students, builds their vocabulary

- Too much preparation required
- Lessons content too dense

+ Preparing and eating foods together is worth the fuss
+ Activities suitable for the year level
+ Lesson material prepares the teacher well
+ Supporting resource to use in-class very good

6 Development of an implementation strategy

6.1 Form of the resource

The current resource is available in written form. It was developed as a stand-alone resource that contains all the information schools and teachers need to start using the vegetable education resource. Teachers deliver the program themselves to their students. It consists of:

- An overall Manual for Implementation
- One Manual and one In-class support slide set (Powerpoint) for each Stage (Early Stage 1/Stage 1, Stage 2 and Stage 3).

Teacher feedback has confirmed that this form is desirable. However rather than the current Power Point slide set, it was recommended to provide in-class support material as a slide set using specific software for educational purposes (such as One Note or Notebook). This software is designed for interactive white boards, and allows more interactivity for teachers and students.

In its current form, materials can be distributed electronically, and teachers can print the materials as necessary.

6.2 Program delivered by the teacher or trained educators?

Although the resource has currently been set up as a resource for teachers, this does not mean it cannot be used in a different form.

A resource applied by the teacher obviously has a great benefit in that the costs are low, as teacher time is already accounted, and it can be implemented in every school, regardless of location. The program therefore may further benefit from ‘a train the teacher program’.

6.2.1 Train the teacher

The vegetable education program is unique in that its ultimate goal is to change behaviour in children, but the pathway to achieve this goal needs to be through alignment to the Curriculum objectives. Thus, the teachers’ ability to understand, embrace and behave in accordance with the behavioural aims of the program is paramount to the success of the program. For example, if a teacher does not like vegetables themselves, and is not fully aware of how their explicit and implicit behaviour impacts on their students, they may unconsciously undermine the goals of the program. Teachers should also be aware that explicit reference to health should also be avoided as it may have a negative impact.

Currently information on the theoretical background of the program, including information on the development of food preferences, is included in the Overall Manual for schools and teachers. This

is likely however to be limiting in its ability to train the teacher effectively. Personal, face-to-face training has the potential to deliver this information in a much more interactive and effective way, thereby increasing successful implementation of the program. Similarly, successful practical and organisational implementation of the program in schools is critical to its uptake and continued use, which could be strengthened by face-to-face training.

A 1hr training session was given by key project team members for the pilot trial, which covered both these aspects of implementation, and teacher feedback showed that this was very useful.

Teacher Professional Development provides an opportunity to prepare teachers to teach the Vegetable Education Resource in the most effective way. Teachers are required to undertake professional learning activities each year, and therefore such training would not require additional effort from the teacher.

It would not be necessary for every teacher in a school to take part in this face-to-face training. The school could select one or several (one for each Stage) teachers who would follow the training, and they would then act as champions for the program further distributing this information to other teachers in the school.

In addition, face-to-face contact with teachers also creates an opportunity to provide them with physical items, for example a start up kit with some consumables. This is the approach used by the Taste Lesson program in the Netherlands, which has been found to encourage attendance.

6.2.2 Specialised educators

Another option is that the program can be delivered by specialised educators. This has an advantage in that the trained educators can receive a higher level of training on the objectives of the program, and therefore may be able to embrace behavioural change objectives better than training of teachers would allow. Another advantage is that the trained educators could bring all the required equipment and materials, which would make it easier for the teacher. In addition, these so called ‘incursions’ are highly enjoyable for students, and feedback from the CSIRO Education programs where CSIRO educators have taught children about science in their classroom indicated that it was inspiring for the students to see another young person in-class, and learn from them.

There is unlikely to be benefit to videoconference delivery of the program by trained educators, due to the hands-on nature of the lessons, as well as the value of face-to-face learning.

The key disadvantage of trained educators will be the cost. Face-to-face visits will mean that there are ongoing costs, and it is very unlikely that a business model could be developed in which these lessons can be provided to schools at no or very low cost in the long term. This means that incursion costs would most likely have to be covered by parents of students, which may limit the programs uptake, in particular in lower socio-economic areas.

