Cultivating digital roots:
A case study on the co-creation of a digital tool for school gardens

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Abstract

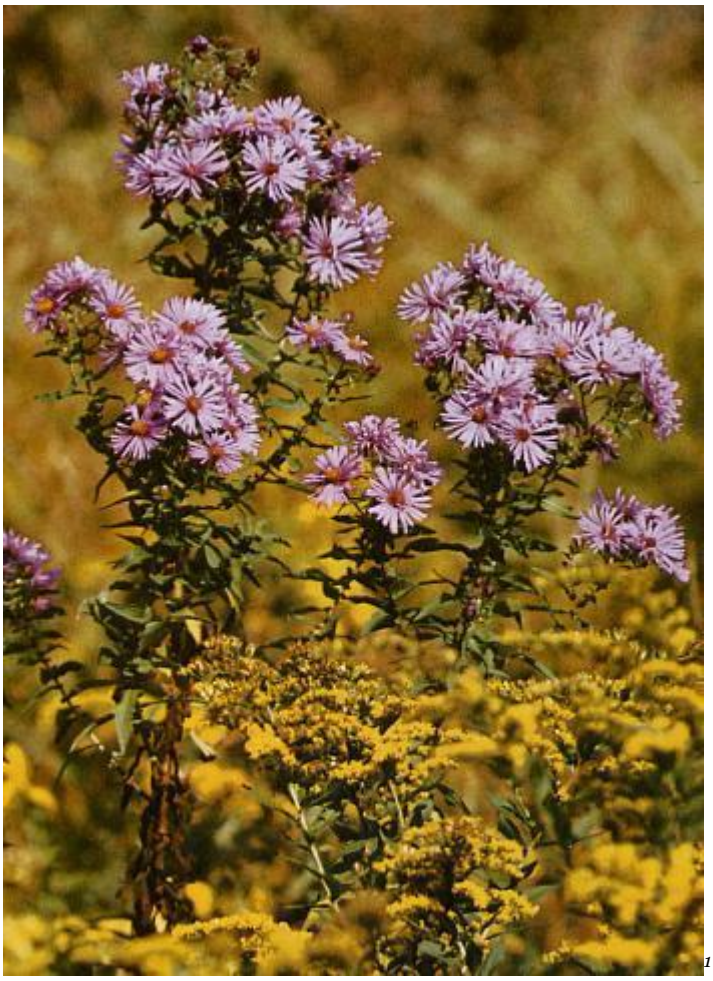
This case study explores the design and development of a co-created digital garden tool prototype with a Teacher Design Team (Binkhorst, et al., 2011) of garden educators from the *Natuur en Milieu Educatie Programma* of the Gemeente Amsterdam. The design research project sought to document the process of creating a garden app prototype, functioning as a boundary object (Starr, 2010), with the goal of better addressing the various perceptions of discontinuity (Bronkhorst & Akkerman, 2016) across the NME Program operation and management, home, and school environments.

Using Design Thinking principles and an outcome-based, novel approach, weaving together professional development and curriculum reform, the project team co-collaborated in the design of an app prototype that was tested with a pilot group, resulting in a layered understanding of the main research question: *how can a digital tool prototype, based on garden themes and content, be developed in co-collaboration with garden educators to promote continuity between garden, school, and home environments?*

The research design is then critiqued against the phenomenon of *learnification* (Biesta, 2013), and ecological principles are discussed in relation to understanding the NME program as an ecosystem, addressing the sub research question oriented on support strategies and infrastructure research needed to conduct similar projects, as well as within other informal education programs.

The following recommendations are made for future research: *If you want to design a collaborative, professional development project, broader consideration for the function in relation to structure-- ecosystem dynamics-- of the garden program should be done in order to have the proper depth perception guiding the research design and execution. Improving communication across the levels of the NME program in order to better identify the necessary supportive strategies can function like microbial networks, allowing educators to root down so that they can branch out, try new things and feel supported, and feel that they are capable of integrating new types of curriculum tools and strategies. If you want something to happen on the student group level, you need to have boundary crossing at other levels and support infrastructures across the different layers.*

Keywords: informal education, garden education, professional development, curriculum reform, design thinking

 [1]

"Why are they beautiful together? It is a phenomenon simultaneously material and spiritual, for which we need all wavelengths, for which we need depth perception. When I stare too long at the world with science eyes, I see an afterimage of traditional knowledge. Might science and traditional knowledge be purple and yellow to one another, might they be goldenrod and asters? ***We see the world more fully when we use both.****"*

Robin Wall Kimmerer, 2015
Braiding sweetgrass: Indigenous wisdom, scientific knowledge, and the teaching of plants, p. 46

[1] Line, L. (2008, September 14). Aster days [New England asters and goldenrod]. Retrieved from https://www.audubon.org/news/aster-days

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Klimbonen sprouts and learning goals: a vignette

Sandrine[2] teaches garden lessons on Mondays and Fridays. On an unforgivingly hot Friday in June, around 12:30, she walked into our small office for lunch and a break from the heat. She was covered in an unmissable layer of dirt and sweat-- evidence she'd been busy tending to the recently sprouted klimbonen and onslaught of weeds that had popped up over the weekend to greet the heatwave of 2018. As per habit, and as the curious intern that I was, I asked Sandrine how her two morning lessons went, to which she let out a big sigh, "One group didn't show up, and the other was total chaos." With obvious frustration, she revealed that two of her three Friday groups had only had a single lesson on the garden. By that point, it was already seven weeks into the outdoor season.

As a result, Sandrine was responsible for the maintenance of those nearly sixty 8-square meter gardens, and she noted that the students themselves had very little personal connection to what was growing there. When I asked her what she considered as learning goals for two absent groups, she said "they just show up and there are plants and things to harvest, because I did it." With a sigh, she continued, "I hope those groups just enjoy themselves in nature." Sandrine's Monday groups and the third Friday group, however, can be challenged with more content-focused learning goals-- something she attributed to not only higher attendance, but also demographic differences, such as higher socio-economic status of the parents as well as more exposure to nature themes in the classroom and at home. On that note, the conversation was put on pause, and the rest of the brief lunch break was eaten in quiet recharge before the afternoon groups arrived for their lessons.

[2] All names have been changed.

Introduction

Like the Wood Wide Web of fungal networks connecting trees[3], nature and garden education have cultivated their roots across the world. As educators seek to bridge the gap between contemporary science issues in society--such as climate change and the growing interest in the origins of our food-- the lack of context in traditional, formal science education provides an interesting and challenging nexus for curriculum developers. Research has shown the power of creating context within science curriculum, and gardens can serve as a physical context within which students have the opportunity to interact with these contemporary, interdisciplinary socio-scientific issues. One particular concept important to these issues is citizenship education, which incorporates environmental education, scientific literacy, and civic responsibility (Disinger 2001; Kolsto, 2001; Krasny & Tidball, 2009; UNESCO, 2013) into its objectives. Dorothy Blair's 2010 evaluative review of garden-based education indicates a constructive relationship between school gardening and positive social and environmental behaviors: two important aspects of citizenship education.

Looking to the literature, a global effort for conducting research that empirically validates anecdotal evidence of school gardening's impact on children has been led largely by the United States. Collectively, the research illustrates the value of a garden education to the personal growth of not only kids, but also community connections. Where the literature is lacking is in explicit support strategies for garden educators in facilitating community-building actions via program aims. Additionally, most research focuses on the orientation of a garden in physical proximity of the school itself which is not representative of all school garden programs types globally, as is the case in the Netherlands.

In 2020, the Municipality of Amsterdam's Nature and Environmental Education program, or *Natuur en Milieu Educatie Programma* in its native Dutch, will turn 100 years old. In the mid 1920s, the focus of the program was on improving children's nutrition and food security, whereas in the 2010s citizenship education and curriculum contextualization come into play. Despite the changing times, the overarching purpose of the program has held fast: to give city kids a chance to interact with and experience a form of nature. The setup of this particular garden program is rare outside of the Randstad in the Netherlands. In the NME program, 13 gardens across the municipality are professionally maintained full-time by 100+ educators and gardeners. Once monthly from January through March, and then weekly from April through November, school children between the age of 10-12 in group 6-7 visit the garden for an entire growing season, each with their own portion of land to tend to. This program is funded entirely by the municipality, and is free for every Amsterdam student. Schools opt into the program, and are assigned to one of the 13 school gardens based on location and accessibility. In the NME program, garden educators not only educate, but they take care of the maintenance of the children's gardens. Additionally, they are responsible for each garden's operations with the oversight of a group of Coordinators, and are the on-the-ground facilitators of the program logistics.

Research has shown that garden experiences can become isolated from a student's general academic experience (Graham et al, 2005), which in turn can contribute to discontinuity in transferable knowledge and experiences (Blair, 2010). In light of this phenomenon, garden educators strive to facilitate contextualized learning experiences for their students, seeking to bridge the gap between the garden and "the real world". Despite this aim, there is a lack of on-the-ground support for garden educators, which can contribute to another form of discontinuity (Bronkhorst & Akkerman, 2016) amongst workplace satisfaction, which can lead to exhaustion-- like Sabine experienced on that hot summer day in June-- and in some cases, burnout (Dworkin, 2009; Skaalvik & Skaalvik, 2009).

In the case of Nature and Environmental Education program, the discontinuity is indeed being felt in both ways, resulting in healthcare costs annually largely due to burnout-related health issues amongst colleagues. Therefore,

[3] Hidden Life of Trees (Peter Wollhben), http://woodwideweb.no/

it is imperative to shift the onus and burden in as many ways as possible from the garden educators stranded on these islands of informal educational experiences to balance it out more evenly across the different learning environments, namely home and school. This shift would also increase involvement from parents and the teachers at the schools themselves, theoretically contributing to community building within the local communities of Amsterdam.

Due to the unique set-up of the NME program-- off-site gardens that schools must travel to in order to get lessons -- shifting the burden from the garden educators must be done in a way that allows for students, parents, and school teachers to access the garden while they are not physically there. A digital tool, such as a smartphone application-- or app-- could function in that way. The digital tool, which came about during a casual conversation about the future of school gardening between myself and my internship supervisor Reggie, is a possible piece of a solution to shift the burden of responsibility away from the garden educators. The ability to bring the garden home in your pocket, or to pull it up on the smartboard at school increases the exposure and interaction with garden content and topics for kids, their parents, and their teachers. The digitizing of the garden experience can serve a priming function for new curriculum content, while reinforcing prior experiences. Additionally, the cognitive load of the garden program curriculum programming can be distributed more evenly in a temporal sense. In the particular case of the NME program, utilizing school hours and time at home rather than relying on the 90 minutes per week could have a positive impact on the knowledge retention and engagement of the children while decreasing the burden to the garden educators. Across the 10,000 students in Amsterdam, different cognitive abilities and cultural variations prove a difficult task for garden educators to scaffold for diverse learners while providing an equitable education experience. Digitizing the garden can provide additional support that currently is severely lacking.

Currently, the main form of curriculum support for the *Natuur en Milieu Educatie* program-- the school garden book-- is limited in its activity as a boundary object. First described by Starr (2010), a boundary object is an artifact that serves different functions in an education environment. The school garden book, the program's main artifact, currently serves a journaling and data collection function, documenting the school groups' activities as they progress through the curriculum, primarily during the indoor season. While studies have shown the impact of nature journaling as well as a link between science achievement and drawing (Uum et al., 2016), the physical nature of the program limits the utility and use of the notebooks, and they are locked away in the garden's classrooms for more than 75% of the program's outdoor season lessons. In light of this, the choice to explore the incorporation of a digital support tool became an attractive solution for this case study was twofold: technology is already integrated into the formal education experiences of nearly every school group served, and specifically looking at the evolution of the NME program, it has been moving towards modernizing the notebook, searching for alternatives to phase it out in favor of a more efficient means of curriculum materials.

Not only would curriculum reform in this informal education environment contribute to the domain of educational research, this case study sought to bring elements of Design Thinking via co-creation into the curriculum reform. Existing literature details the impact of co-collaboration of educators and curriculum developers in formal education settings via Teacher Design Teams (TDT, Binkhorst et al., 2011), but elements of these project teams have yet to be incorporated into an informal education setting. Autonomy and diversity are important elements to the colleagues of garden educators in the NME program, and through a project team where shared and vertical leadership elevated the expertise of the garden educators, the impact of this project could have a positive effect on the integration of this tool into garden educators' teaching strategy toolkits.

