



Growing capable kids: Exploring the nexus between the Australian Curriculum's general capabilities, global competencies, and one school garden program

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Abstract

Many countries include core competencies in their educational curricula. The purpose of competencies is to ensure a holistic education that equips students with skills to flourish in the twenty-first century. Across the literature on this topic, however, there are limited studies that investigate how primary schools embed competencies into their learning programs. A qualitative case study of one Australian primary school with an established environmentally friendly garden program revealed how gardening as part of the school program provided opportunities for the development of core competencies, in particular the general capabilities of the Australian Curriculum.

Keywords General capabilities · Key competencies · Twenty-first century competencies · Global competencies · School garden programs · Outdoor education

Introduction

Educators have long recognised that education is more than the study of subjects, yet historically, a holistic approach to the development of the student has not been a focus of curricula. In the early years of the twenty-first century, a new focus came to the global education scene as governments began to intentionally include a broader

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range of competencies into their educational curricula. The term competencies in this paper refers to the broad spectrum of twenty-first century skills adopted globally in education. In the Australian context, competencies are called general capabilities. Another area of change has been greater flexibility in learning spaces, including more opportunities to learn outdoors. The purpose of this study was to investigate an alternative outside learning space in the form of one school garden and to seek evidence of opportunities to encourage the development of the Australian general capabilities (AGCs).

School garden programs have been steadily increasing as a specialised area of outdoor and environmental education. The benefits of outdoor education, environmental education, and nature pedagogy are well documented in the areas of physical, social-emotional, and cognitive development of children (Barlow, 2015; Chawla, 2012; Cutter-Mackenzie, 2009; Knight, 2013), and advocates have been working to raise the profile of outdoor learning in the Australian National Curriculum (Gray & Martin, 2012).

This study brings together an understanding of the educational work of school gardens with the AGCs. The AGCs are a set of “knowledge, skills, behaviours, and dispositions that, together with curriculum content in each learning area and the cross-curriculum priorities, will assist students to live and work successfully in the twenty-first century” (Australian Curriculum, Assessment and Reporting Authority [ACARA], n.d.).

The main research question guiding this study was articulated as: “What opportunities for the development of general capabilities, if any, are evident in one school garden program?” This question focused the research in a timely way, combining an increasing interest in school gardens as places of learning with the current focus on holistic wellbeing which is supported by the AGCs.

The general capabilities of the Australian Curriculum

In a quest to give children life-skill advantages in a changing world “13 countries have defined education as being much more than equipping students with basic academic skills or technical skills for the world of work” (Care et al., 2017, p.1). This has led to the inclusion of competencies in school curricula. Although known by various names, for example, key competencies, twenty-first century skills/competencies, global competencies, soft skills, and general capabilities (Lucas & Smith, 2018), these skills are embedded in frameworks that integrate across the curriculum. Many of these competency frameworks are similar in structure and intent, with slight variations depending on the context. England, Finland, Japan, Scotland, Singapore, Australia, some provinces of Canada, and the USA are examples of countries that have a similar conceptual approach to competency frameworks (Ontario Ministry of Education, 2016, p. 9; Borowski 2019).

In keeping with global education trends, the Australian Curriculum moves beyond prescribed learning areas by embedding an additional critical dimension for twenty-first-century learners: the AGCs (ACARA, n.d.). The AGCs align with essential life

skills identified in the *Alice Springs (Mparntwe) Education Declaration* (Council of Australian Governments Education Council, 2019).

Australia has embedded seven general capabilities across its six learning areas (ACARA, n.d.). While these capabilities come with continuums and descriptors of practice, there is scant research-based evidence to suggest how general capabilities are integrated into educational programs (Lucas & Smith, 2018; Scoular, 2018). In this study, the researchers investigated one school's environmentally friendly garden program as a case study, motivated by the work of Lucas & Smith (2018), who stress the importance of creating “clear case studies to show how capabilities can be fostered through education” (p. 9.). A single school case study approach was chosen, based on the reported quality of the school's garden program and its proximity to Avondale University for ease of on-site data collection over an extended period of time. This facilitated the gathering of evidence for how the AGCs were integrated into an actual educational program.

The seven AGCs are Literacy, Numeracy, Information and communication technology (ICT) capability, Critical and creative thinking, Personal and social capability, Ethical understanding, and Intercultural understanding (ACARA, n.d.). These foundational capabilities undergird the learning areas and are intended to be taught both intentionally and incidentally across the curriculum so that students can apply them to their learning and their lives beyond school. Each AGC is divided into “organising elements” (ACARA, n.d.) that elaborate on each capability and guide the conceptual framework (Table 1). There is provision for each State to develop its own approach to how the AGCs are implemented.