However, mixed models could be envisaged, whereby the teachers teach the majority of the lessons, however there is an option to outsource one or several of the lessons, and students pay an incursion fee for this lesson. This may be useful in particular for lessons that require specialised equipment and which are very hands-on (e.g. a juicing lesson in Stage 3, or a micro-wave lesson in Stage 2).

There are several options for such trained educators. One option includes partnering with existing organisations. For example, Life Education (www.lifeeducation.org.au) is an organisation that implements education in schools focused around safe and healthy life styles, using their Healthy Harold program.

6.3 Distribution - initial access to the resource

The form of the resource allows free distribution, which would promote its uptake.

There are several main options that could be considered for making the resource available:

1. Via Scootle
2. Via a separate website
3. Ausveg promotion to growers.
4. Combination of the above

6.3.1 Access via Scootle

Scootle (www.scootle.edu.au) is a website for Australian teachers. It includes over 20,000 quality-assured digital learning resources aligned to the Australian Curriculum. Scootle is supported by the Australian Government Department of Education. It includes learning resources from the National Digital Learning Resources Network, managed by Education Services Australia on behalf of all Education Ministers. Most of the resources available are short, e.g. worksheets, video's, reading texts etc.., although it does also include Units of work.

As all teachers can get access to Scootle, this distribution method would make the resource instantly available to all teachers. However, without supporting promotion the resource is likely to be lost amongst the wealth of material available to teachers. For example, a search on the keyword "vegetable" returns 221 hits for primary schools only; similarly the word "senses" returns 231 hits for primary schools.

Another disadvantage of the use of Scootle is that it does not allow tracking of who downloaded the material. This means that an important metric for the success and impact of the vegetable education resource is not utilised.

Scootle also offer a Publisher Gateway, which is an avenue for publishers to share information about their resources with educators currently subscribed to Scootle. Each record features a link that directs users to the publisher website in order to purchase teaching resources.

6.3.2 Access via a separate website

The use of a separate website to make the resources available has a key advantage in that it can collect details of those who download the materials. As such it will provide parameters towards uptake of materials, although the registration itself does not provide the guarantee that the material will actually be used, or if it is intended to be used in only one class, or several classes in

the school. It will also create a database of schools specific to the vegetable education resource, which can be used for further activities.

A website can have many forms. In its simplest form, it can be a dedicated page on an existing website, e.g. the website of CSIRO, AUSVEG or HIA. In its most extensive form, it can have a dedicated website with lots of add-ons.

CSIRO has different webportals for some of its community and educational programs.

For examples, the CSIRO Health & Wellbeing Diet has been made available online recently through partnership. Participants can sign up online and complying with the program, posting selfies before and after the 12 week program entitles participants to a refund of the $149 they initially pay.

CSIRO Education has a dedicated website, including pages for teachers and children, and science kits can be purchased online.

As mentioned, one key advantage of making resources available via a website, is the ability to collect information about the schools that want to use the material.

Other advantages of hosting the resource via a webpage are:

- Can easily be updated
- Can create a platform to provide feedback for teachers who have worked with the resource
- Can be used as a referencing platform or portal related to sourcing of materials for the vegetable education program, or extension/enrichment activities
- Can provide new content to maintain interest and ensure return visits to the website
- Interested stakeholders (such as partners in the Vegetable Industry Advisory Committee that will be built as part of project VG15005) can include a link to the website in their own communications

6.3.3 Industry promotion

Active promotion by Ausveg to their members through a link to the program may be useful. Many growers are likely to be parents too and could act as ambassadors for the program to their own children's schools through talks about their industry. Potentially such an activity could be linked to the Industry Development strategy.

6.3.4 Combination of the above

The last option combines the use of a website with Scootle. Scootle could then be used as a referencing point for teachers, to maximise exposure. Essentially this means that Scootle would be used as one of the advertising/promotion channels for the resource. Similarly, industry promotion should be seen as an additional means of promotion.