Due to the time constraints of the Masters Research Project timeline of one year, the primary aim of this research is to document the design and development process of a co-created school garden app prototype. My role in this project was as a facilitator, and more affectionately, "twee warme handen". Using my prior internship experiences and the many rich observations and conversations, combined with the theoretical and pedagogical

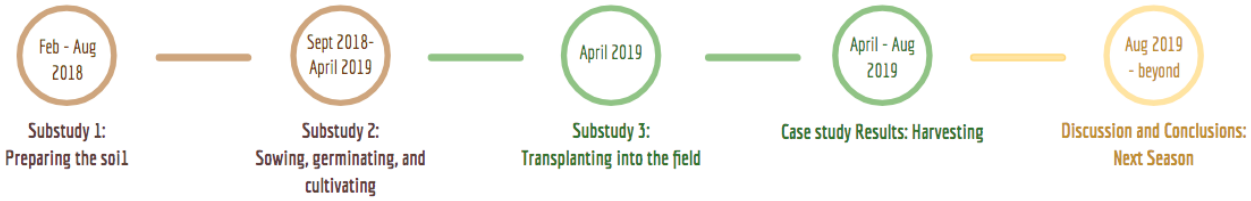
tools I had acquired, it was evident to me that the pieces of this project were already present and needed to become puzzled together. The result is this exploratory case study seeking to answer this main question:

How can a digital tool prototype, based on garden themes and content, be developed in co-collaboration with garden educators to promote continuity between garden, school, and home environments?

This case study serves as documentation of the trial and error process of applying formal education research methodology to an informal and dynamic setting. The process and its resulting lessons, are important to share in order to provide context for a more important conversation of informal educator support structures in relation to curriculum reform and professional development. The use of TDT-style project teams and Design Thinking are not typically employed in informal education settings, and the novel application of their combined use generated valuable insight into what is possibly, more broadly considered, a phenomenon of learnification (Biesta, 2013) in informal education programs. More broadly considered, the combination of adapting these strategies to the garden program is a novel addition to the conversation of educator support in informal education environments. Specific to the Amsterdam school garden program, this case study took the important first steps into a larger curriculum reform process, and recommendations are made as food for thought moving the project forward beyond this case study. This research also includes a critique of the project design and process, as well as a reflection on the subquestion that drove much of the intention behind the research:

What specific support mechanisms should be put in place in order for garden educators to express confidence in their ability to incorporate an app into their teaching strategies?

A season on the garden: reading guide



This case study follows the general structure of design research (Bakker, 2018), with a few deviations. To characterize the research project as a whole, I use the chronological phases of a garden season to discern the distinct phases of this case study. Literature and theoretical background are woven throughout the three substudies, serving to underpin the narrative. For each substudy, a table is included with a summary of the types of data collected and how it was utilized.

First, a problem analysis of the current situation in the garden program was conducted during my first internship with the NME program, from February through August 2018. The orientation of the first substudy was to become acquainted with the culture and operation of the NME program, as well as conduct observations of and conversations with the garden educators to better understand their role and obligations. At the garden, the soil must be prepared properly before we can plant and seed, and that preparation requires planning and reflection on the past growing season. Out of Substudy 1 emerged two principles, each shaping and informing the proceeding substudies.

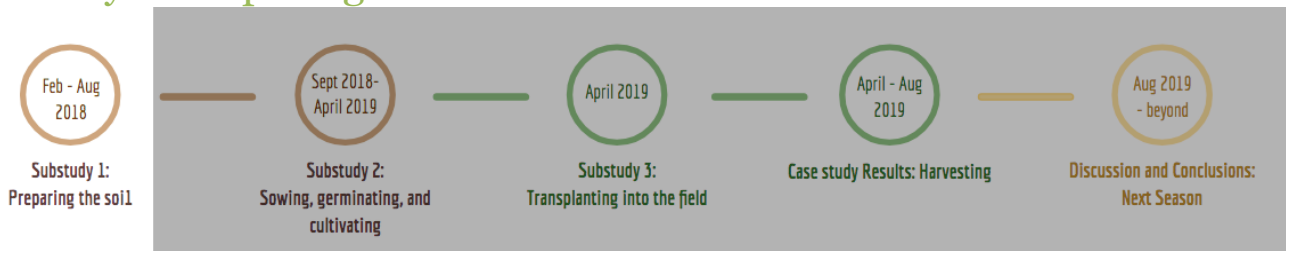
Once the soil is prepared, the seeds must be sown and germinated. Substudy 2 served as these processes: first the design of the project team methodology, then the recruitment and establishment of the team, collaborative brainstorming and feedback sessions with the team of garden educators. It is helpful to consider that the seeds of

the project team were sown, germinated, and cultivated through the exploration of the design and development process, resulting in the creation of a prototype and aims to pilot with selected school groups.

Substudy 3 saw the cultivated prototype and pilot aims transplanted into the field: executing a two-part pilot session with a selected school group in the classroom and on the garden with the goal of observing responses to the prototype, students as the primary and educators as the secondary. The results of the pilot session were harvested and analyzed, incorporating data from all three substudies. Implications for garden seasons to come as well as recommendations for moving the app development project forward are found in the discussion of this third substudy. Substudy 3 should then be considered as an exploration of the impact of the results of Substudy 2 -- the developed prototype -- on the pilot group of children. The results of Substudy 3's pilot sessions are nestled within the substudy's discussion, relating back to Substudy 2.

Before looking to future growing seasons in the conclusions, a critique on the design and development of the case study as a whole is discussed in order to situate the implications of this research in the broader conversation of educators support structures in relation to the phenomenon of learnification in education. A reflective evaluation of each substudy is done with respect to ecological principles that drive management of natural resources-- a consideration made literally in gardening and metaphorically in this research. Food for thought is developed in the conclusions: a set of principles and recommendations for how to further this not only this research in the future but also informal education programs seeking to conduct a similar project.

Substudy 1: Preparing the soil



In February of 2018, I began my first internship under the lens of product development with the *Natuur en Milieu Educatie Programma* (NME, Nature and Environmental Education Program). During this internship I was enlisted, alongside a fellow intern, to create a set of lesson activities underpinned in Inquiry-Based Learning principles for garden educators to use. While developing activity lesson plans, we soon became uncomfortable asserting ourselves as the so-called experts, recognizing that these activities were best developed by the educators that would be using them. Instead of sticking with the initial challenge and recognizing the time constraints of the garden educators, we chose to pivot. Embracing our perspective as outsiders, we took up the position to act as facilitators. In this facilitator role, we brought in academic terminology and strategies from our Masters studies. Employing these strategies instead as supportive functions within a flexible, self-reflective tool rather than a rigid, finished set of activities as a product, we also sought to create and hold a space for garden educators to develop their own activities using this tool.

Theoretical Background: Attitude and intrinsic motivation

As defined by Ryan and Deci (2000), intrinsic motivation "refers to doing something because it is inherently interesting or enjoyable" (p. 55), and it results in desirable behavior outcomes such as "interest, enjoyment, felt competence, and positive coping" (Ryan & Deci, 2000, p. 63). Consequently, intrinsic motivation is an important factor to the development of attitudes towards science concepts and sustainability topics.

Not only is attitude important to consider in science education, but also in educator professional development. Attitude is a crucial component to sustainable behavior development in students (Blair, 2010; Skinner et al, 2011), and it is also key for educators designing and redesigning education materials (Binkhorst, Handelzalts, Poortman, & van Joolingen, 2015). Osborne, Driver and Simon (1998) describe strategies to impact the

affective domain-- which contains attitude as well as values and behaviors-- as including project-based learning, using real-world examples, and consistency in affective learning outcomes to be set by educators.

Seeking to promote autonomy amongst the garden educators while also honoring both educator and school group variation, an evaluative framework tool anchored in Inquiry-Based Learning strategies was developed, and subsequently piloted in a workshop aimed at collecting feedback on how the educators approached using the tool. Both the tool and the workshop were designed to facilitate educator interactions with the academic structures and the literature-based, good practices of IBL, creating the space for the garden educators to integrate these good practices with their expertise and develop their own lesson activities. A year later, the *Onderzoekend en Ontwerpend Leren Kaart* tool is still used by nearly 10% of garden educators, with the expectation that percentage will continue to rise and impact the nearly 10,000 groups 6/7 students yearly.

Through the process of moving away from prescriptive curriculum development and towards co-collaborative and autonomy-supporting strategies, I began to develop a better understanding of the support tactics necessary for educators in the NME program to be able to integrate new teaching strategies into their educator toolkits. However, this understanding became complicated when I attempted to map out these support strategies in relation to how the garden interacted with the school and home environments. The strategies, while mindful of supporting garden educators with professional development opportunities on the garden, focused solely on the educators improving their teaching strategies while on the gardens and in relation to what they themselves could do for communication strategies. As a result of lesson observations and conversations with garden educators, it became abundantly clear that professional development for educators was being used as a remedy for a broader, more complex problem: discontinuity.

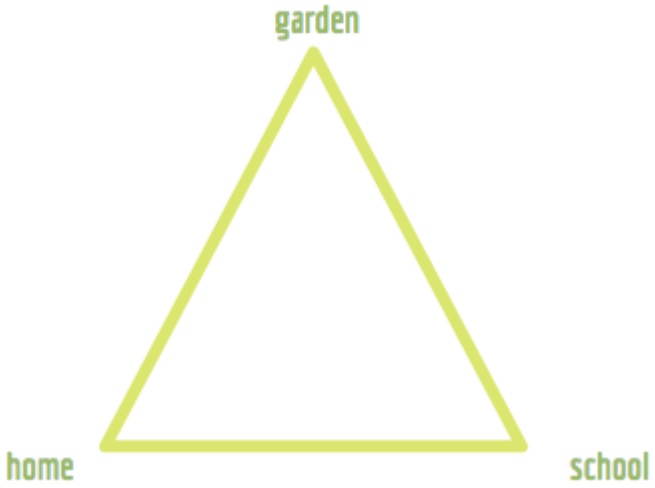
Theoretical Background: Discontinuity

Bronkhorst and Akkerman (2016) explain discontinuity in relation to informal education and transfer of knowledge across learning environments. Their research draws upon boundary crossing research, stating that different education contexts can have different purposes and meaning, noting that using boundary crossing research can help us become more sensitive "to the way students' learning may take place across contexts, despite such differences".

Furthermore, discontinuity is not necessarily definable, due to the complex and variable nature of learning across different contexts. This research speaks to the observational experiences I had as well as conversational follow-ups with garden educators about their perception of the education experience for school groups, many noting that "not everyone is on the same page" (Reggie, personal correspondence, June 2018) which aligns with Sandrine's experience described in the vignette of this case study.

Although visited regularly by school groups, the 13 gardens of Amsterdam are islands in the city. Not only are they green oases amongst the sprawling metropolis, but metaphorical islands of experiences, where school groups take a trip to visit once a week, and return to their daily lives of home and school. Observing groups struggle to recall information and garden educators exhausted in reteaching week after week, the garden content and experience is generally not as integrated into the everyday life of students. It appeared to be that case that the connection between schools and homes is "typically much stronger" (Wilbur, personal correspondence, 06 June 2019), as it is enforced daily, compared to the weekly visits to the garden. To better understand how these interactions played out across the learning environments as students moved across them, I developed the Learning Landscape Continuum, seen in Figure 1.

Figure 1: Learning Landscape Continuum: perceptions of discontinuity in practice



The main site of garden-based education is the garden; simply for the reason that you cannot facilitate the majority of the curriculum, which is based on a physical interaction with the gardens themselves, without physically being present at the garden site. In the event that you could take parts of the garden with you, for example, the vocabulary and visual components to the curriculum, this could have a beneficial impact on engagement with garden and nature-based topics while not physically present in a garden or nature context. Applied to the NME program, engaging children with garden content potentially has a positive impact on the way that kids engage with educators and lessons while they're on-site. This should in turn also have a positive impact on content retention, as they will have been exposed to the content in multiple arenas, thus theoretically decreasing the amount of time and energy garden educators must expend in order to keep students engaged and building knowledge during the garden lessons. Ultimately, the impact that could potentially be seen weekly is a more efficient advancement through curriculum topics, rather than spending a majority of the time reteaching content-- like utilizing the *teeltplan*, or cultivation plan, to recognize their growing plants, or how to properly use a *hark,* or rake-- and build upon prior lessons in order achieve greater depth in curriculum topics.

Theoretical background: Garden-based education
Garden-based education typically exists in three main categories: educational gardens that exist on the property of a school (Blair, 2010; Graham et al., 2005; Ratcliffe et al., 2011), community gardens that schools interact with (Datta, 2016), and separate gardens that school groups visit (ANMEC, 2017). The purpose and objective of school gardens may vary, but typically they incorporate positive, concrete experiences between students and nature (Blair, 2010), while also linking activities on the garden to traditional classroom instruction (Ratcliffe et al., 2011).

The organization of the Natuur en Milieu Educatie Programma falls under the third category of school garden type: separate gardens that school groups visit. Where there is a relative abundance of research available on the first two categories, the lack of literature published and available regarding separate garden education programs indicates a need for research to be conducted with the NME program, as it can serve as a model for aspiring garden programs worldwide.