Each AGC has a specific focus and purpose. The Literacy capability prepares students to engage with process and communicate information and relies on “the intrinsic and interdependent relationship between social context, meaning and language” (ACARA, 2012, p. 11). The Numeracy capability focuses on applying mathematical knowledge and skills across a variety of contexts, so students understand the “inter-connected nature of mathematical knowledge” (ACARA, 2012, p. 31), enabling broad application of mathematical skills. Zevenberg and Zevenberg (2009) found that people understand mathematics better when it is taught in context rather than in isolation, and this provides the rationale for the inclusion of Numeracy as an AGC. Not all countries adopt literacy and numeracy as competencies, instead viewing them as learning areas.

The ICT capability includes the effective and ethical use of ICT to “access, create and communicate information and ideas” (ACARA, 2012, p. 49). The ICT capability complements the capability, Critical and creative thinking, which challenges students to think deeply and broadly, using logic and imagination. The intent of these capabilities is to give students the confidence to become problem solvers, in school and beyond (ACARA, 2012).

The final three capabilities aim to develop ethical citizens who appreciate and embrace personal and cultural diversity. The Personal and social capability focuses on social and emotional learning, building on the work of researchers including Gardner (1983), Seligman (1998), and Goleman (2006) to empower students in building identity, self-worth, and healthy relationship skills (ACARA, 2012). Working collaboratively in mixed ability groups is identified by Lucas & Smith (2018) as one

Table 1 Organising elements of each AGC (compiled from ACARA, n.d.)

GENERAL CAPABILITY	ORGANISING ELEMENTS
Literacy	Comprehending texts through listening, reading and viewing Composing texts through speaking, writing and creating
Numeracy	Estimating and calculating with whole numbers Recognising and using patterns and relationships Using fractions, decimals, percentages, ratios and rates Using spatial reasoning Interpreting statistical information Using measurement
Information and communication technology capability	Applying social and ethical protocols and practices when using ICT Investigating with ICT Creating with ICT Communicating with ICT Managing and operating ICT
Critical and creative thinking	Inquiring – identifying, exploring and clarifying information and ideas Generating ideas, possibilities and actions Reflecting on thinking and processes Analysing, synthesising and evaluating reasoning and procedures
Personal and social capability	Self-awareness Self-management Social awareness Social management
Ethical understanding	Understanding ethical concepts and issues Reasoning in decision making and actions Exploring values, rights and responsibilities
Intercultural understanding	Recognising culture and developing respect Interacting and empathising with others Reflecting on intercultural experiences and taking responsibility

strategy for building interpersonal capabilities in children. Ethical understanding, in which students recognise the impact their values have on those around them is the sixth AGC. This capability equips students to manage the complexity of conflicting values, interests, and moralities found in society. The final AGC is Intercultural understanding, a capability that is both inward and outward-looking, focusing students' attention on their cultural mores as well as those of other cultures; understandings that are imperative in multicultural societies.

The literature reveals limited research about AGCs in the school context. Research by Skourdombis (2016) found that teachers' attitudes to the AGCs fell into three categories. The teachers interviewed in Skourdombis's study either perceived that the AGCs were nothing new, saw them as another policy requirement, or believed that

they contextualised and complemented their teaching. In the latter category, Batham (2012) found that classroom blogs were “an ideal conduit for embedding these general capabilities into curriculum and pedagogy across different learning areas” (p. 14). La Marca (2013) posits that school libraries play a positive role in developing general capabilities, and Thompson & Christian (2016) identified how a student-operated news program broadcast on a school website naturally embedded the AGCs in its processes. These studies suggest that teachers may find it easier to track AGCs in multi-disciplinary programs that connect learning across a range of curriculum areas.

Despite some gains in this area, there is still capacity for improvement. Lucas & Smith (2018) have proposed eight steps to strengthen capabilities through Australian education practices. One of these, the creation of clear case studies that demonstrate how capabilities may be encouraged through education, underpins the purpose of this study.

School gardens and general capabilities

While there is a paucity of literature that links the AGCs explicitly to school garden programs, many international studies positively connect aspects of competencies to children’s gardening activities. Passy (2014) found that “teaching and learning in the school garden can make a valuable contribution to children’s social, academic and emotional development” (p. 36), while Christensen & Wistoft (2019) describe the conditions under which this is most likely to happen. Other studies are more focused. For example, school garden programs offer a rich milieu for the development of literacy skills (Nuttall & Millington, 2013; Pascoe & Wyatt-Smith, 2013; Ramsden, 2015), including skills in comprehending and composing texts.

Numeracy is another competency that frequently appears in school garden literature. Research reports that students apply problem-solving skills to everyday situations such as water use (Clarkson, 2010), proportional reasoning (Hilton et al., 2013), elements of scale and area (Lyon & Bragg, 2011), financial and enterprise skills (Nelson et al., 2011), and statistical literacy (Selmer & Rye, 2014). Other research reports on the integration of a broad range of mathematical skills in school gardens with positive outcomes (Boynton, 2010; Civil & Khan, 2001; Ford & Ludes, 2018; Hazard et al., 2011; McCarty et al., 2018). Pigg, Waliczek, and Zajicek (2016) add a cautionary note, however, questioning the efficacy of garden programs in improving primary students’ achievement in mathematics, and posit that further research is needed in this area.