6.4 Breaking down the barriers of logistics / preparation

The current logistics / preparation was found to be challenging for the schools, which could impact on the programs uptake in schools. There are several ways in which this aspect could be made easier for schools.

- **Reduce the amount of material needed.**
    - More detailed information on quantities needed can be provided. Shopping lists currently specify how much is needed per class or child. Information is provided per unit (e.g. 1 slice or ham, 1 broccoli floret) however teacher feedback showed that if information was provided in grams this would reduce wastage as sourcing would be more accurate.
    - For the juicing lesson in Stage 3 quantities could be based on a blender, rather than a juicer. Juicing has been found logistically too difficult, due to vegetable pulp waste, cleaning, and time required to make the juice. Basing the quantities on blenders means about the third of the vegetable is required. This lesson was by far the most expensive, and will lead to significant cost reduction as well as less time required in sourcing and preparing (washing/cutting) vegetables.
    - Reduce options in several lessons. There are several lessons, in particular lesson 5, where a sandwich, salad and juice are created, where students are provided with multiple options. Teachers indicated that they found it difficult to guess which options would be most popular with the students, ultimately leading to wastage. Providing slightly fewer options (e.g. 5-6 options for vegetables rather than 10) would allow for more accurate sourcing, leading to less waste and less time to prepare
- **Providing schools more time to prepare**
    - In the current pilot test, schools had relatively little time to organise the logistics of the program involvement, as timings were not certain until quite late due to the need for ethics clearance from the Department of Education. With more time in advance, schools could better organise the logistical part of the program. For example, there would be more time to organise parental involvement in the program, and certain non-perishable consumables could be bought in advance. Once the resource moves away from a research project, no ethical approval will be required, which will mean planning will be easier. Schools can therefore plan at the start of the year in which Term to schedule the lessons, and prepare accordingly. They can also stagger the lessons for different stages, if storage (fridge) space is limited.
- **Reinforcing best practice for implementation**
    - Teacher feedback indicated that the school that involved parents, and followed a stage-by-stage coordination was slightly more positive about the logistics and preparation than the school that followed a whole-of-school approach without parental involvement. Strongly promoting the first approach, in the materials as well as teacher training, is recommended

- **Facilitating the procurement**
  - Ultimately the success of the program is dependent on tastings of vegetables and other foods. Therefore, the barrier can never be completely overcome. Online procurement and delivery of materials to the schools is probably the least time consuming, however this may be associated with higher costs. There are different options for different items:
    - Vegetables and other perishable foods need to be ordered/delivered only a short time in advance. Several retailers have online ordering systems, whereas green grocers often take phone orders. Long term, a strategic collaboration with a retailer, wholesaler or producer may be sought for this program, and the options to reduce costs (through sponsoring) may be discussed. It would be ideal if vegetables could be made available in a cut form, so that no preparation at school is required.
    - Making a Physical Kit available. Primary Connections has units across the entire Science Curriculum, and has developed complete initial Kits. The Kit consists of a large box, in which all materials can be kept, as well as the materials for the lessons. One of the Units even contains seeds and soil. Units (i.e. the actual lesson material) can also be purchased as a hard-copy through this website. These Kits can be ordered via Abacus Educational Suppliers (www.abacused.com.au), which is a provider of education materials. Consumables can also be re-ordered via this website. Making these materials available via a website portal would mean that schools do not have to find the stores, or think about the quantities / specifics to buy. Abacus is a general provider, and not specific to Primary Connections, hence they could be considered for development and distribution of a physical kit for the Vegetable Education Resource. Similarly, CSIRO Education has a website in which Science Kits can be purchased.
    - Initial items or Kits could also be provided (at cost or no cost) to teachers during a face-to-face teacher training. Against, opportunities for industry sponsoring could be explored.

6.5 Creating ongoing use of the resource – distribution and promotion

Our goal is not only to have teachers starting to use the vegetable education resource, but also to continue to use this program in their schools in future. Developing a good product that meets the teacher's needs obviously is a critical element, as well as making that resource available. However, this is unlikely to be sufficient to maintain interest in the long term. There are many educational resources available to teachers, and many new resources are brought to teachers' attention constantly. Therefore, ensuring continued support and interest in the resource will be important to ensure 'repeat usage' by the teachers.