Beyond contextualized science curriculum, the garden is a place where children grow mentally, physically, as citizens, and as young scientists (Blair, 2010). Like other garden programs worldwide, the NME program promotes

and facilitates beneficial experiences for urban children to interact within a natural context and with nature content (Cairns, 2017). Unique to the NME program is how the program seeks to make equitable its garden experiences across all of the school gardens. Between 2014 and 2015, the 13 gardens of the NME program came under a consolidated form of management. Prior to then, each garden had full autonomy over how the facilities were managed, curriculum developed and executed, and the type of experience offered to school groups varied based on the type of culture and educator dynamics cultivated on the garden as well as soil type and quality of the area. A few years post-consolidation, Ninke Kwikkel of ANMEC-- the curriculum oversight group now in charge of directing the gardens' noses all in the same direction-- developed a document outlining the main goals and aims of the NME program, and how they could be integrated into lesson planning and teaching strategies for educators. Garden educators were then introduced to the operationalized learning goals via workshops and presentations.

Theoretical background: ANMEC *leerlijnen* (Kwikkel, 2017), or learning goals

Original Dutch	*English translation*
1. leren tuinieren	1. learn to garden
2. natuurlijke invloeden op de groei van planten	2. natural influences on the growth of plants
3. natuur- en wetenschappelijk onderwijs en duurzaamheid	3. nature and scientific education and sustainability
4. gezondheid en voeding	4. health and nutrition
5. geïntegreerde leeromgeving	5. integrated learning environment
6. persoonlijke groei van het kind	6. personal growth of the child

Additionally, it is important to acknowledge that educators in these informal programs, especially within the NME program, come from a variety of backgrounds. For example, on one garden alone, there are colleagues with backgrounds from Biomedical Sciences to Communications, and at another with backgrounds from Politics to Ecological Biodiversity. So not only is it essential to diversify the tools in their teaching strategy tools set for kids, but for educators. Around the same time as the story of Sandrine and the *klimbonen* in June 2018, the NME program was approached by an app design company who had created an app for the school garden program of the municipality of Rotterdam. In Rotterdam, a large focus of their garden programming is on healthy eating choices, especially for the low income and more vulnerable *basisschool*, or primary school, groups they serve. The app company pitched a similar, gamified nutrition-based app to the NME program managerial team. The consensus was unanimous; although nutrition is a core learning goal, the app itself was not tailored enough to the rest of the NME program goals and aims. More importantly, the conclusion that was reached was one that acknowledged the importance of the garden educators having a representative voice at the least, and involvement in the design of the app at the most in order to better reflect the NME program and its garden educators.

With so many hats to wear, It's important to support these garden educators in a variety of ways and equip them with a number of different and diverse tools. As one would expect, garden-based education programs are not typically structured in the same way as formal education programs, and this is especially the case with the unique set up of the NME program in Amsterdam. At school, children interact with the teachers and classroom settings regularly, if not daily. As a consequence, these teachers and students are able to theoretically build a learning community based on these high levels of contact hours. In informal education, the contact hours are not consistent-as with in museum exhibits- or are drastically decreased as compared to formal/traditional education environments.

Substudy 1 Data

Type of data	Collected	Used
IBL spreadsheet	Analyzed the school garden book against IBL literature.	To make a general judgement about the level or amount of IBL strategies/activities already available/being done across the gardens in a documented way, and how to further tweak or change existing activities to align more with IBL literature and strategies.
OOL workshop write up	Conducted a workshop introducing the IBL tool and workshopped how to use it with colleagues, gathered feedback on how to improve the tool.	To give an impression of the dynamic of educator collaboration and how to approach professional development and curriculum reform with the garden educator colleagues.
Full Internship Product Development report[4]	Documented the entire process of IPD course setting at the garden. Described the process pivoting from creating a set of activities to developing a dynamic IBL-based tool for educators and the theory underpinning the design choices.	Serves as a way to set the stage for the research project, as much of the observations and my perceived discontinuity across the learning environments arose from doing this internship in this manner. Additionally, there is overlap in the justification and rationale for switching from set activities to a flexible tool and the creation of the digital support tool/app prototype.
Development log	Kept track of observations and conversations important to the development of the IPD project towards shifting focus to the IBL tool.	Quotes and observations to be used in the contextualization of perceptions of discontinuity via garden educators.
Quotes and observations via notes	Largely informal, during side conversations and casual conversations here and there quotes were picked out and written down regarding the importance and purpose of school gardening, why we do this work, how colleagues are experiencing discontinuity, frustrations with organization, etc. Observational notes from one of the indoor lessons can be found in Appendix A.	These quotes serve as the backbone to a large portion of my argument that the garden educators shoulder a larger part of the burden in remedying the discontinuity across the learning environments and aside from the physical toll, it also has an impact on workplace satisfaction and psychological/emotional well-being. This can also be seen in the economic health costs incurred by the NME program as a result of colleague burnout.

Substudy 1 Summary: Results and Discussion

From Substudy 1, the major results are that there is a problem with the distribution of educational output across the learning landscape continuum. As a result, the garden educators feel obligated to take up that burden, thus contributing to feelings of malcontent, and in worst case scenario, leading to burnout[5]. In addition, indoor and outdoor lesson observations throughout the season indicated that there appeared to be issues with knowledge transfer and application of skills, as compared to the amount of content being taught by garden educators.

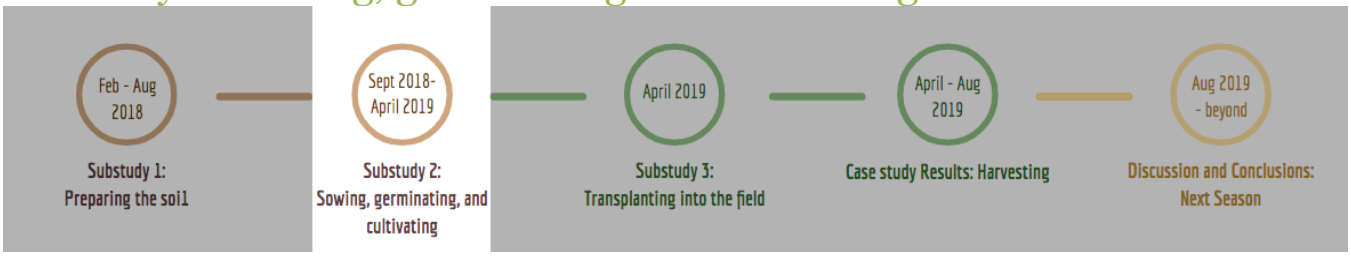
[4] Full report can be furnished upon request.

[5] Yearly, every NME colleague fills out a survey in relation to the operations of the NME program. I specifically took a look at the management evaluation and workplace satisfaction categories. The brief distillation above was followed-up in a conversation with a managerial colleague for clarification on some of the affective-related language used, as the survey was in Dutch.

With the aforementioned results in mind, and incorporating methodology from Van den Akker as discussed by Bakker (2018), two design principles were developed to guide the subsequent research project, and what would ultimately develop into Substudies 2 and 3. For clarification purposes, the principles were developed using the understanding of principles as guidelines (Bakker, 2018). From the design principles, it was valuable to create conjecture maps (Sandoval, 2014) to envision the implications of the research design, especially for an informal education program such as at the garden. The principles, and their coinciding lines of conjecture, are in the table below.

Principle	Aim/action	Expected outcome
If you want school garden groups to be more present and engaged while on-site at the garden, you are advised to increase their exposure and access to garden topics and content while off-site.	Development of an app prototype anchored in the curriculum and culture of the garden program, and test with children.	With increased access off-site, via priming and reinforcement, the expected outcome is increased engagement on-site.
When developing a digital tool for a school garden program, you are advised to involve the garden educators of the program, and ideally in a co-collaborative way in the design process.	Incorporating co-collaborative strategies -- teacher design teams-- in a volunteer-based project team.	By focusing on the attitude and intrinsic motivation of volunteer educators and encourage autonomy, this involvement in the co-collaborative team should have an effect on the incorporation of the reformed curriculum into their own teaching strategies.

Substudy 2: Sowing, germinating and cultivating



Design process: Conceptualization of the digital tool

In the design and development process of Substudy 2, we are planting the seeds of modernity across the garden, but also attempting to link up the root systems of the education environments across the learning landscape continuum. Described by garden educators, the continuum depicted in Substudy 1 is being disrupted at multiple points, leaving the gardens as a stand-alone environments. Similarly to how trees that are planted in parks are very far away from their supportive network of the forest, they have to work harder to survive in different ways, than if they had protection and support from the forest (Wohlleben, 2016). These contextualized learning experiences that happen in each of the learning environments should support and complement each other, not unlike members of a forest.

As described in the introduction, a boundary object is an artifact (Star 2010; Akkerman & Bakker, 2011) and the boundary object in this case study-- the digital tool-- is used as a means of bringing these environments

metaphorically closer together using a digital representation of the garden landscape. The app, as designed by a project team of educators, would serve different functions to each of the learning environments that it travels to. Surpassing the physical limitations of the garden itself, an app can literally travel in your pocket. The sophistication and function of apps across different mediums additionally increase the accessibility of such an app to be utilized across environments and contexts in different capacities. While discussing the potential use of a school garden app amongst colleagues at the end of an outdoor season day, garden educator Reggie noted that, *"some teachers have expressed interest in bringing the garden to school and doing more with the content but they currently don't have reliable or continuous access to that information, especially across all 13 gardens."* In the case of the NME program and related schools, many participating school teachers incorporate the use of technology via interactive white boards, also known as smartboards, into their curriculum; an opportunity for a digital garden tool to cross the boundary of the garden and into the classroom.

At home, the garden educators that I talked with envisioned an app connecting parents to what happens at the garden on a more regular basis outside of *Open Dagen*, or Open Days at the gardens, which occur annually each fall across all of the gardens. While exciting and informative, Open Dagen are limited in their ability to maintain a more regular sense of connection between the garden and home environments. These educators envisioned the app as a solution to this glaring lack in contact as a way to broaden parental understanding of the function of the school gardens, and specifically in the way of inviting them to participate more, or, as suggested by another colleague Wilbur, locally via recipes. The focus, from the garden educator perspective, is largely on recipes because what the kids grow and harvest are ingredients more traditionally used in Dutch recipes. Widespread representation of the other cultural demographics seen across Amsterdam are not currently well incorporated into recipe introduction, but this varies from garden to garden and educator to educator. As it stands currently, it is difficult to relay recipes and messages home via the school groups regarding Dutch vegetables and herbs, and how might the families use these harvested crops in Ghanian or Suriname cooking for example. In another conversation, colleague Wilbur noted that *"... representation and promotion of local food used in cultural dishes is missing, except for when we mention it during a lesson, but then it is up to the child to relay the message home. Lord knows what happens after the groups leave the gardens"* (Wilbur, personal correspondence, 6 June 2019[6]).

During a short pause one day in November, Juliette was discussing what she'd like to see in an app, pointing out that even though there is a website hosted by the municipality called schooltuinrecepten.nl, *"tips and tricks are lacking, especially in terms of preparation and storage of the gewassen harvested"*, with Reggie chiming in that *"many of my colleagues believe that there is a lot of food waste happening with salad greens and other things that are harvested and are "dirty" or have dirt on them". A* significant leap has to be made in order for some cultural groups to embrace what's harvested on the garden into their diet, and the app could help facilitate bridging that gap. Harking back to his representation thread, Wilbur suggested *"including testimonials from families that tried out a recipe or used a vegetable, and can explain how they did it, like a substitution for traditionally used vegetable, or just that they enjoyed it. Something to bring the garden and home closer together, but also to bring families closer as well."* Reggie completed the thought, *"So the app could serve as a community-building tool!"*

Following my prior internship experience, as detailed in Substudy 1, I recognized a breakdown across lines of continuity between the different learning environments the students occupy. And as a reminder, as described by the garden educators, the connection between the school and home appeared to be stronger than the connections between home and the garden and the garden and school respectively. The garden exists as an island of an experience; during the *binnenlessen*, school groups visit the garden only once a month January, February, and March, then transition to weekly visits between April and October, visiting one last time in November to wrap the year up. The frequency with which the school groups are physically present and interacting with the garden themes and contexts is far below that of the "regular" school experience. There is little control that garden

[6] Quotes from Wilbur were recorded in June 2019 after over a year of informal conversations leading to a more formal, recorded conversation that reiterated much of Wilbur's perspective and observations since I had started working with the garden program.

educators have over the education experience once the children leave the garden, and that can impact the depth of understanding what themes and concepts were discussed during the 90-minute lesson, as well as the use of the harvest from those days.

At the end of the outdoor season, and following the conclusion of Substudy 1, I found myself pondering the following question: *How do you sustain a connection between kids and the increasingly important topics of sustainability and place in nature if that connection is primarily fostered when they are physically there?* This question fueled the design of the project team, and the methods I implemented in order to explore it further with the group of garden educators.

Theoretical Background: Design Thinking and Teacher Design Teams
Tim Brown, the CEO of design company IDEO has defined Design Thinking as such: "[a] human-centered approach to innovation that draws from the designer's toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success[7]." This approach to the project team and app development process is especially important to incorporate, as the garden education environment is non-traditional, typically follows a different structure than traditional and formal science education, and employs educators from a variety of different educational backgrounds. Due to the fact that this research project has a focus on the environment within which educators would feel confident and comfortable developing and using a digital tool in a traditionally analogue setting, the needs of the educators should be front and center in the design process. Currently, design thinking is being supported by IDEO across the world, largely in the United States, in formal K-12 classroom settings[8], but informal education settings, and specifically garden education has not been reported as such.