The ICT capability covers a broad range of knowledge and skills. The Stephanie Alexander Kitchen Garden program, an Australian education program described by Ramsden (2015), outlines the creation of recipe books through researching and designing, all well within the scope of the ICT capability, and related to other gardening programs in schools as well, beyond those directly linked to the Stephanie Alexander Kitchen Garden Foundation (n.d.). While there is an opportunity for the development of ICT skills within a school garden program, there is little explicit attention given to this area in the literature.

School gardens appear to provide a natural context for thinking skills (Colins et al., 2015; Williams & Brown, 2012). There is evidence to suggest that gardening experiences foster problem solving that requires higher-order thinking (Ausherman et al., 2014; Pigg et al., 2006). Selmer and Rye (2014) point out the importance of questions, both asked and answered, in developing critical thinking in school garden programs. Williams & Brown (2012) add that “learning from experience is contingent upon critical reflection after the completion of an activity” (p. 198).

Elements of the Personal and social capability feature generously in school garden literature (Williams & Brown, 2012). Research reports school gardens as promoting holistic wellbeing. Dyg & Wistoft (2018) investigated the role of gardens as a context for developing “interpersonal interactions with peers, garden educators, and teachers” (p. 1181). They found that working together in the school garden offered opportunities for cooperation, empathy, conflict resolution, self-esteem, and identity, all of which belong to the Personal and social capability. Townsend et al., (2012) adopt a similar perspective, positing that the volunteers required to maintain a vibrant school garden program also have the potential to broaden a student’s “social circle,” leading to “increased levels of confidence as a result of interacting with other adults” (p. 231). Furthermore, sensory experiences, group work, opportunities for taking responsibility, following a task to completion, and experiencing success all contribute to eliciting positive emotional responses and raise self-esteem and social cohesiveness (Cairns, 2017; Robinson & Zajicek, 2005).

The development of Ethical understanding is also briefly noted within the literature on school gardens. Moore et al., (2015) describe the concept of “playful labor” in school gardens (p. 409), which they assert helps to develop values and ethics, fostering the imagining of “alternative futures,” encouraging “different ways of being and doing” and creating relationships with non-human living things that may affect ethical stances and behaviours into the future (p. 413). Sprague (2016) offers school gardens as a means of enhancing social justice, an idea aligned with ethical understanding.

Closely connected to Ethical understanding is Intercultural understanding. Participation in a school garden may operate as an equaliser, where children from different backgrounds come together on an equal footing (Cairns, 2017; Sprague, 2016). Cutter-Mackenzie (2009) describes a multicultural food gardening program designed to build intercultural understanding as “a space for improved cultural awareness and sensitivity amongst students and teachers” (p. 133). School gardens are noted for improving social interactions within class groupings, and fostering cultural appreciation and inclusion (Block et al., 2015; Wistoft, 2013). Ralston (2011) also believes that school gardens can be a “normative force, whether as moral spaces, sources of social solidarity, intergenerational bridges or sites of political contestation” (p. 19).

Overall, the literature provides evidence that school gardens offer opportunities for developing specific competencies, although there is potential to investigate the nexus between school garden programs and AGCs by mapping the range of AGCs evident in one school garden program as a particular and concrete case. This gap in the literature was an important motivating factor for conducting this study.

Method

Data collection and analysis

The case study school in this investigation was a small Australian school in a semi-rural setting, chosen for the reported quality of its garden program and its proximity to Avondale University. At the time of this investigation, the school operated a garden program where students participated in mixed age rotating activities for 45 minutes each week. The climate allowed the garden program to operate all through the school year. The students grew watermelons, pumpkins, kale, cabbages, cauliflowers, potatoes, sweet potatoes, zucchinis, cucumbers, beans, tomatoes, lettuces, herbs, and other seasonal crops. The garden also had some blueberry bushes, citrus trees, and a small “bush tucker” garden which grew Indigenous food plants. At the time of data collection, the students were planning and clearing ground for an Asian garden.

While this garden program was originally designed to have an intentional mathematics focus, there was no deliberate attempt to teach syllabus content to specific grade levels. How the garden program enriched, applied and consolidated mathematical learning across multiple grade levels has been explored more fully in Williams et al., (2021).

The study used a qualitative approach to capture the experiences and perceptions of the participants (Yin, 2014). Four distinct cohorts were involved in the collection of data. These were (1) students ranging from Pre-Kindergarten (~ four years old) to Year 6 (~ 12 years old), (2) all teachers, (3) all volunteer helpers, and (4) parents who responded. One part-time teacher also volunteered on gardening days.

Each research instrument: interviews, focus groups, field notes, audio recordings, and journals, was chosen for a purpose. Interviews with teachers, and parent and student focus groups were used to establish the participants’ perceptions of the garden program and allow for emerging ideas (Charmaz, 2014). Focus group members were chosen by teachers based on each child’s ability to articulate clearly and their willingness to speak up in a group. The teacher interviews and student focus groups included recollections of the participants’ lived experiences of gardening activities that covered the whole school year. To enable triangulation of data, we also made field notes and audio recordings during the garden program sessions (Cowie & Hipkins, 2014).