This long term strategy would benefit further from having a website portal specific to the vegetable education resource. For example the database of participating schools obtained through the web portal could be used as a basis for a Customer Relation Management database. It can also

be used as a distribution list for a newsletter. New content can be added, e.g. enrichment activities.

The distribution and promotion function would then be combined.

It would be desirable to create additional materials to support the vegetable education resource to extend its visibility amongst students and teachers. 'Promotional' materials for use in the classroom could include a poster with vegetables, their name, and their key sensory properties, or a poster with the five senses. Other examples could be small items for children to use in the classroom (pen, rubber).

It would also be highly recommended to track sustained use of the program as a measure of success and impact. This may be linked to renewed registration, or downloading of updated versions of the resource.

The program may also offer opportunities for research on a large scale and /or longitudinal data collection on children's vegetable related behaviours. For example, teachers could be provided with some incentive, or could be provided with materials for free, if they agree to provide some data to the funding organisation.

Long term, models that include grower involvement in the program would be desirable. This could consist of grower video's, for example growers talk about their crops and what they do to ensure the best tasting quality, or talk about the different tastes of the crops they grow. 'Talk to the grower' could provide a platform for interviewing a grower via videoconferencing. In addition to the objectives of the vegetable education program, these activities can contribute towards another objective of the vegetable industry, i.e. creating positive awareness of the vegetable industry, and interesting students in career opportunities in the horticultural industry as succession planning.

6.6 Developing a business model for the future

Any technical implementation needs to take costs constraints into consideration. As the previous sections have shown, there are many different ways the educational resource can be distributed and further supported, which mostly will require on-going costs.

Therefore the development of a financial implementation plan, and business model, should be a key focus in the next phase for large scale roll out across Australia.

There are different organisations with shared interests and objectives. These include the government, in particular state and federal health departments, but perhaps also educational departments, as well as vegetable industry supply chain partners, such as seed manufacturers and retailers. A public-private partnership seems one of the most viable options to create a long term strategy to grow and continue supporting a network of schools across the country. The Vegetable Industry Strategic Alliance (VG15005) could provide one platform for promotion.

6.7 Discussion

There are many options to optimise, grow and extend the vegetable education resource. Ultimately, a nationwide uptake in schools is our aspiration, and will require a staged approach to be successful in achieving this goal.

The number of schools can gradually be expanded, and the success of the vegetable education resource in meeting student outcomes and teachers needs can be investigated scientifically.

In the short term, the following would be recommended:

- Optimise the resource on the basis of the teacher survey and the validation study
- Develop a Professional Learning Module for teachers
- Test the vegetable education resource on student and teacher outcomes, and determine the additional value of the Professional Learning Module

Simultaneously, a platform for distribution of the resource can be built, and longer term collaborations can be initiated.

The Implementation Strategy Recommendations in a nutshell

- Continue in the form of a written resource as a unit of work for teachers to teach themselves
- Develop and evaluate a Professional Teacher Learning module
- Distribute the resource via a website
- Build a database of schools that use the vegetable resource
- Develop and implement a promotion strategy
- Use a staged approach to gradually expand the network of schools
- Determine and develop collaborative partnerships to grow and support uptake amongst schools
- Develop a Financial Business Model for national roll out

7 Outputs

The outputs that this project has provided are:

1. A feasibility report that describes the positive potential to develop a Vegetable Education Resource aligned to the National Curriculum
2. A scientific review describing existing overseas classroom-based educational initiatives that aim to increase children's vegetable consumption and/or promote healthy eating habits, including their effectiveness
3. A Vegetable Education Resource (VER2.0) that teachers can use in the classroom. The vegetable education resource is a written document for use by teachers, pilot tested in two primary schools in NSW. It consists of an Overall Implementation Manual for schools and teachers, as well as a Unit of work for each of the three stages (Early Stage 1/Stage 1, Stage 2 and Stage 3)
4. Data and insights from a Validation Study that demonstrates the effectiveness of the Vegetable Education Resource (VER2.0) in achieving behavioural change amongst students in factors associated with vegetable intake
5. Data and insights from teacher feedback from two NSW primary schools on the Vegetable Education resource (VER 2.0), and recommendations for further development
6. An implementation strategy outlining a recommended pathway to achieve adoption of the Vegetable Education Kit in the educational sector.
7. Recommendations for upscale and roll-out.