Teacher Design Team (TDT)
Binkhorst, Handelzalts, Poortman, & van Joolingen's (2015) research on Teacher Design Teams is serving as a guiding text for designing the project team process. It lays out a framework within which to create a teacher design team, what conceptual framework and methods are important to include and why, and how to evaluate the process. Matter of factly, the article notes that professional development projects that include collaboration in the design process has a positive impact on the integration of the educational materials into the educators' classroom practice.

As the project team was being developed with informal educators, not every aspect of the TDT conceptual framework was applicable or useful to incorporate into project design. All of the process features were included, but team interaction, goal alignment, and vertical and shared leadership were more specifically emphasized due to the fact that they were aspects of TDT functioning that, in the particular case of the NME program and project team being conducted in Dutch, these features could more easily be observed and documented as a non-native Dutch speaker conducting the sessions.

Project team development: Design in theory and practice

At the beginning of this process, I developed a general timeline with specific goals to attain by certain periods of time to keep the project on track based on the initial goals set forth. As the year went on and it became apparent that I would have to be more flexible in the timeline schedule, I began to document the specific changes per period of time to compare with the initial ambition and design. The proposed timeline was initially developed in November and December, and updated in February and March. It is important to note that the original version of the timeline and log extends into the period of time that Substudy 3 takes place, but for organizational purposes, the full version can be found in Appendix B.

Proposed timeline	Project log

[7] https://www.ideou.com/pages/design-thinking
[8] https://www.designthinkinginschools.com/about/

December/January: Put team together, preliminary questionnaires and baseline attitude assessment	**Early December**: Identification of potential project members with member of garden management team. Developed interview scheme for intake of project team members. Strategized with Reggie over multiple days about TDT mechanics and his role as my supervisor/participant (coach vs. member, shared vs. vertical leadership). 12 December: Pitched project team at colleague borrel to drum up interest. 2 educators signed on with 3-4 interested in being reserve, 2-3 interested and enthusiastic, but "too busy". **January** 9 January: listserv email sent out to colleagues asking for more volunteers, split the project time commitment into 3 phases over email (design/development, piloting, feedback), restructured TB and methods to reflect educator focus and adaptation of TDT and design thinking rather than direct incorporation, updated interview scheme to include teaching style question. 10 January: Sabine volunteered for testing and piloting phase. Email sent out to 6 confirmed volunteer team members. Planned first meeting, restructured intake interview scheme. 18 January: Reworked interview scheme into an intake survey, confirmed week 6 and 7 as first group meeting weeks.

Theoretical Background: The Theory of Change

As the development process of the digital tool via co-collaboration is the driving aim of this case study, documenting expectations, motivations, and attitudes of the volunteer project team participants is extremely important. For this reason, the Theory of Change[9], which is a comprehensive and descriptive depiction of how and why a desired change is expected to happen, in a particular context (Jensen, 2018; Nesta, 2011), is used as a tool to capture educators' positionality in the project team via the intake survey.

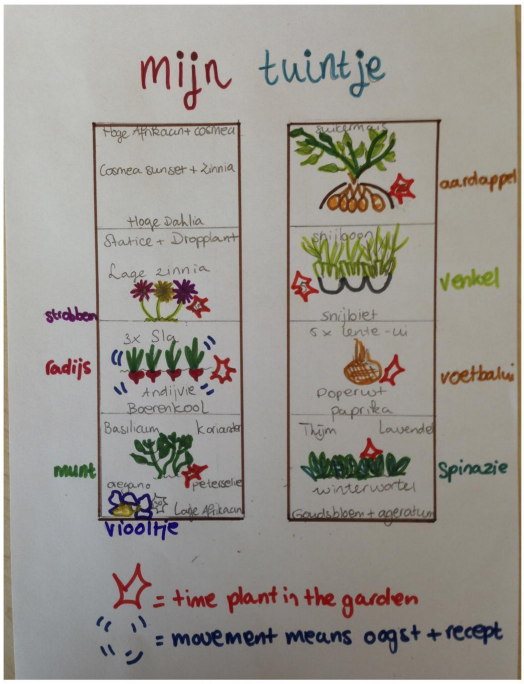
This particular tool has been chosen, as it aligns nicely with the conceptual framework teacher development teams (Binkhorst, Handelzalts, Poortman, & van Joolingen, 2015). The Theory of Change also supports Design Thinking strategies, as they are both following the same ideology of a human-centered approach to operationalizing change within an organization through creating goals that are outcome-based.

The completed intake surveys by the project participants can be found in Appendix B. Below are two of the responses to the final question on the survey, which asked project team members to draw what they envision

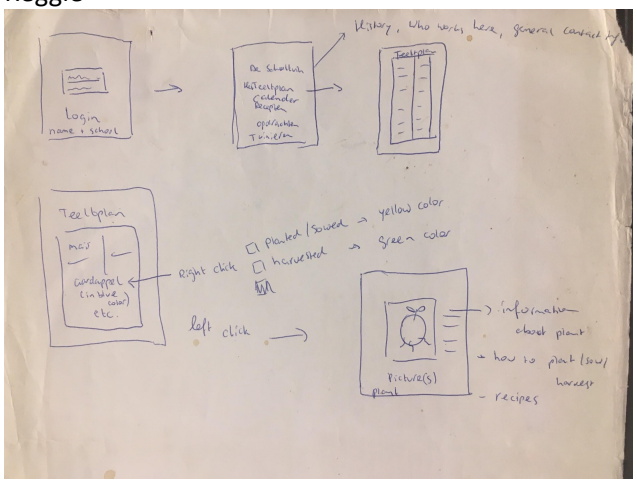
[9] http://diytoolkit.org/tools/theory-of-change/

the app to look like.

Fenna



Reggie



Proposed timeline	**Project log**
January: Collect survey responses and plan first project team meeting agenda.	24 January: Sent out intake survey via email to participants and doodle requesting availability for the first meeting. Gave educators one week to complete. 25 January: Self-teaching session with InVision tutorials and practice. 29 January: Received log book materials from Floor Binkhorst to model project team observation scheme after. 30: Sent out reminder email for survey responses.
End January/February: Team goals established, schedule confirmed	**February** 19 February: Lost Paloma as a participant officially (personal correspondence), spoke with Juliette about being a flex/on standby participant (sent survey), informal participation based on availability. 20 February: Received completed survey from Juliette, who joined the team as a flex participant. First project team meeting with Reggie, Fenna, and Fiona at Schooltuin Reigersbos. Problem definition as

	a group and first brainstorm of possible prototype focus.

First project team meeting

The meeting at Schooltuin Reigersbos began with a discussion on the survey results, in order to get the project team members present-- Fenna, Reggie, and Fiona-- on the same page with the problem definition. After making the links between learning environments explicit, I asked the team to envision their ideal garden app, and using the white board with the triangle of the Learning Landscape Continuum, to draw the connections between what they envisioned to the goals of the NME program. From there, we drew up possible scenarios for teachers, students, and parents to interact with the app and for what purposes. One of the major takeaways from the brainstorm session was that the team members collectively agreed that *"At school, the app would be super useful if the teachers could tap into it in a more functional capacity, like if there were minilessons or additional information, preparatory or reminder information."* Drawing on those scenarios, the team identified possible situations where we could test out small pilots in order to give us a broader understanding for what the app should contain and how it should work.

Prototype #1: *"Mijn tuintje in het lente"*

One of the major goals of this research project was to visualize and give legs to the brainstormed ideas of the project team in the form of an interactive prototype in order to get closer to understanding how the digital tool could be created. Since I am not a programmer by nature, it was important to identify a small enough intervention that, when carried out, serves as a basis for understanding the broader themes and goals of app development and professional development combined; one of the aims of this research.

Theoretical background: Impact assessment in informal education

According to Eric Jensen (2018) of Warwick University, impact is defined as the overall net outcomes or results of an activity or intervention- intended or unintended- for individuals or groups. Types of impacts can include development in learning about a specific topic, attitude change, a greater sense of self efficacy, enhanced curiosity or interest in a subject, and improved skills or confidence, for example (Jensen, 2018). Evaluation of impact should be based on specific changes in a student or participants in relation to their behavior, knowledge, skills, and/or emotions.

For the project team, it was important to discuss what the team members considered the purpose of school gardening, and what they wanted participating children to take away from the garden. The functionality of the app was then discussed in relation to how the students should feel and what they should know, and two aims were co-created by the project team to test out with a prototype of the app in the school-to-garden interaction since it was the connection that was most easily accessible to me as an non-native Dutch speaking intern.

Proposed timeline	**Project log**
End February: Build first iteration of prototype.	**End February/Beginning March**: Created the first prototype based on the brainstorm session.

Germination: Prototype development

As a result of the brainstorming session discussion, the project team and I focused our efforts on producing a prototype that housed informational material, recipes, and interactive screens that children, their parents, and teachers could click through at will-- the app functioning as a boundary object. Additionally, the prototype was envisioned to include information from their former lessons, and practical knowledge about what grows

as the outdoor season marched on.

Theoretical Background: Boundary object

A boundary object is an artifact that serves different functions in an educational environment (Starr, 2010). Not only can the object serve different functions in different environments, the various environments can also dictate how the actors in that environment function differently as a result of interacting with the boundary object. Most importantly, a boundary object serves as a tool and means of communication between the different environments; a major key to the NME program prototype development.

Modeled after the *kringloop*, or life cycle of the garden, the prototype initially focused on the themes taught in the indoor lessons: seeds and germination, soil and its origins, and getting to know the school garden rules and culture. Figure 2 shows the brainstorming process of the project team, Figure 3 is a distillation of the major themes and components of the purpose of school gardening, and Figure 4 is a visualization of that distillation via the InVision Studio programming. This triptych illustrates both the breadth of topics covered in the school garden program and the depth of inspiration as compared to what is possible to develop in a clickable, web-based prototyping program; they are not a 1-to-1-to-1 match.

Figure 2

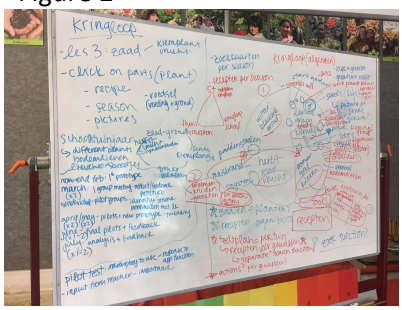


Figure 3

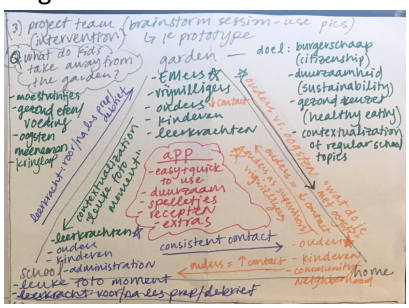


Figure 4

Following the meeting, I created a brief for the project team educators to share with their prospective pilot group teachers as a part of an invitation to participate in the project. The brief (see Appendix B) contained the two aims and goals of the pilot described below:

1. *First pilot aim: recall of prior knowledge learned in the indoor lessons 1, 2 and 3*
    a. *Goal: Your students will engage with the app/website at school. During the first few outdoor lessons, I will hopefully observe your students using terms and concepts they learned during the lessons in January, February, and March.*
2. *Second pilot aim: introducing new concepts for outdoor lessons.*
    a. *Goal: Your students will engage with the app/website at school. During the first few outdoor lessons, I will observe if students will utilize new information (such as how to harvest a vegetable) at the garden.*

Using the InVision Studio program, I developed artboard screens[10], such as the one seen in Figure 4, for the prototype to create opportunities to test these aims. Initially, the two pilot aims above were developed to test individually, and the first iteration of the prototype was built in reflection of that ambition.

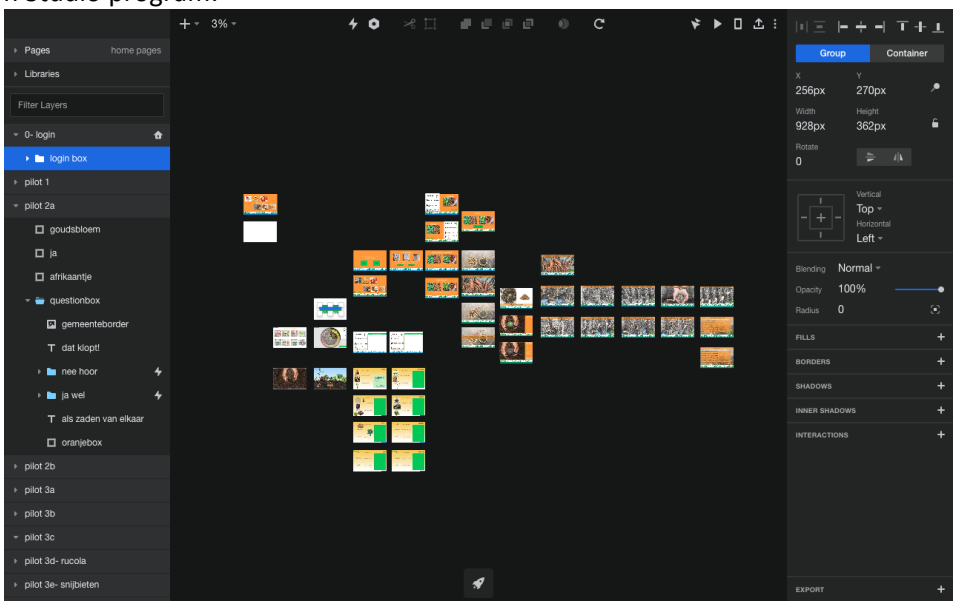
[10] A pdf containing screenshots of the prototype artboard can be found in Appendix B.