The collection of on-site data occurred during nine consecutive weeks in the final term of the school year. During the period when data was being collected, the 45 min rotations covered garden design where new gardens were planned and prepared; maintenance which included weeding, mulching and watering; chicken husbandry including the hatching, raising and care of chickens; a market shop where students tallied orders from parents and friends, harvested produce, calculated change and prepared orders for after-school pickup; and finally, and a kitchen activity where students followed a recipe using fresh ingredients picked from the garden.

Two complete rotations were covered during the data collection period. Each group was led by a teacher or volunteer who coordinated the tasks for the session. The garden shop and kitchen each had two facilitating adults. The organisational structure meant that students were engaged in a different activity each week. The rotating groups were comprised of students of different ages and abilities and were

Table 2 Research instruments used for data collection

Instrument Cohort	Observations/ Conversations	Focus groups	Interviews	Garden journal
Students	36	24 students		39 entries
Teachers	4		4 teachers	39 entries
Parents		5 parents		
Volunteers	5	5 volunteers		39 entries

fixed for the duration of the school term. Observations of a school garden open day were included in the data. The open day was held over one morning and showcased the school garden program to parents, friends and the community. On this day, students gave oral presentations, operated activity stations, made green smoothies for visitors to sample, and sold produce.

In addition to the abovementioned instruments, a garden journal was used as a source of data. The garden journal entries used as data spanned the entire school year and were compiled jointly by students, teachers, and volunteers (Lichtman, 2013). Each week, the groups recorded their actions and learning. This information was compiled onto a large flip style journal containing photographs and other visual and written text. The types of information recorded included graphs of weekly rainfall, tallies of orders for vegetables, total produce sales for the week, estimations, most popular vegetables, possible arrays for planting seedlings, equivalent fractions and doubling recipes. The purpose of this journal was to share learning across the groups and to keep a record of garden activities that could be referred to in future garden sessions. One large sheet of paper hung under the garden shelter for easy access, and a second one hung in the school's kitchen. The information recorded was combined into one journal. As all groups were comprised of children of all ages, the data taken from the garden journal could not be identified as belonging to any one grade. The journal contained a weekly record of learning and provided data that was analysed the same way as the field observations and data from the interviews and focus groups.

Table 2 summarises the research instruments used to collect data from each of the cohorts. As children were participants, this investigation complied with rigorous ethical requirements for research conducted by Avondale University.

Following data collection, audio files were transcribed, and all data were analysed using a matrix (Groenland, 2014). The matrix was constructed using the AGCs as pre-determined themes with allowance for including additional themes that emerged from the data. Deductive line by line analysis was used. The first level of analysis identified which AGCs and global competencies were evident in the garden program and in which activities they were embedded. The second level of matrix analysis identified the extent to which the AGCs were evident in the garden program by further mapping the themed data to the organising elements within each AGC. This resulted in tables that indicated the AGCs and their organising elements that were evident in the garden program.

Table 3 Literacy: organizing elements that were evident (ACARA, 2012, p.14)

GENERAL CAPABILITY	ORGANISING ELEMENTS	EVIDENT
Literacy	Comprehending texts through listening, reading and viewing	→
	Composing texts through speaking, writing and creating	→

Findings

It should be noted that the findings of this study are not directly transferable to other school garden contexts due to the specific characteristics of how this program was organised and implemented (Yin, 2014). As each school setting is unique, educators seeking to strengthen competencies should tailor programs to suit their school context.

The findings report on each AGC individually. This approach facilitates a clear understanding of the extent to which each AGC was evident in the school's garden program.

Literacy. Literacy learning was evident throughout the garden program with students engaged regularly in both comprehending and composing written and verbal texts, as seen in Table 3.

Multiple opportunities existed across the garden rotations to comprehend both verbal and written texts as children followed instructions and answered questions. This was observed during each data collection session. Comprehension of written texts was most evident in the kitchen rotation, with children required to read and follow recipes. Reading comprehension was also embedded in the market shop where children had to read orders accurately, and younger children used the garden word wall to find the vegetable labels for the tally board. The students in Grades 3/4 and 5/6 focus groups identified viewing of texts when speaking of speech preparation for the school garden's open day. As part of their research, students viewed specialists from the television program "Gardening Australia" (Australian Broadcasting Corporation, 2021) presenting on various relevant topics.

The garden program also provided ample opportunities for composing texts, with written texts composed during follow up activities in the classrooms. The garden journal offered evidence of writing adjectives, sequencing a procedural text, and simple descriptive writing for children in lower grades. Texts identified in the garden journal also included writing sentences to describe what they were doing in photographs; for example, "I am tipping the scraps into the compost bin", "I am cutting the lemon".