Communication outputs related to this project are:

1. An article about the start of this project in Vegenotes to inform growers, associated with the trade journal Vegetables Australia (issue 45, 2014).
2. A communication about this project for a trade journal to inform growers and stakeholders on the outcomes of this project
3. An abstract submitted to the scientific conference SenseAsia - the 2nd Asian Sensory and Consumer Research Symposium

   Poelman, A.A.M., Broch, M., Cox, D.N. and D. Vogrig (2016). Development of a school vegetable education program and its effect on factors associated with vegetable consumption in children.
4. It is anticipated that results will be further disseminated in peer-reviewed scientific journals and relevant conferences (outside the scope of the current project).

8 Outcomes

The outcomes so far indicated are limited to the schools where the Vegetable Education Resource has been taught. More far reaching outcomes for the Vegetable Industry is likely to be achieved once the Vegetable Education Resource can be rolled out to all schools across the country and perhaps adopted as part of the national curriculum. The validation study has demonstrated that children who have been taught with the Vegetable Education Resource had an increased awareness and acceptance for vegetables, and were more willing to consume them. This is expected to positively influence the child's vegetable consumption and therefore support increased demand for vegetables amongst parents who are responsible for purchase of vegetables.

There may also be long term benefits from the program on influencing children's food choices as adults. Research has shown that sensory preferences of children can be predictive of their preferences as adults, and therefore the future demand and eating of vegetables could go up if acceptance for vegetables as a child can be increased.

It has been recommended by the WHO and national guidelines that consumers should eat more vegetables, in order to obtain optimal health benefits. However, for most people these recommendations are not being achieved. The vegetable education resource could help promote an increase in demand for vegetables and an increase in consumption by consumers which in the long run will benefit the Australian population through improvement in associated health benefits (i.e. help in the prevention of cardiovascular diseases and certain cancers).

Education in the classroom about vegetables also indirectly increases children's awareness about the Vegetable Industry in general.

9 Evaluation, discussion and recommendations

This project has met its intended aims, and has been effective in developing a Vegetable Education Resource that leads to behavioural change amongst students and has been positively evaluated by teachers.

A scientific validation study amongst children has shown that the Vegetable Education resource led to a statistically significant increase in knowledge, ability to verbalise their sensations and an increased willingness to try vegetables amongst students, as well as showing trends to increase vegetable acceptance and intentions to eat more vegetables and a greater variety. These outcomes are known to be positively related to higher vegetable consumption.

Feedback from teachers has shown that the program was found to be valuable and engaging for students and teachers, and it was closely aligned to the Australian curriculum. The hands-on aspects of lessons in which children were exposed to the vegetables were found to be the most valuable, although these tended to be challenging to implement in a school context. Several options however have been identified in this report to reduce this barrier.

The results of this project warrant continued investment in the development and roll out of the Vegetable Education Resource to achieve outcomes on a larger scale, potentially on a national level. These outcomes include the increase in knowledge, awareness and enjoyment of vegetables by children, which are known to be positively related to vegetable consumption and will lead to higher vegetable demand amongst children and their families. As children's preferences and habits tend to track from childhood into adulthood, the program has the potential to set them up towards lifelong healthy eating habits, which will also benefit the Vegetable industry through more demand for vegetables in the long term.

The Vegetable Education Resource could also indirectly increase positive awareness by children of the Australian Vegetable Industry, and this aspect could potentially be further strengthened by involvement of growers in the program.