Theoretical background: Knowledge transfer, educational apps, and InVision Studio
Hirsh-Pasek et al.'s 2015 research describes the qualities of a good educational app. Their criteria for what makes an app "good" is based on an examination of best learning practices of children from research in the Science of Learning across app development. With their research, it is possible to not only utilize the principles identified to evaluate what kinds of apps are currently available, but also to use their evidence-based guide to create a rough timeline for the development process itself. The four "pillars" of learning that should be incorporated into an app for it to be considered educational are that the app promotes 'active, engaged, meaningful and socially interactive learning' (Hirsh-Pasek et al., 2015). Additionally, the incorporation of game-based learning principles into educational apps can have a positive impact on learning gains (Lester et al., 2014), which can have an impact on the transfer to real-world application.

In Huber et al.'s 2016 research, it was concluded that young children are able to, after learning how to solve a problem on a touchscreen, apply their learning in real life. This finding indicates that children, even as young as four years old, are capable of transferring learning from digital to physical environments (Huber et al. 2016). In contrast, Hipp et al. (2016) discussed the "transfer deficit" that can occur between touchscreen and face-to-face learning, giving strategies that help address this gap. Strategies include making explicit the links between 2-D and 3-D learning material and providing scaffolding in educators' instruction upon introducing the digital environment (Hipp et al., 2016).

InVision Studio is a prototyping program used by app design companies to develop new ideas before creating an app. The program itself is similar to Adobe Photoshop, with a major difference being the ability of the to be tested via a clickable, web-based prototype available on different devices. InVision was selected for use in this project for the flexibility in building multiple versions of a prototype, the ability to be used on multiple operating systems, and its relative ease in picking up the tools and features of the tool. In the figure below is a screen grab of the program with the layout of the initial prototype.

Figure 5: InVison Studio program.



Proposed timeline	Project log
February-March weekly/bi-monthly meetings to prototype; check-ins with questionnaires; design sprint process (input from Irene's teacher group about attitude and willingness	**March** 13 March: Lost Frank as practical team member (busy with his own experiment) and gained Juultje as flex participant primarily functioning as giving feedback

to implement in their classroom/what is necessary to feel comfortable incorporating into school garden preparation,etc.) A schedule to meet with pilot groups will be made so that contact is made on the gardens between myself and the participating teachers, before organizing the pilot sessions (mini-lessons) being built for the teachers) and planning the pilot session times.	and brainstorming. Sabine also signed on to pilot and give feedback. 19 March: Second project team meeting; feedback session where the group interacted with the first prototype. Gave impressions as well as discussed how they expected children and teachers of pilot groups to interact with the prototype- which indicated the types of changes they would like to see based on the outcomes they hope for and expect to test our co-created aims. This included making the artboard screens more clickable and interactive within the constraints of the program and my programming abilities. Project brief for the prospective pilot group teachers was created, sent to project team members and passed along to potential pilot group teachers.
Proposed timeline	**Project log**
March- mid April: Selection of schools to pilot prototype; pre-test & post test (check in with Irene about schools to include in pilot sessions; go in and introduce the app/feedback session with select school garden groups) EMers choose their own pilot groups- filling out a form to explain their pilot group choice, found in Appendix C, and the rationale will be included in the discussion of how to move the project forward beyond the pilot sessions. Goal: Visit the pilot groups on the garden between the first two *buitenlessen*/outdoor weeks, set up pilot within first 6 weeks and follow up observation session within 1 week of pilot.	**March/April:** Pilot group selection process largely dissolved.

Limitation: Pilot group selection

After we had the brainstorm session in February, I asked the project team members to select the school group they felt would have an enthusiastic teacher and group to pilot with, since the first part of the pilot would be taking place in the school and the second part on the garden. This proved to be tricky, especially with scheduling around the vacation times, as well as the busy start to the outdoor season. Ultimately, Sabine and Fiona were unable to secure pilot groups and essentially ceased participation in the project. Fenna found a teacher and group that was willing to join the project, but scheduling around the vacation times proved too difficult to maneuver, and a pilot session was not arranged. Since the brainstorm session, Reggie had tried for weeks to get in touch with the teacher of his selected group, but due to issues on the school's end-- they had a rotation of four teachers visiting the garden with that group-- Reggie explored his second selected group as

a potential pilot option. Juliette tried to enlist two groups to no success, and limited her participation to feedback moments via informal conversations.	
April: Pilot testing of multiple groups on multiple gardens using the *kringloop*-based prototype.	**18 April:** Pilot group confirmed for the following week (Tulpen, Thursday morning group of Reggie at Schooltuin Reigersbos). Determined with Reggie that a new prototype and context had to be developed and built. Arranged with the school teacher to go to the school on the Wednesday before the Thursday lesson to give part 1 of the pilot in the classroom. **24 April:** De Tulpen teacher was ill, arranged with the headmaster to return the following day before the garden lesson to give part 1 of the pilot lesson with the prototype. **25 April:** Gave the classroom/part 1 pilot to the group, walked over to the garden and observed part 2 of the pilot on the garden. Had a short debrief conversation with Reggie on how he felt the lesson went and whether or not he detected a difference in the group's response to the lesson in relation to the prototype mini-lesson.

Substudy 2 Data

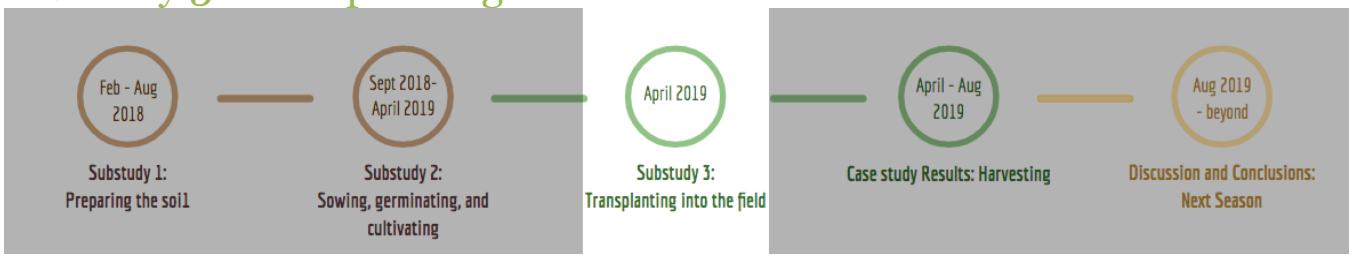
Type of data	Collected	Used
TDT participant intake survey	Based on the Theory of Change, the intake survey was emailed to participants to complete prior to the first group brainstorm session.	This was used to understand participants' perspective on the problem as well as to gather their ideas on what the app should do, how, why, etc. It was also used to establish a baseline attitude and self-efficacy measure, but that piece of data is no longer relevant as the group effectively dissolved as the outdoor season began. Participants answered in Dutch or English.
TDT intake surveys	Sent out to colleagues who expressed interest in joining the project team for either or both project phases (design and development / pilot testing and feedback).	To establish similar ground before meeting together on the problem definition/perceived problem definition and discontinuity across learning environments. Also to begin the conversation in the brainstorming session with the drawings of the app and problem as defined by the participating educators. To check assumptions I was making about the problem definition and solution direction.
Brainstorm session	I transcribed the conversation (largely in Dutch but also in English at	The notes and pictures were used to develop the first version of the prototype. While using InVision

pictures, notes and audio recording (~4 hours audio recording)	moments) around the learning environments continuum and ideas about visualizing the app/prototype on whiteboards and took photos[11] and notes of the results. 4 hours of audio recording were taken of the entire brainstorm session.	Studio, I tried to visualize and operationalize the wishes of the project team as best as I could within the limitations of the program. For example: most of the project team wished for moving parts or animated sections, but InVision doesn't support those kinds of feature). The audio file was referred to throughout the design process, but it was not fully transcribed.
Feedback on prototype #1: notes and audio recording (~1 hour)	I held a brief feedback session (1 hour) with the project team members where they interacted with the first version of the prototype and gave feedback on how it matched their vision from the brainstorm session as well as how to revise it to better match their vision.	This feedback was used to improve the first version of the prototype, but in actuality, the feedback received helped me pivot to creating the new prototype for the carrot pilot. Example: since adding videos or animations wasn't possible, the suggestion instead was to create multiple artboard screens to give the illusion of more interaction with the prototype. This was implemented in the carrot prototype with many clickable screens.
Notes from informal conversations with colleagues	I attempted to jot down short notes in casual conversations I've had with colleagues, as these moments tend to be more revealing and informative than if I sat people down for a formal interview. It also allowed me to gather data from a broader set of colleagues than the ones I regularly interact with (project team, supervisor).	These notes helped contextualize the prototype and how it could be used. Ultimately, the initial vision and version of the prototype were set aside as the executed design was no longer relevant to test the further into the outdoor season. These conversations helped shape my ability to quickly and flexibly build a new prototype based on the first version but with a new context.

Substudy 2 Summary: Results and Discussion

The development of the first prototype from the brainstorming and feedback sessions directly informed how the second iteration of the prototype in a new context should be developed. Although the pilot group selection process led to project team members unwillingly leaving the team, their participation and enthusiasm during the meetings ultimately transformed into support throughout the redesign of the prototype. Project members checked in regularly to give feedback on the design, and their input was reflected in the mini-lesson and new prototype that was piloted in Substudy 3. The artboards for the first prototype can be found in Appendix B.

Substudy 3: Transplanting into the field



[11] Photos from the brainstorm session can be found in Appendix B.

Prototype #2: *Winterwortel zaden & zaaistappenplan*

To rewind a bit, at the beginning of March I began to conduct observations of Reggie's Thursday group lessons for the outdoor season. One of the groups in particular, De Tulpen, was one that Reggie had considered a group to conduct a pilot session with, as the school is representative of the demographics and "general cognitive ability" (Reggie, personal correspondence, April 18, 2019).

April 1st initiated the outdoor season's weekly lessons, or *buitenlessen*. As the days went on, it became abundantly clear that the original pilot aims and prototype needed to be adjusted to the rapidly advancing garden program. Two educators had dropped their participation already, and I learned that a third was unable to secure a pilot group to participate. This left two project team members with tentative pilot groups, and they were on slightly different schedules being educators on two different gardens. I decided to focus on my home garden, Reigersbos, and took a look at the *tuinleshandleiding,* or garden lesson schedule, to see what theme I could create a new pilot prototype and mini-lesson in the hopes of combining both pilot aims. Luckily, one of the last crops the children would be seeding were the carrots.

The carrots are an important crop at the school gardens, as their cultivation takes nearly the entire season and culminates in the *Winter Wortel Westrijd* at the end of the outdoor season and effectively the end of the garden program. Seeding these correctly was important for the children to learn, and double lucky for me, their seeding plan differed slightly from the *zaaistappenplan*-- or step-by-step sowing plan-- the children were introduced to at the beginning of the outdoor season. This was an opportunity to call back to prior knowledge about seeds that the groups had learned in the indoor lessons- that not all seeds were the same. The recollection of this important piece of content could then be juxtaposed against the seeding skills they learned at the beginning of the outdoor lesson as well as against the different aspect of planting carrots. Because carrot seeds are very small and lightweight, seeding them in the same way that the kids learned how to seed raapstelen would result in carrots with small roots-- no good for eating, and certainly no good for a competition to see who has the biggest carrot. For those reasons, the garden mixes the carrot seeds with sand-- another opportunity to incorporate indoor lesson content about good school garden soil and what seeds need to germinate-- into the pilot.

With a date set within a week to pilot with De Tulpen, I sat down with Reggie to brainstorm how we could build this prototype. We specifically paid careful attention to how he would then teach the lesson as close to his regular lesson plan structure, while I could harvest observations about the groups' response to the in-school intervention with the prototype. Reggie and I created a mini-lesson collaboratively to ensure that the vocabulary and actions would be what I based the prototype and mini-lesson plan on. Below, the general write up for the mini-lesson are detailed, and the artboards for prototype #2 can be found in Appendix C.

De Tulpen carrot pilot mini-lesson write up:
Part 1: In-classroom pilot session with a guided mini-lesson of the prototype on the classroom smartboard. 20 minutes, conducted in both Dutch and English, weaved together pilot aims 1 and 2, and also tested knowledge at the end of the lesson with a group fill in the blank activity that identified specific vocabulary and actions-- identified by Reggie as the key content items that children should walk away from the lesson knowling. These indicators of knowledge acquisition were then used to build the observation scheme used during part 2.