Students in grades 1–6 engaged in authentic writing tasks when they composed masterclass speeches for the school garden open day. Evidence of this was observed when the students read their speeches to an audience consisting of families, friends, and community members. A portion of one speech from a grade 5 student follows:

Using natural pesticides will improve your planted crops. It is hard to define which is better - organic or not organic. Organic is really the best way to go because it does not harm the environment. One particular pest known is white moth, also known as white butterfly. It likes kale and silver beet. Mint helps keep it away, which is also called companion planting.

Table 4 Numeracy: organizing elements that were evident (ACARA, 2012, p. 36)

GENERAL CAPABILITY	ORGANISING ELEMENTS	EVIDENT
<i>Numeracy</i>	Estimating and calculating with whole numbers	→
	Recognising and using patterns and relationships	→
	Using fractions, decimals, percentages, ratios, and rates	→
	Using spatial reasoning	→
	Interpreting statistical information	→
	Using measurement	→

As gardening is a group activity, the comprehension and composition of verbal texts were very evident to us during the gardening sessions. One of our observers in the kitchen wrote, “there’s a lot of literacy happening here, reading recipes, asking questions, answering questions”. Teacher 1 explained how she used the gardening activities “as a stimulus for writing” in her classroom.

Numeracy. The garden program offered multiple occasions where mathematical thinking and practice occurred. This was expected as a mathematical focus had intentionally been built into the garden program. The only organising element rarely evident was recognising and using patterns, as seen in Table 4.

Calculations with whole numbers ranged from sales tallies to calculating the number of seedlings required to plant a garden bed. Estimation featured strongly with activities that included hefting to estimate the weight of watermelon and pumpkins. One garden journal entry about pumpkins records, “We made a good estimate. Yay!”. There was also ample evidence of estimation in a kitchen journal entry, “We estimated how many raspberries would be in 100 g. We got close at 90 g and 95 g.”

Fractions, decimals, and percentages were all applied in the garden rotations. The kitchen journal recorded learning such as, “the recipe makes 900ml (approximately) which is the same as 3½ cups.” Decimals and basic operations with numbers featured each week in the garden shop where children added up money orders, calculated change and counted it out. Each week the children calculated 10% of their sales for charitable giving. Foundation work for ratios was laid through recipe amounts as shown by this example in a kitchen journal entry, “one recipe makes 500ml therefore to feed everyone 100ml we need to make seven lots of the recipe.” We observed spatial reasoning as students planted out seedlings, and also observed the foundations for statistical interpretation as students graphed weekly rainfall and total sales from the shop.

Measurement was the most evident of the Numeracy organizing elements in the garden rotations (Table 5) and in student comments. In the grade 3/4 focus group, one student commented on the incubator: “We had to see that the incubator was the right temperature.” In the grade 5/6 focus group, a student shared that “We measure the soil temperature”; and another student revealed that, “In the kitchen, we use math to measure in millilitres, litres or kilograms.” “We have to weigh all the potatoes,” said a younger student from the grade 1/2 focus group.

The organising elements of Numeracy were evident in the garden program in an applied way to engage students and foster understanding, as summed up by a student

Table 5 Formal and informal use of measurement in the garden program

GARDEN ROTATION	WHAT WAS MEASURED	UNITS OF MEASUREMENT	MEASURING INSTRUMENTS
Market shop	mass of vegetables quantity of vegetables	gram, kilogram, bunch	balance and digital scales counting
Garden care	rainfall distance between plants length of garden beds	millilitre centimetre metre	rain gauge ruler metre ruler
Chickens	Incubation time	day, month	calendar
Kitchen	Ingredients cooking time temperature	millilitres, litres, grams, kilograms teaspoon, tablespoon, ½, ¼, 1 cup pinch minutes degrees	kitchen scales measuring spoons measuring cups fingers timer oven thermometer

Table 6 ICT capability: organizing elements that were evident (ACARA 2012, p. 53)

GENERAL CAPABILITY	ORGANISING ELEMENTS	EVIDENT
<i>Information and Communication Technology</i>	Applying social and ethical protocols and practices when using ICT	X
	Investigating with ICT	→
	Creating with ICT	→
	Communicating with ICT	X
	Managing and operating ICT	→

in the grade 5/6 focus group, who said of mathematics in the garden, “It’s better because you’re actually doing it for a reason”.

Information and Communication Technology (ICT) capability. Three organising elements were evident in the ICT capability, as seen in Table 6. Learning with ICT was evident every week in the garden program in a limited capacity. Although we observed students using computer tablets during gardening sessions, it appeared this use was restricted to older and more capable students while younger students observed. In the market shop rotation, students used a tablet on-site to record and graph their total sales. This was a cumulative process and was used to create comparative charts.

One event included in the open day program was the delivery of “masterclass” speeches by Grade 1 to Grade 6 students, each one speaking on various aspects of garden care. When asked in focus group conversations, “How did you get so knowledgeable?” grade 5 and 6 students responded, “by researching” and “by technologies.” One teacher explained that all students participated in research by viewing garden documentaries and that older students also did independent research on electronic devices. Although this did not occur during the weekly garden sessions, it was related to the garden program. We did not observe the organising elements of social and ethical protocols or ICT communication during the garden sessions.