It is recommended to continue the development and roll out of the Vegetable Education Resource, to ultimately achieve national uptake of the resource in schools. Continued research into the effectiveness of the resource is needed to maximise the impact of the resource, and to validate its effectiveness amongst larger samples representative of Australian children nationwide. Therefore a recommendation is to undertake a further levy-funded research project, with continued co-investment by CSIRO (that meets the R&D requirements for co-investment), to develop an approach to grow the network of schools that implements the vegetable education resource.

A suggested follow-up project could contain the following activities:

- Develop and test a Professional Learning module for teachers to teach the Vegetable Education Resource more effectively
- Create a web-based platform for distribution of the Vegetable Education Resource
- Reduce preparation time required from teachers, and test its effectiveness

- Develop a VER 3.0 of the Vegetable Education Resource based on findings from the current research and further input from the teachers
- Establish a wider cohort of schools (in NSW and one other state) to further test the utilisation of the vegetable education resource program and assess the benefits
- Evaluate the effectiveness of the Vegetable Education Resource (VER 3.0) on behavioural change amongst students with and without the use of a Professional Learning module for teachers
- Develop and apply a scientific methodology to measure the effectiveness of the Vegetable Education Resource (VER3.0) on behavioural outcomes of younger students (5-7 year olds)
- Initiate stakeholder engagement and partnering options for large scale roll out in to schools
- Develop a financial business plan for national roll out of the program, e.g. through development of a public private partnership

10 Scientific Refereed Publications

None to report.

Scientific dissemination in refereed scientific journals is anticipated, but falls outside the scope of the current project.

11 Intellectual Property/Commercialisation

No IP and commercialisation costs were included in the current project. The Vegetable Education Resource is anticipated to be co-branded (HIA/AUSVEG) and CSIRO) and will be amenable to wider commercialisation. An appropriate commercialisation plan to maximise the uptake and benefits from the investment by both parties into its development will need to be developed, and it is proposed to include this activity as part of an overall strategy to roll out the Vegetable Education Resource.

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Appendix A Children's Survey Questionnaire (Yr 5-6)

Hi,
We would like you to complete some questions about food. We are interested to learn about you. Just complete the questions by yourself. Do not discuss with your classmates.

First, write your full name and your class

My name is (e.g. John Brown): _____

I am in class (e.g. 6P): _____

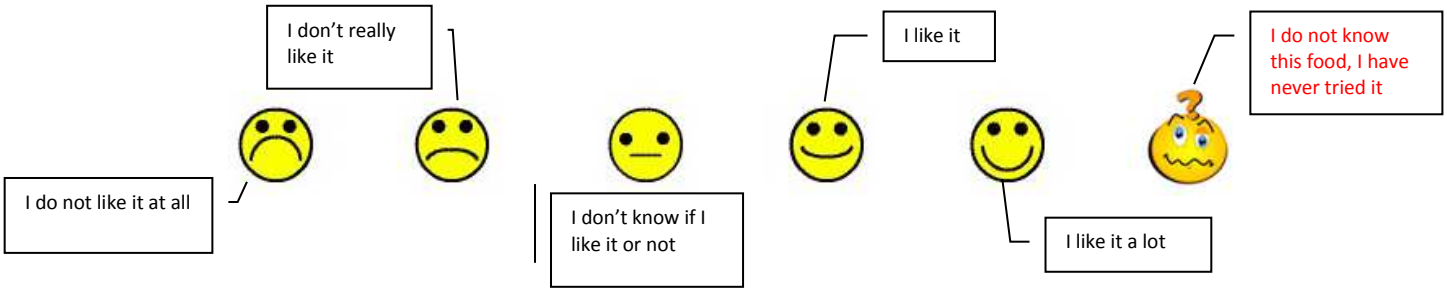
1. **How old are you?**
   - o 9 years
   - o 10 years
   - o 11 years
   - o 12 years
   - o 13 years
2. **Are you a**
   - o Boy
   - o Girl

3. How does it taste and feel in your mouth? Write as many describing words you can think of.

 Cherry tomato	
 Spinach	
 Chocolate biscuit	

4. How much do you like these foods?

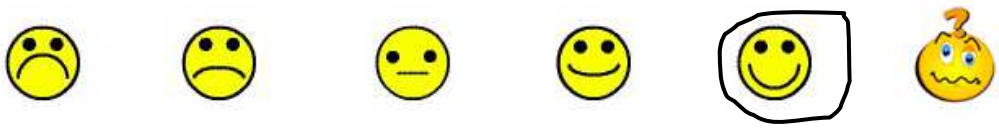
Circle the smiley that best shows how much you like it.
If you have never tried it, circle the last smiley.