Part 2: The group visited the garden for their lesson with Reggie.

As mentioned in the introduction for this substudy, both of the prototypes were rooted in the brainstorming and feedback sessions with the project team. Below, in Figure 6 is a table comparing the design choices and their corresponding implications for the case study.

Figure 6: Prototype development and design choices

	Design choices from brainstorming and feedback sessions	Implications
Prototype #1	Visualization of the *kringloop,* or circle of life on the garden, linked to the seasonal *gewassen*, or crops grown during that time as the anchor for interacting with content about crops and recipes.	The development of this first prototype led to a lot of information incorporated, making the prototype itself very colorful, busy, and informative, but without a specific learning direction. This prototype is more of a representation of how the app could be envisioned to be explored at one's own pace.
Prototype #2	A specific context of carrots as the anchor for recalling prior information from the seed and soil lessons and the *zaaistappenplan*, as well as the introduction of new information via this specific context.	The specific context and narrative style of the questions building upon each other requires more engagement with the material. Children can easily interact with the prototype lesson, as it was built to eventually bring children interacting with it to the end point, but guidance or the fill in the blank cumulative test at the end would be best utilized if it was guided by a teacher and reflected upon as a group.

Substudy 3 Pilot Results

Below, in Figure 7, is the survey given to the pilot group, and the major themes from their responses. A table of the full results can be found in Appendix C.

Figure 7: Pilot survey and main themes of results.

<table>
<tr><td colspan="2">Wat vond je van de mini-les over het zaaien van de winterwortels?
Kleur een smiley in.
(What did you think about the mini-lesson about sowing carrots? Color a smiley in)
 
25/27 students colored in the smiley face. Two colored in the neutral face.</td></tr>
<tr><td>Welke tip neem jij mee naar de schooltuinles, waar je zelf winterwortels gaat zaaien?
(Which tip will you take to the school garden lesson, where you will sow your own carrots?)</td><td>4 children explicitly said the #1 tip they took away from the mini lesson was not to listen to what Meester Reggie says.
A good majority of them said that they would take all of the tips with them when they do the seeding themselves.</td></tr>
<tr><td>Stel: er komt een schooltuin-app die je op school of thuis op een tablet of smartphone kunt gebruiken. Jij mag bepalen wat er zeker in deze app moet komen. Wat zou dat dan zijn?

(Imagine: there will be a school garden app that you</td><td>Dream app: 6 children explicitly mention games, 4 mention filmpjes, 2 mention tips in general and also good gardening, 1 mentioned whatsapping with Reggie.</td></tr>
</table>

can use on a tablet or smartphone at school or at home. You can determine what should definitely come in this app. What would that be?)	

Following the mini lesson at their school, the Tulpen kids were enthusiastic and engaged, and were eager to get to the garden. The second part of the pilot took place over the course of 30 minutes, and was situated between the regular garden maintenance activities of weeding, raking, and harvesting. During the course of the 30 minutes, many children visibly indicated that they remembered the steps as Reggie was showing them, by doing actions such as turning to signal to me, physically completing an action or in the case of one child, swiftly turning in my direction which was off to the side, making eye contact, and nodding excitedly. Despite the engagement by a few of the students, there was still the great majority of the class not verbally or physically indicating recollection of prior knowledge. The observation scheme can be seen below in Figure 8.

Figure 8: Observation scheme for the outdoor part 2 of carrot pilot.

stappenplan	**keyword**	**observations**
stap 1: onkruiden weghalen (wieden)	onkruiden	2 girls were very intent on getting rid of every weed, and called me over to inspect their work. They showed me a "clean" spot, and asked what to do next.
stap 2: maak de grond los met de haak	de haak	Multiple children identified *de haak* correctly, and simultaneously 2-3 other children were already trying to make the *zaaigeul*.
stap 3: maak een zaaigeul met je hand	hand (x5)	2 children explicitly stated *"5 keer met je hand"*. All children in the group had proper hand posture while making their *zaaigeultjes*.
stap 4: zaaien (met je handen met zand)	zaaien, handen wassen of stroien	Nearly every child except 1 seeded the carrots properly using the *handen wassen* method. 1 boy was very lost with the steps and needed multiple cues. Ultimately, he threw his handful of seeds and sand in 1 spot with a relatively aggressive fist.
stap 5: maak de zaaigeul dicht met handen wassen of knippen	zaaigeul, knippen	Multiple children (more than 10) demonstrated hand movements when I came over to their garden to ask how it was going with them.
stap 6: stempel/aandrukken met de achterkant van je hand	stempel, aandrukken	I asked one boy what the last step was, as he was ready for that step, and his neighbor offered the answer while the boy mimed the action of *stempel met de achterkant van je hand*. A few children had to be reminded to complete the last step, but they knew the vocabulary words when they were cued with a prompt such as me reminding them that they should make sure their seeds are safe, etc.

Substudy 3 Data

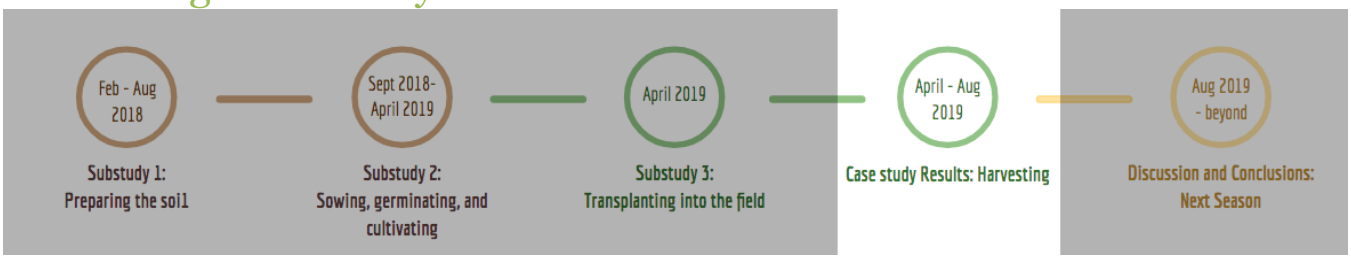
Type of data	**Collected**	**Used**
Prototype #2: carrot prototype	Put together using the advice and vision of the brainstorming and feedback sessions as well as strategic conversations with supervisor Reggie.	During the indoor part of the pilot with the school group, the prototype was projected onto a smart board and interacted with through a pre-designed mini lesson. The classroom session was audio recorded and short surveys were distributed to the

		children following the pilot.
Audio recording of classroom pilot part 1 (~30 minutes)	Recorded with signed permission from the headmaster of the school during the classroom session on my iPhone.	Audio recording used to compare engagement in first part of pilot and second via the observation scheme.
Observation scheme of pilot part 2	Observations (and supplemental video clips) taken with signed permission from the headmaster of the school during the garden session on my iPhone.	Observation scheme was used to gain a better understanding of how the pilot group was transferring knowledge expected to be transferred during the first part of the pilot lesson -- interacting with the prototype-- to the second on the garden in the physical context and their visible and audible indicators of knowledge transfer.
Surveys from pilot group	Gave a short survey to the children following the indoor pilot session to fill out on their own (in Dutch).	Reinforce and support desired features of the app as postulated (by me) and described (EMers). Also to add to the discussion section about what to do next and what is needed in the coming research on this project.

Substudy 3 Discussion

There are a number of variables that were at play here, including the context within which I introduced the pilot, the format of the prototype, the cognitive processing of the kids, whether or not there was enough time allocated to the prototype content itself, and knowledge transfer. For this reason, it is difficult to determine to what extent each of these possible factors had an impact on the results of the pilot. More pilot sessions would provide additional information on potential patterns, and where specifically to focus efforts on redesign in subsequent design cycles.

Harvesting: Case study results



In this 1.5 year-long case study, I discovered that there were many barriers to carrying out a co-collaborative project team with garden educators. To reiterate, the main research question was as follows:

How can a garden-based, digital tool be developed in co-collaboration with garden educators to promote continuity between garden, school and home environments?

In relation to the aim, which was to document the design and development process, there were major lessons that came out of the research that speak to the research question of how a garden app should be developed. Principle development drove the design of the two subsequent substudies, which had implications for how the research was thusly conducted in response to unforeseen limitations. We return to the lines of conjecture to help summarize the major results and lessons learned through the design and development process.

<table>
<tr><td colspan="3">Substudy 2 conjecture map</td></tr>
<tr><td>Principle:
When developing a digital tool for a school garden program, you are advised to involve the garden educators of the program, and ideally in a co-collaborative way in the design process.</td><td>Action/aim:
Incorporating co-collaborative strategies -- teacher design teams-- in a volunteer-based project team.</td><td>Expected outcome:
By focusing on the attitude and intrinsic motivation of volunteer educators and encourage autonomy, this involvement in the co-collaborative team should have an effect on the incorporation of the reformed curriculum into their own teaching strategies.</td></tr>
<tr><td colspan="3">Substudy 2 outcomes:
1. Due to scheduling issues and difficulties getting pilot groups to sign on to the project, the first pilot prototype was effectively abandoned. This was one of the more important lessons learned during this project: identify possible pilot groups as early as possible, and establish a more generalizable pilot prototype design. This is largely due to the differences in garden to garden varying enough that it generates more work in personalizing the prototype. The fact that the garden schedule must be flexible to the schedules of the schools they serve means that sometimes established dates and times and meetings fall by the wayside in order to keep moving through the garden program as already established. Nature does not wait for anyone, and plants keep growing, even if there aren’t children at the garden to tend to them.

2. InVision Studio was very limited in its ability to translate the app desires from the project team, and having to teach myself also was time consuming and limiting. Collaborating in the prototype building would have been more efficient.

3. The potential diversity of functions of the app as a boundary object was not explored due to the design and limitations of this case study. Broadening the scope of subsequent research to include prototype pilots aimed at the parents as well as choosing a specific set of functions for the app to design with an app developer to get a more representative emulation of the project team design is also important to developing the app project further in the future.

4. Although attitude and intrinsic motivation were incorporated the TDT design, they were unable to be tracked for the majority of the garden educators throughout the case study due to the project team dissolving. A follow up interview was conducted with Reggie, and he reported feeling more confident in his knowledge and understanding of new methodology of curriculum reform as well as feelings of ownership over the process and prototype due to his involvement in the project team (Reggie, interview, July 31, 2019). While this is a promising result, it is a very small, unrepresentative sample.</td></tr>
<tr><td colspan="3">Substudy 3 conjecture map</td></tr>
</table>

Principle: *If you want school garden groups to be more present and engaged while on-site at the garden, you are advised to increase their exposure and access to garden topics and content while off-site.*	***Action/aim:*** *Development of an app prototype anchored in the curriculum and culture of the garden program, and test with children.*	***Expected outcome:*** *With increased access off-site, via priming and reinforcement, the expected outcome is increased engagement on-site.*

Substudy 3 outcomes:

1. I told the group that Reggie didn't know I was there and that he would try to mess them up while he was explaining how to seed the carrots because he wants to win the carrot growing competition. 4 children explicitly said the #1 tip they took away from the mini lesson was "not to listen to what Meester Reggie says", which was an unfortunate consequence of context overshadowing content.

2. Dream app: 6 children explicitly mention games, 4 mention filmpjes, 2 mention tips in general and also good gardening, 1 mentioned whatsapping with Reggie. These responses were consistent with both literature (Hirsh-Pasek et al., 2015), as well as what the project team had predicted how the children would respond to this prompt.

3. During the pilot, the group's regular teacher wasn't present during the lesson, and that might have had an effect on the behavior management aspect of the classroom dynamic.

4. I spoke a mix of Dutch and English when I conducted the pilot, asking some students to translate when I would speak English. That might have been distracting for some students since it was a large group, and we didn't have much time to check in during the lesson to make sure everyone was following along beyond the group-wide thumbs up and verbal affirmations I prompted.

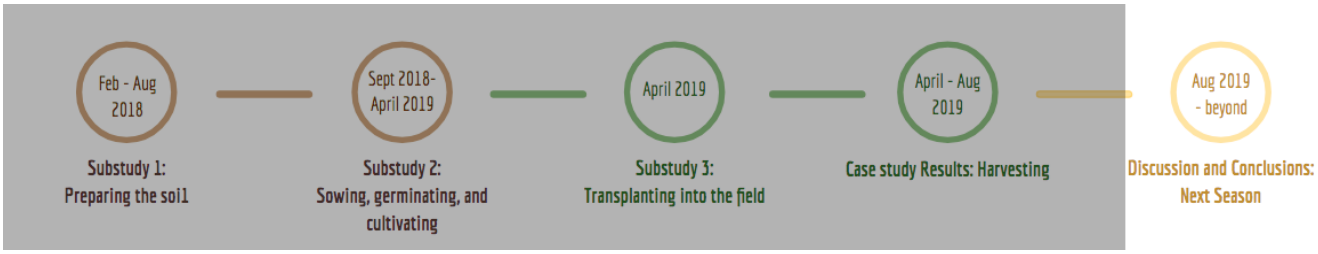
5. The pilot was conducted using a smartboard, so I was the one physically interacting with the pilot while the group followed along. Originally, I was hoping to test this same prototype with a different group with tablets, but was unable to arrange a pilot session with another group due to holiday conflicts and scheduling issues. It would be important to pilot the prototype as representative of how the app acts as a boundary object; different functions and interactions in different scenarios:
    a. In the classroom- on the smartboard led by the teacher.
    b. At home- on the computer, a smart phone, tablet device, by the student and/or with the parents.
    c. At the garden- not specifically meant to be used on the garden, but could be referenced during the indoor lessons on a projector, or an EMer could pull up the app to see what was uploaded from yesterday's dinner made with the harvest of last week for example.