Critical and creative thinking. Critical and creative thinking was evident in the garden program with all organising elements observed, as shown in Table 7.

Table 7 Critical and creative thinking: organizing elements that were evident (ACARA, 2012, p. 72)

GENERAL CAPABILITY	ORGANISING ELEMENTS	EVI-DENT
<i>Critical and creative thinking</i>	Inquiring – identifying, exploring, and clarifying information and ideas	→
	Generating ideas, possibilities, and actions	→
	Reflecting on thinking and processes	→
	Analysing, synthesising, and evaluating reasoning and procedures	→

There was consensus amongst the adult participants that the garden program encouraged an attitude of inquiry. Most of the evidence for creative and critical thinking came from the focus groups and comments made by Teacher 1, who was the garden program coordinator. However, other participants also recognised the influence of the garden program on Critical and creative thinking. One volunteer reflected on the children's behaviour, observing "... they [the students] are questioning. I just love to hear them ask a question ...". Teacher 3 observed that the students "... are more interested in things that happen outside. They're far more aware." An educational presenter on a school excursion affirmed the established culture of asking questions with a volunteer reporting the presenter's comment as, "... they're so far ahead of other groups ... with the questions they asked...".

Many group discussions, both formal and informal, filtered through the garden program. In the market shop, when orders were low, Teacher 1 recalled that "we were having a chat about it with the students...", and further elaborated on how the ideas the students generated were acted upon, resulting in extra orders.

We observed an emerging culture of reflection. Helpers noticed that the students were making connections. One focus group volunteer noted, "When our rainfall gauge is huge there is huge excitement ... when we look back at the data ... sometimes we might have forgotten why there was a low patch, and someone will comment ... or why there was a high patch and what we did there. They remember and ... reflect." We observed that critical and creative thinking was fostered deliberately by some teachers and volunteers more than others.

The garden open day offered intentional opportunities for reflection, analysis, and evaluation. After the event, students and teachers reflected as a whole school. Teacher 1 felt "the students were able to chat about what happened ... and then what we could do better next time ... the students were just buzzing what they had to say was important ... the next time they'll be dreaming even bigger." Although Teacher 1 acknowledged that limited time resulted in missed opportunities for reflection, we observed students posing questions, generating ideas and drawing conclusions from their garden experiences, all elements of critical and creative thinking.

Students were also encouraged to make their thinking visible in their garden journal, for example, generating ideas for establishing a butterfly-friendly garden. Making the students' thinking visible gave opportunities to foster critical and creative thinking and encourage authentic reflection.

Personal and social capability. Personal and social awareness was frequently observed within the garden program, and evidence of this capability also came from

Table 8 Personal and social capability: organizing elements that were evident (ACARA, 2012, p. 87)

GENERAL CAPABILITY	ORGANISING ELEMENTS	EVI-DENT
<i>Personal and social capabilities</i>	Self-awareness	→
	Self-management	→
	Social awareness	→
	Social management	→

teacher interviews, focus groups with children, teachers, parents, and volunteers. The scope of evidence covered all organising elements, as seen in Table 8.

In a parent focus group, one participant observed that her children had grown in “confidence” and “satisfaction because they’re involved with doing something that’s making a difference.” She noted that she could see “the tension levels drop” when her children learned “outside with purpose”. She felt that students need “... that time just to have space, slow down, ... and connect with ... [a] sense of wonder as well.” A participant in the volunteer focus group reported observed growth in students’ “confidence,” and greater “self-reliance.”

Self-management was evident during garden sessions. Teacher 1 reported behavioural issues as rare. She used the word “thriving” to describe the students and commented that even those who withdrew initially, eventually became “fully engaged.” She offered her belief that this engagement seemed to transfer beyond the garden, “setting them up and giving them a much better day.” Teacher 2 also commented on the social benefits of the garden program, stating that, “we’ve seen some amazing progress with ... how they get along socially,” and added, “community is important.”

When asked about the benefits of the garden program, one focus group volunteer commented, “I also see social benefits because they’re always in groups working with older or younger kids. They’re learning to interact differently in different situations.” He also added that the students “can contribute to society now.” A parent noted that as the children work in teams, they also mix with community volunteers and said she felt they “learn to interact. It’s just another way of teaching them how to be caring ... working with other people.” Teachers, parents, and volunteers commented on the growing sense of responsibility amongst the children involved in the garden program. They also noticed increasing responsiveness to others’ needs. In the Grade 5/6 focus group, students also recognised and attributed personal growth in the areas of “patience,” “self-control” and “kindness” to the garden program.

Observational and conversational evidence showed that the older students were given opportunities to develop as compassionate leaders. They became mentors to the younger children, as this comment from a Grade 6 child in a focus group shows:

I don’t have any brothers or sisters younger than 10 ... but through gardening I’ve got people from pre-kindy and kindy in my group and you learn to actually know what they’re like, how they work really well, ... so you can kind of help them with that, and then they help you as well to understand some other things from others’ points of views.