First, look at some examples:

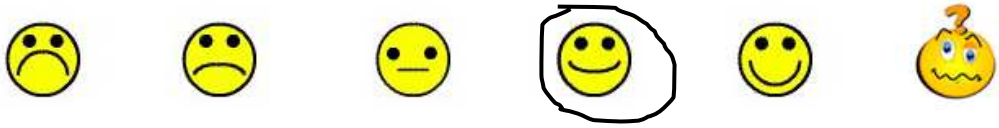
How much do you like swimming?

⇨ If you like swimming a lot, you would choose this face:



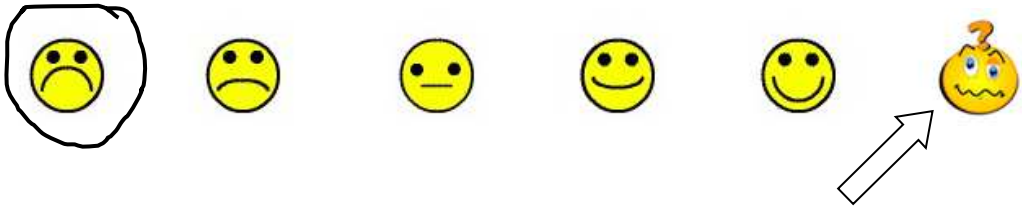
How much do you like tennis?

⇨ If you like tennis a bit, you would choose this face:



How much do you like 'washing the dishes'?

⇨ If you do not like '*washing the dishes*' at all, you would choose this face:



⇨ If you have never tried '*washing the dishes*', you would choose this face

Now it's your turn.

4.1 How much do you like 'carrot'?

Never tried

4.2 How much do you like 'capsicum'?

Never tried

4.3 How much do you like 'green beans'?

Never tried

4.4 How much do you like 'tomato'?

Never tried

4.5 How much do you like 'cauliflower'?

Never tried

4.6 How much do you like 'celery'?

Never tried

4.7 How much do you like 'spinach'?

Never tried

4.8 How much do you like 'broccoli'?

Never tried

4.9 How much do you like 'beetroot'?

Never tried

4.10 How much do you like 'peas'?

Never tried

5. Quiz

5.1 Write down the name of the vegetable on the picture.

 _____	 _____
 _____	 _____

5.2. Name the five senses: _____

5.3. Which of these four is a basic taste?

- ☐ Minty
- ☐ Salty
- ☐ Yummy
- ☐ Fruity

5.4. Cooking time can change the taste of a food True ☐ False ☐

5.5. Name all Asian vegetables you can think of _____

5.6. If you dislike a food, can you learn to like it? Yes ☐ No ☐

5.7. How does it taste? Select one word.

Hot chips 	Sweet Salty Sour Bitter
Plain yogurt 	Sweet Salty Sour Bitter
Pumpkin 	Sweet Salty Sour Bitter

6. How do you feel? Select one box per question.

6.1. *When you see a food for the first time you are afraid to taste it.*

Strongly disagree	Disagree	Agree	Strongly agree

6.2. *You like to taste new foods.*

Strongly disagree	Disagree	Agree	Strongly agree

6.3. *You are offered a new kind of fish with a good taste. Would you like to try it?*

Not at all	Not really willing	A bit	A lot

6.4. *Your parents are eating a new kind of fruit. Would you like to taste it?*

Not at all	Not really willing	A bit	A lot

6.5. *Your parents are eating this food*  *. Would you like to taste it?*

Not at all	Not really willing	A bit	A lot

6.6. *You are offered this food*  *for dinner. Would you like to taste it?*

Not at all	Not really willing	A bit	A lot

6.7. *Your best friend eats a new kind of vegetable. Do you want to taste it also?*