6. Exposure to the prototype alone was not enough to ensure increased engagement on-site. Knowledge transfer is more complex (Hipp et al., 2016), especially across a group of diverse learners. The interplay between this complexity and the execution of the pilot mini-lesson must be further explored with other pilot groups and investigation.

Discussion: The school garden ecosystem

"This is our work, to discover what we can give. Isn't this the purpose of education, to learn the nature of your own gifts and how to use them for good in the world?"

Robin Wall Kimmerer, Braiding sweetgrass, p. 239



Through the process of synthesizing the results from each substudy, my analysis culminated in a crystallizing moment. Although I had been implicitly developing and conducting this research with attention and intention towards garden educator support, I realized had not designed this case study research to reflect that ambition. This discussion serves as a critique of the case study design itself, weaving together the major lessons learned from the design and development process, with the recognition of the school garden program as a complex ecosystem rather than simply an observable landscape, like I had previously been interpreting it. Upon this realization, it became clear that there would be a need for a specific framework of analysis combining education theory and ecological principles to be developed in order to better understand the dynamics of this complex educational ecosystem and its components.

As I had already borrowed language and terminology from the world of ecology throughout the design and development of the case study, it seemed natural to explore the application of ecological principles into my analysis. Most notably, the characterization of the visible dynamics of the school children as they navigate their educational experiences in relation to the garden as the *learning landscape*. Additionally, it became impossible to ignore the similarities between the evolution of education research as compared to the evolution of forest management research, especially considering the evolution of both in response to a changing climate.

Evaluating the results of the Nature and Environmental Education Program case study, it became abundantly clear that using this learning landscape lens focused this research on the easily seen, or in ecological terms, aboveground dynamics. Broadening the analytical lens, little attention had been paid within the execution of this research design to the interactions behind those visible interactions; how the educators internalize these dynamics and interact within this system. And more importantly, the impact of a support infrastructure that is lacking. Looking to ecological terms again, educator support dynamics can be considered the deeper and not as easily seen below ground activities, when disregarded, ultimately are manifesting as burnout in a worst case scenario. For these reasons, the discussion returns to the case study's sub research question, which was initially abandoned during the design process for the sake of narrowing the scope of this project:

What specific support mechanisms should be put in place in order for garden educators to express confidence in their ability to incorporate the app into their teaching style?

Alongside the consideration of expansive learning philosophy, while revisiting the concepts of boundary objects and discontinuity, the application of ecological principles serve as a way to root this case study within the broader problem of learnification. Moreover, the application of forestry principles into agricultural systems management, by the way of agroforestry, speaks to the novel approach this case study took in combining professional development of informal educators and curriculum reform.

Within this discussion, I first introduce the literature and rationale for the theoretical framework I used to analyze the case study as a whole. Then, per substudy, a brief synthesis of the major lessons or problems encountered, implications for the case study as a whole, the ecological principles applied in developing recommendations for future research consideration.

Theoretical Framework

Expansive Learning vs. Discontinuity

As previously introduced in Substudies 1 and 2, the discontinuity research put forth by Bronkhorst and Akkerman was primarily utilized in relation to the school garden groups. While taking a look at this case study as a whole, it became apparent that the initial aim and scope of the project had been expanded, revealing dynamics indicating that the NME Program functions more as an ecosystem than a landscape; a more expansive and complex set of dynamics than previously anticipated.

The case study design analysis revealed a major assumption made at the conclusion of Substudy 1: that the goal or function of the app would be to function for the children and their families. This assumption is not incorrect, however mistimed. The critical impact: a prior condition of the function of the app as a boundary object had not properly been established. Who does the app truly serve, and why? The analysis of this case study has revealed the true function of the app -- and ultimately design and development-- should be focused on what it can do for the educators as an integrated piece of a larger support infrastructure. Where the app would dominantly be used off the garden site by the children, their parents , school group teachers, and parents, it ultimately serves as a digital element of the garden educators toolbox. This digital tool, as it could function developed by garden educators for their own garden education programming, could serve to help educators delineate their roles as educators better; to reclaim their terrain in the ecosystem so to speak. When asked about the responsibilities and roles of the garden educator in a follow up interview conducted with the remaining project team member--Reggie--he

By co-collaborating to design and develop the app prototype, this case study began to make visible the perspective of the garden educators, revealing a more complex and deeper issue of discontinuity than previously considered. With that revelation in mind, research conducted by Engestrom & Sannino (2009) on expansive learning helped frame this critical understanding of the NME Program, and the relationship of my role evolving as the case study was conducted. As described by Engestrom & Sannino, the theory of expansive learning involves learners as actively being involved in the “construction and implementation of a new, wider, and more complex concept for their activity” (2009, p.2). Using this theory, it is evident that the conceptualization of this project has expanded past its original aim and intention; from a landscape to an ecosystem.

Returning to Bronkhorst: Discontinuity

The previous application of discontinuity to this case study centered around the idea of discontinuity in the education experiences of the students. Where I had previously focused my data collection on how the educators were perceiving the discontinuity and its impact on the children, it was impossible to ignore that an additional layer of discontinuity existed in the perception of support infrastructure offered by management. Discontinuity is manifested in different ways across the levels of the NME program-- individual to individual, garden to garden, cluster to cluster, and administrative management teams to each level. An analysis of the conversations, interviews, and surveys done points to discontinuity experienced by the garden educators in relation to the types of support they experience, especially in relation to the consolidation of the management that occurred approximately four years ago (Lianne, personal correspondence, August 9, 2019. In a conversation with one of the members of the management team for the NME program, Lianne, it was revealed that discontinuity is also perceived in the ability of management to provide adequate support, noting that prior to the consolidation, “smaller group management [occurred] by region, which made it much easier and faster to make plans and make it happen”. Additionally, the consolidation “brought together the islands”, and “a new initiative to check on the

quality of education we offer has begun." "Unfortunately," Lianne continues, "implementation of the quality control check hasn't happened yet, and the power of management [has] broke[n] a lot of people."

Learnification

When analyzing at this research study as a whole, each of the three Substudies, at particular moments of time, speak to the broader phenomenon of *learnification* in education. Coined by Dutch education philosopher Gert Biesta in 2006, learnification of education is the constructivist-based focus and development of education, centering the learner as the most important with the majority of resources and energy focused on them, and where education is largely defined by "teaching and learning" (Laverty and Gregory, 2017). In *Interrupting the Politics of Learning*, Biesta (2013) zooms into the linguistics of education and the impact that specific words have on our understanding and operationalization of policies and practices. Most notably, according to Biesta, one of the impacts of learnification is the emphasis on students and their activities as opposed to the teachers and their input (p.5). Furthermore, the implications for describing education using the word 'learning' on the dynamics in an educational environment can have unintended outcomes, described in the following excerpt from Biesta (2013):

"The fact that 'learning' is an individualistic and individualising term -- learning is, after all, something one can only do for oneself; it is not possible to learn for somebody else -- has also shifted attention away from the importance of relationships in educational processes and practices, and has thus made it far more difficult to explore what the particular responsibilities and tasks of educational professionals, such as teachers… actually are." Interrupting the Politics of Learning, p.6

The quote above speaks to the discontinuity experienced across the different levels on the garden; a lack of program-wide understanding of the purpose of school gardening has led to a shift of responsibilities towards the garden educators to not only facilitate the educational experiences of the children, but also to determine themselves the ways in which those experiences can be improved in quality without necessarily receiving the appropriate amount of support for that type of responsibility. Additionally, while an underlying motivation for this case study was in fact educator-focused-- initially aiming to orient the project to address support structures, the design of the study largely fell victim to this "unintended outcome" as Biesta would describe it; the research question and aims that grew out of principle development resemble a focus on the learner and their actions.

Ecology and forest management principles

Published in *Forestry: An International Journal of Forest Research, "Successional and structural responses to overstorey disturbance in managed and unmanaged forests",* Morrissey, Saunders and Jenkins (2015) set up their research with a great representation of forest management practices and terminology. From their introduction, I'm borrowing the following historical narrative and principles of forest management to apply to the NME program, but I am leaving out their applied use of the management principles to their research for the sake of simplicity and applicability.

Over the last 100 years, forest management research has shifted from utilizing forests as purely an economic resource for economic exploitation, towards the integration of economic and ecological values held equally important for management practices (Morrissey et al., 2015). Considered "nature-based", these practices largely center around the principle of *ecological resilience*, which was first introduced to the literature by C.S. Holling in 1973 (Gunderson, 2000) but characterized by Morrissey et al. as the "capacity of a system to absorb a perturbation without experiencing a change to a fundamentally different state" (p.376). Additionally, this ecological resilience is facilitated by the maintenance of ecosystem function, structure, and diversity. Within temperate hardwood forests-- the site of Morrissey's research-- it has been understood that as a forest experiences disturbance outside of its natural pattern, the successional dynamics of the forest become largely homogenized. In other words, there is a certain amount of disturbance that a forest system can naturally respond

to while maintaining species composition and function. Disturbances falling outside of that natural range of activity leads to decreased variety of species, which in turn can lead to decreased numbers of individual species groups as well as a decrease in the components of biodiversity of species to work in complementary ways, also known as *functional diversity* (Lohbeck et al., 2012).

Furthermore, another important principle to forestry management is the consideration of heterogeneity, or diversity, across levels within the forest ecosystem to ecological resilience. The ability to predict management effects across a long-term time frame is largely depended on the understanding of the range of disturbances tolerable to the forest ecosystem across the components of the forest is important (Morrissey et al., 2015). This means that in order to have a grasp on the extent of ecological resilience within an ecosystem, one must consider the resilience of not only the whole forest, but also species groups per spatial area-- or *stands*--, the interactions between species groups composition-- functional diversity--, and the resilience of individuals themselves.

In recent years, two major shifts have begun to take place in relation to forest management research and climate change. The first, fungal network research, has proven fruitful for the combination of ecological and economic value integration in management development. Fungal networks have been found to not only facilitate ecosystem services provided by forests, but to also aid in the promotion of ecological resilience by means of an interplay between the impact of management practices on the fungal species, also known as *micosilviculture*, and the species-specific responses of the mushrooms (Tomao et al., 2017). By investigating the specific ecological needs of these belowground fungal communities and their expected impact on the stands they support aboveground, the health of the forest ecosystem can also be better understood.

The second line of research has focused on the integration of forestry management into agricultural management practices. Although complex in strategy, simply put, *agroforestry* is the practice of managing trees and non-tree crops or animals in the same land area, and has been used globally for centuries (Nair, 1993). Where historically, European-birthed silviculture-- or the practice of controlling the growth, composition, and health of a forest for specific means (Matthews, 1991)-- took hold and was proliferated as colonialism also rooted itself globally (Sivaramakrishnan, 1996; Tucker, 1982), agroforestry approaches have been largely reincorporated into agricultural and land management research and practice as a response to climate change (Noorderwijk, 2018). The benefits of agroforestry are many, but specifically the flexibility in strategies to incorporate within management planning and the emphasis on planting perennial, multi-purpose crops that yield long-term benefits in order to make maximum use of the land (Martin and Sherman, 1992) are particularly significant to this analysis.

Evaluation of Substudies

The following is a brief synthesis of the limitations of each substudy with the ecological principles I selected in the theoretical framework to help formulate recommendations for subsequent research.

Substudy 1: Preparing the soil

School garden groups don't have enough exposure to garden topics, and do not easily or efficiently take topics with them home and to school. This has an effect on the garden educator input and output. This observation led to the principles to be developed based on these specific, visible interactions, and my understanding was fixed on what could be easily tested and seen: implement an intervention, see a result; hopefully increased engagement based on priming. This limited the scope of the project, which was important to do to be able to accomplish something within the allocated time period, but limited conceptualization of could possibly be needed "behind the scenes" in order for project team volunteer participation to be sustained. This idea surfaced throughout the rest of the case study as a result of the design based on the assumption that garden educators could sustain volunteer support. Considering the interactions of the children across the learning environments as a landscape flattens the interactions, focuses on the learners, and disregards the facilitation of the experiences via the garden

educators --- and ultimately the support systems and strategies that are needed in order to facilitate these contextualized science and nature experiences.