One volunteer summed up the social impact of the program with the comment: “I just think that the whole school is pulling together better.”

Table 9 Ethical understanding: organizing elements that were evident (ACARA, 2012, p. 102)

GENERAL CAPABILITY	ORGANISING ELEMENTS	EVI-DENT
<i>Ethical understanding</i>	Understanding ethical concepts and issues	→
	Reasoning in decision making and actions	→
	Exploring values, rights and responsibilities	→

Ethical understanding. Learning to enhance Ethical understanding was evident in the garden program with all organising elements evident, as seen in Table 9.

A range of ethical concepts and issues were covered in the practical context of the garden program. Animal welfare issues were evident to this Kindergarten child who commented, “bugs have feelings too and they don’t want to die.” Teacher 3, who was responsible for the chickens, pointed out that “even little things like how you hold a chicken is ethical, because, do you hold it like this and swing it upside down? You’ve got group consensus talking about, ‘Hey don’t do that.’”

Honesty issues were addressed in the garden sessions. Teacher 1 identified the following practices as based on ethical behaviour: “not overpricing food, giving correct change, making sure organic advertised has to be organic.” One of the volunteers felt that the real-life application introduced opportunities to think about ethical behaviour and gave the following example. “It’s really cool that we get to actually work with real money. Sometimes they’re [the students] just going through the motions and I’ll point out, are you sure that’s the right amount and then I’ll have to look, oh it’s not, now we have to give the right change.”

We identified sustainability issues throughout the garden program. One student in the Grade 3/4 focus group stated emphatically, “If we don’t look after it [the environment], there’s going to be nothing for us left and then we could eventually end up dying it will be very hot and not much food and not much water.” One volunteer noted the use of sustainable practice in the garden program, noting that “instead of using plastic disposable plates to serve students food on, we have more solid plastic plates...we set up washing stations...that’s building responsibility and ownership.”

The value of work done in growing food and using sustainable methods was developing awareness in students. This school garden was organic and one student in the Grade 5/6 focus group contributed that “it’s expensive to buy organic things because it’s pretty much more cost for farmers and more effort for them to... produce it.” Following a similar thought, one volunteer thought that selling food from the garden “puts value on the work that’s done.” He commented that in “some places they grow stuff and give it away” and felt that this could “give a false...sense of worth.”

While we found evidence of Ethical understanding, we also acknowledge that the potential for this AGC was greater than the reality observed.

Intercultural understanding. Evidence of Intercultural understanding in the garden program focused primarily on the organising elements of recognising culture and developing respect; and interacting and empathising with others as shown in Table 10.

Table 10 Intercultural understanding: organizing elements that were evident (ACARA, 2012, p. 114)

GENERAL CAPABILITY	ORGANISING ELEMENTS	EVI-DENT
<i>Intercultural understanding</i>	Recognising culture and developing respect	→
	Interacting and empathising with others	→
	Reflecting on intercultural experiences and taking responsibility	→

There was some cultural diversity in students observed participating in the garden program with scope for increasing intercultural understanding through working together with food experiences related to the garden program.

Teacher 1 reported that an Indigenous person came to the school to talk about bush tucker (indigenous food), and also indicated that students had recently planted a “bush tucker” garden. They planted rosella seedlings and a lilly-pilly seedling according to a student presentation at the garden open day. For the open day speeches two year 5 students researched and reported positively about potential contemporary uses of rosellas, lilly-pillies, finger limes and other indigenous bush foods. An example of contemporary rather than traditional indigenous use was the rosella jam we sampled on scones at the open day. Using rosella jam provided an opportunity for bridging between indigenous and non-indigenous food cultures.

The kitchen volunteers indicated an interest in exploring the use of rosellas, lilly-pillies, pigface, and potentially warragul greens from the bush tucker garden, as well as native grasses from the local area. Teacher 1 reported that students were making plans for an Asian garden and one parent reported their child’s excitement about this planning. The kitchen volunteers indicated that while they had used some of the existing garden produce to make curries in the cooking sessions, they had not looked at the cultural aspects of these foods. This could change once the Asian garden had useable produce available for the cooking sessions, providing further opportunities for students to explore and reflect on cultural food practices.

Other findings related to competencies. We also found evidence of additional existing or emerging competencies. Financial competency is rapidly gaining importance as a global skill (OECD, 2019). Financial literacy was embedded through the operation of the market shop with children learning to tally orders, calculate change, and graph sales, laying the foundation for participation in economic life. Closely tied to financial competency is initiative and entrepreneurship, included as a key competency by Finland and Canada, among others (Ontario Ministry of Education, 2016). The market shop included elements of these competencies as students explored ways to increase their profit from market shop sales.

Canada, for example, also includes sustainability in its key competencies (Ontario Ministry of Education, 2016), while Australia includes it as a cross-curriculum priority (ACARA, 2012). The case study school garden was organically grown, and we observed children engaging in, and learning about sustainable garden practice.