Not at all	Not really willing	A bit	A lot

6.8. *Someone suggests you to try this food*  *. Would you like to taste it?*

Not at all	Not really willing	A bit	A lot

6.9. *Your best friend eats this food* 

I will try it immediately	I hesitate and will then take a small bite	I will try only if I am forced to	I will refuse to taste it

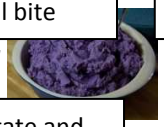
6.10. *This is a food you can eat with sauce.* 

I will try it immediately	I hesitate and will then take a small bite	I will try only if I am forced to	I will refuse to taste it

6.11. *Here's a new kind of food*  *tastes good.*

I will try it immediately	I hesitate and will then take a small bite	I will try only if I am forced to	I will refuse to taste it

6.12. *A* | I will try it immediately | I hesitate and will then take a small bite | I will try only if I am forced to | I will refuse to taste it | *t is*

6.13. *At a school party there is this food*  *for you to try.*

I will try it immediately	I hesitate and will then take a small bite	I will try only if I am forced to	I will refuse to taste it

7. Tick the box that matches how you feel about it

	Yes, definitely	Yes, probably	Maybe	No, not really	No, definitely not
7.1 It is a good idea to eat a variety of foods daily.					
7.2 It is a good to try foods I never tasted before.					
7.3 It is good to eat a variety of vegetables.					
7.4 It is good to try vegetables when they are offered to me.					

	Yes, definitely	Yes, probably	Maybe	No, not really	No, definitely not
7.5 My teacher would like me to eat a variety of foods daily.					
7.6 My teacher would like me to try foods I never tasted before.					
7.7 My teacher would like me to eat a variety of vegetables.					
7.8 My teacher would like me to try vegetables when they are offered to me.					

	Yes, definitely	Yes, probably	Maybe	No, not really	No, definitely not
7.9 My friends find it cool to eat a variety of foods daily.					
7.10 My friends find it cool when I try a food I have never tasted.					
7.11 My friends find it cool when I eat a variety of vegetables.					
7.12 My friends find it cool when I try a vegetable offered to me.					

8. Tick the box that matches how you feel about it

	Yes, definitely	Yes, probably	Maybe	No, not really	No, definitely not
8.1 I often find new foods fun					
8.2 I often enjoy eating new foods.					
8.3 I often find new foods boring					
8.4 I often find new foods yucky					
8.5 I often find vegetables fun					
8.6 I often enjoy vegetables.					
8.7 I often find vegetables boring					
8.8 I often find vegetables yucky					

9. Tick the box that matches how you feel about it

	Yes, definitely	Yes, probably	Maybe	No, not really	No, definitely not
9.1 I will eat a variety of foods.					
9.2 I will eat a variety of vegetables.					
9.3 I will try a new food when it is offered to me					
9.4 I will try a vegetable when it is offered to me					

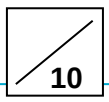
	Select one word for each of the boxes.	
	10. Have you ever tried it?	**11. Would you try if someone offered it to you?**
 Gai Lan	Yes / No	Yes / No
 Bok Choy	Yes / No	Yes / No
 Radicchio	Yes / No	Yes / No
 Broad beans	Yes / No	Yes / No

Appendix B Teacher's Survey Questionnaire

Please tick the box that matches how you feel about the program

	strongly agree	agree	neutral	disagree	strongly disagree
1. The program was engaging					
2. The program was educational					
3. The information provided prepared me well to teach the program					
4. The program encouraged student participation					
5. The program related well to the curriculum/learning unit					
6. The program support materials were useful					
7. The amount of preparation was reasonable					
8. The program is likely to encourage students to enjoy vegetables more					
9. The program helped students gain knowledge of vegetables					
10. The program is likely to have a lasting positive impact on the students					
11. I would use this program again					
12. I would recommend this program to other teachers					

13. Overall score for Program out of 10; 10 = excellent, 5 = average, 0 = unacceptable



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