Finally, collaboration is universally considered a key competency (Borowski, 2019), either in its own right, or embedded in personal skills development and this aspect of the garden program was evident in the various activities, all of which involved either paired or small group work.

Discussion

This investigation of the case of one particular cross-disciplinary school garden program, driven by the recommendation of Lucas & Smith (2018), demonstrates that such a program offering activities and experiences that connect learning across the curriculum can present rich opportunities to add depth to AGCs and global competencies in children's learning. It supports research that has reported on successful cross-disciplinary approaches to embedding AGCs into school programs (Batham, 2012; La Marca, 2013; Thompson & Christian, 2016). The evidence of AGCs across all aspects of the school garden program indicates both the opportunities and benefits that a cross-disciplinary approach to developing AGCs may have for primary students. The teachers at this school supported the category identified by Skourdoumbis (2016): that the AGCs contextualise and complement teaching without the need for intentional planning.

We did note, however, that not all the teachers and volunteers interviewed were conversant with the AGCs. Although the coordinating teacher did not develop the garden program with the AGCs as its focus, analysis of the data sourced from the various participant cohorts showed that AGCs were naturally occurring in this program. Raising awareness on the part of participating adults around the presence of AGCs could help to capture teachable moments, those unplanned opportunities for deep learning that present themselves.

We concur with the literature that reveals the possibilities of numeracy and literacy learning in school garden programs (Boynton, 2010; Civil & Khan, 2001; Hazzard et al., 2011; McCarty et al., 2018; Nuttall & Millington, 2013; Pascoe & Wyatt-Smith, 2013; Ramsden, 2015). We found that both literacy and numeracy featured strongly in the garden program, especially applied numeracy which was intentionally included in the planning of activities.

References to the nexus between ICT and school gardening programs were scant in the literature, and our findings indicated that while there were limitations in this area, possibilities for garden-related learning with computer tablets and internet research were being explored. We observed that ICT use in this school's garden program was not contrived, but used appropriately and with a purpose, although not extensively.

The garden program appeared to be a natural context for creative and critical thinking with opportunities for children to pose questions, explore solutions and critically reflect on their gardening practice, although this seemed to be underutilised due to time constraints. Two teachers and three volunteers commented that garden sessions sometimes felt rushed, and students unanimously voted in their focus groups that they would like more time in the garden. We observed this limited reflection time. As reflection improves learning, we would recommend a lengthened gardening time to allow for reflection both during and at the conclusion of each session, a practice promoted by Williams & Brown (2012).

The literature indicated that the Personal and social capability features strongly in the outcomes of school gardening programs, and data from each cohort in this investigation, including students, supported prior research (Cairns, 2017; Robinson & Zajicek, 2005). We observed reciprocal social interaction between students, teachers and volunteers. During the school garden open day, students also interacted with

visitors to the school, a factor that Townsend et al., (2012) found increases students' confidence in broader social situations.

The findings suggested two additional practices that provided opportunities to cultivate the Personal and social capability. Firstly, we found evidence that mixed-age groups acted as a catalyst in developing social competency, including leadership skills, a strategy promoted by Lucas & Smith (2018). Secondly, the group rotation system facilitated the development of teamwork skills. Students were able to establish good working partnerships and accept the challenge of collaborating with diverse students in a variety of contexts.

Recommendations and conclusion

Our investigation of one school's garden program resulted in the identification of several characteristics that were potential opportunities for students to further develop in their achievement of the AGCs.

1. The program utilised experienced and enthusiastic volunteers who interacted with the students in positive ways providing opportunities to build social skills and confidence with adults beyond their families or teachers. This contributed to both social awareness and social management in the Personal and social capability.
2. The program schedule allowed all students to experience a wide range of activities over the gardening season, exposing them to the whole spectrum of AGCs.
3. Mixed-age groups facilitated social understanding, empathy, and leadership opportunities in the Personal and social capability.
4. There were opportunities to apply the AGCs focused on literacy and numeracy skills which acted as an enrichment to classroom learning.

We also identified two recommendations that could strengthen opportunities for the development of AGCs in this case study.

1. Review the competencies/capabilities of the country in which the school is located when planning a school garden program to build awareness in teachers and volunteers. This will enable them to be more intentional in their interaction with the students.
2. Plan intentional opportunities for reflection and discussion during and following gardening sessions. Although we observed this happening on occasion, an extended garden time would facilitate deeper reflection and discussion, building a culture of creative and critical thinking.

The opportunities identified by this case study demonstrate the potential of using a school garden program to develop AGCs in primary school students. It offered evidence from multiple perspectives and revealed how AGCs occurred naturally in this school's garden program to provide opportunities for positive learning and development of soft skills. In this study, the evidence of AGCs and additional competencies

endorsed the nexus between this varied, multi-age group school gardening program and the potential development of a broad range of attitudes and skills which support students' achievements.

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Declarations

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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