Implications

Led to high enthusiasm and interest from certain educators, some resistance and skepticism as well as criticism from others, but ultimately low ability to commit to the project team, and a high rate of drop out. As Paloma said in a brief conversation between weeding one day, "before management, the gardens were self-functioning and self-organizing organisms, better able to serve the kids, the teachers, the schools and each other." (Paloma, personal correspondence, July 31, 2019). She continued describing the discontinuity she perceived as "secrecy… the management team keeps secrets from the colleagues. They are not using the ecosystem to better make things efficient, and make things between educatief medewerkers and gardens better." Paloma also felt that the management style currently in place is "too rigid, and causes a lot of people to have mental instability" in relation to their jobs.

Ecological principle: biodiversity count

Looking to stand management and species interaction mapping, biodiversity counts are a useful tactic for the NME program. Through a more adequate understanding of the diversity amongst the colleagues varies, management can gain a more solid understanding of how the gardens interact with each other, with the garden educators, and with the management team themselves. As stated in the case study, the garden educator team is a very diverse group, from teaching styles to background education. Understanding the dynamics of biodiversity of the NME program, and how those interactions play out, should be done in order to more efficiently design professional development and curriculum redesign opportunities.

Recommendation: Substudy 1 principle

If you want to design a collaborative, professional development project, broader consideration for the function in relation to structure-- ecosystem dynamics-- of the garden program should be done in order to have the proper depth perception guiding the research design and execution. This can be done by extending the empathizing phase, conducting more representative interviews of garden educators, and running additional design cycles with a small prototype based on specific support structure requirements across levels-- individual, garden, cluster, whole program. With the help of external position, could shorten that time to shift the burden from self-starting support to actual supportive position and infrastructure.

Substudy 2: Sowing, germinating, and cultivating

More in-depth interviews with participants and broader influence from representative population should be taken into account. Colleagues who were enthusiastic about updating teaching strategies or curriculum were more likely to approach me to talk about the project, and give their opinions. The more "old-school" colleagues, who should absolutely be taken into consideration, as they would be the more difficult ones to motivate to use the tool (Reggie, personal correspondence, June 2019). They could also be benefitted the most with this kind of supportive tool, as they are typically older and more physically taxed with the responsibilities of the job.

Related to the implication of first substudy, the participation of educators was restricted and dictated by the rapid pace of the curriculum program, especially once the outdoor season started. Not only does the program move quickly through content, the task of selecting, contacting, and confirming their own pilot groups select, took far too long. Additionally, my inability to redesign the prototype fast enough was unable to match the pace of the outdoor season curriculum.

Implications

Educators, while enthusiastic, couldn't manage to secure pilot groups. Previously considered as an exercise in autonomy, this task is now understood as a burden when compared to the timeframe of the project. Ultimately the initial prototype had to be abandoned, which also led to all but one of educators decreasing participation despite continued enthusiasm. This would serve a problem for other educators who perhaps were less enthusiastic or intrinsically motivated to volunteer and step away from the project altogether unless better support is in place. Forms of support, such as more vertical leadership from the project team leader, financial or temporal support from management, or even assistance from colleagues, still need to be explored through gathering more representative data from across the gardens.

Related to Paloma's comments, Lianne also described colleagues reporting feeling dissatisfied with their work, feel stressed, or actually burn out (personal correspondence, August 9, 2019). This is with the exception of +/- 10 colleagues across the 13 gardens that are conducting experiments of their own design, and report higher workplace satisfaction and energy, due to the added spontaneity and variety in their teaching strategies, as well as the integration of tools like the *OOL kaart* (Lianne, personal correspondence, August 9, 2019).

Ecological principle: **ecological resilience and the mycorrhizal network**
Through this research, and although not fully understood, the ecological resilience of the NME program ecosystem is starting to be revealed. With educators experiencing stress to the point of detriment and perceiving discontinuity, these are indicators that proper supports are not in place to protect against changes towards a state of duress. This indicates that the NME program is not as ecologically resilient as it could be, and the development of a supportive infrastructure is necessary.

Recommendation: Substudy 2 principle:
Such as forest health above the soil relies on the health of the mycorrhizal networks below the surface of the soil, the toll that a lack of support infrastructure is taking on the educators is being seen and felt. Improving communication across the levels of the NME program in order to better identify the necessary supportive strategies can function like these microbial networks, allowing educators to root down so that they can branch out and try new things and feel supported, and feel that they are capable of integrating new types of curriculum tools and strategies.

Substudy 3: Transplanting into the field

In the design and execution of the pilot, a fuller understanding of knowledge transfer was lacking, and observation scheme thusly did not reflect the complexity. The smart board limited interaction of the children with the prototype, and there were errors in continuity between Reggie's garden pilot and the classroom pilot mini-lesson. The group's regular teacher was ill during the pilot, and Reggie noted the group's classroom behavior reflected the lack of behavior management usually present.

Implications
The aims of the pilot were not necessarily fully met-- more accurately, they were unable to be met. The conjecture map does not tell the whole story, and we potentially missed opportunities to better understand the impact of the prototype on the children by not fully understanding the components of knowledge transfer with this group. Additionally, the inability to get feedback from the group's teacher on how she perceived the pilot and how to improve it was an unfortunate loss of valuable input.

Ecological principle: functional diversity and flexibility
Due to a lack of understanding of the interplay between my role and positioning vs. Reggie and his role as the garden educator, the pilot session survey results revealed a more complex dynamic than previously known, with many children concluding that the most important tip to take away from the mini-lesson was "don't trust Meester Reggie". Functional diversity, or the way that species communities interact with each other to provide an

ecosystem service, can help guide a better approach to incorporating project team dynamics into the design of a pilot intervention. Additionally, understanding the prototype design program better so that multiple design cycles can take place is key, contributing to the flexibility of the response-ability of the project team to an unforeseen outcome.

Recommendation: Substudy 3 principle:
If you want something to happen on the student group level, you need to have boundary crossing at other levels and support infrastructures across the different layers. This includes boundary crossing of educators across the NME program in order to better utilize the dynamics between ecosystem actors, or project team members in this case, to design more efficient prototypes and interventions.

Conclusions: Food for thought

To conclude this research, I would like to return to the quote that introduced it.

"Why are they beautiful together? It is a phenomenon simultaneously material and spiritual, for which we need all wavelengths, for which we need depth perception. When I stare too long at the world with science eyes, I see an afterimage of traditional knowledge. Might science and traditional knowledge be purple and yellow to one another, might they be goldenrod and asters? ***We see the world more fully when we use both.****"*

After completing the pilot substudy and analyzing the results, it became abundantly clear to me that this research, throughout the entirety of each substudy hiccups and triumphs, kept returning to one central focus: educator support. Throughout the process of designing this study, I kept experiencing moments where I felt that although this project is about creating an app to engage children, their families, and teachers better with garden topics, this tool truly is serving a supportive function to the educators. Where I incorporated this thought into the first guiding principle developed from substudy 1, I didn't realize the extent to which this project would reveal a level of depth perception-- as described by Kimmerer -- that I was previously incapable of incorporating into the design and execution of the research itself, in truly grasping garden educator support structures.

Exploring the combination of professional development and curriculum reform with the NME garden educators helped me see clearly that we needed a new vision and starting point. Viewing this ecosystem without the proper depth perception, thus misunderstanding it as a landscape with certain boundaries led to the development of a project that failed to meet its initial aims. Where it flourished instead was in uncovering what was beneath the prepared soil surface: a need to apply this depth of understanding to the discontinuity present, to making the perspective of the garden educators more visible, and where reconsidering the complex dynamics and relationships within the NME program emulate an ecosystem and can be managed as such. Ecological system thinking and the activities and management of a forest can better inform us how to support informal educators in these kinds of projects. In order to better provide quality education experiences for children, supporting the health of the education ecosystem by targeting the infrastructure necessary to maintain to properly support the educators will require additional surveying and investigating the entire colleague cohort in order to be more inclusive, representative, and thorough.

Co-collaborative projects incorporating novel techniques in informal education programs are absolutely possible, but due to the nature of these programs lacking infrastructure more typically existing within traditional education programs, it's important to consider the following principles before designing and developing a project:

1. *If you want to design a collaborative, professional development project, broader consideration for the function in relation to structure-- ecosystem dynamics-- of the garden program should be done in order to have the proper depth perception guiding the research design and execution.*

2. *Improving communication across the levels of the NME program in order to better identify the necessary supportive strategies can function like these microbial networks, allowing educators to root down so that they can branch out and try new things and feel supported, and feel that they are capable of integrating new types of curriculum tools and strategies.*

3. *If you want something to happen on the student group level, you need to have boundary crossing at other levels and support infrastructures across the different layers.*

This research should-- and will-- be continued. There are deep seated and deeply rooted issues in the efficiency of this program that have led to health and monetary costs to the program and its educators, and a co-created garden app development should be a tool that educators are equipped with as a support. Cultivating a better understanding of the ecosystem dynamics of the Natuur en Milieu Educatie Programma will ultimately lead to more effective and equitable professional development and curriculum reform as it moves into its centennial years.

Without initially intending to, this case study research contributes to the broader conversation of the deconstruction of learnification, as well as the whole teacher movement seen in traditional education settings. Due to the popularity and prevalence of these garden-based and informal education programs world-wide, a more intentional focus should be given to the educators facilitating these important and life-changing educational experiences. To not only ensure the sustainability of these programs in the long run, but to sustain the humans behind the experiences. Rooting informal educators to the communities they serve can help alleviate the burden that they experience. And like a rhizomatic root system, the underlying connectivity and basis for growth across the ecosystem, when it runs not only wide but also deep, ensures connectivity and sustainability for decades to come.

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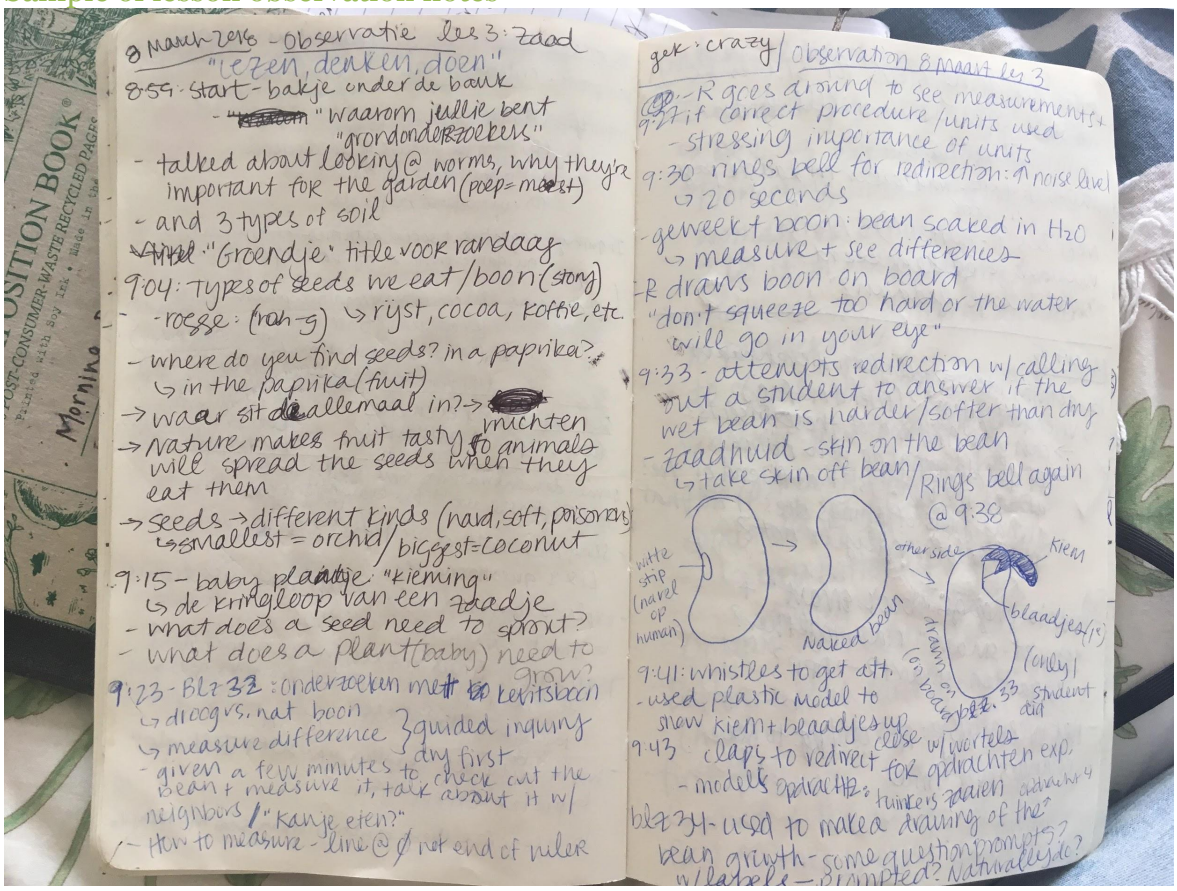
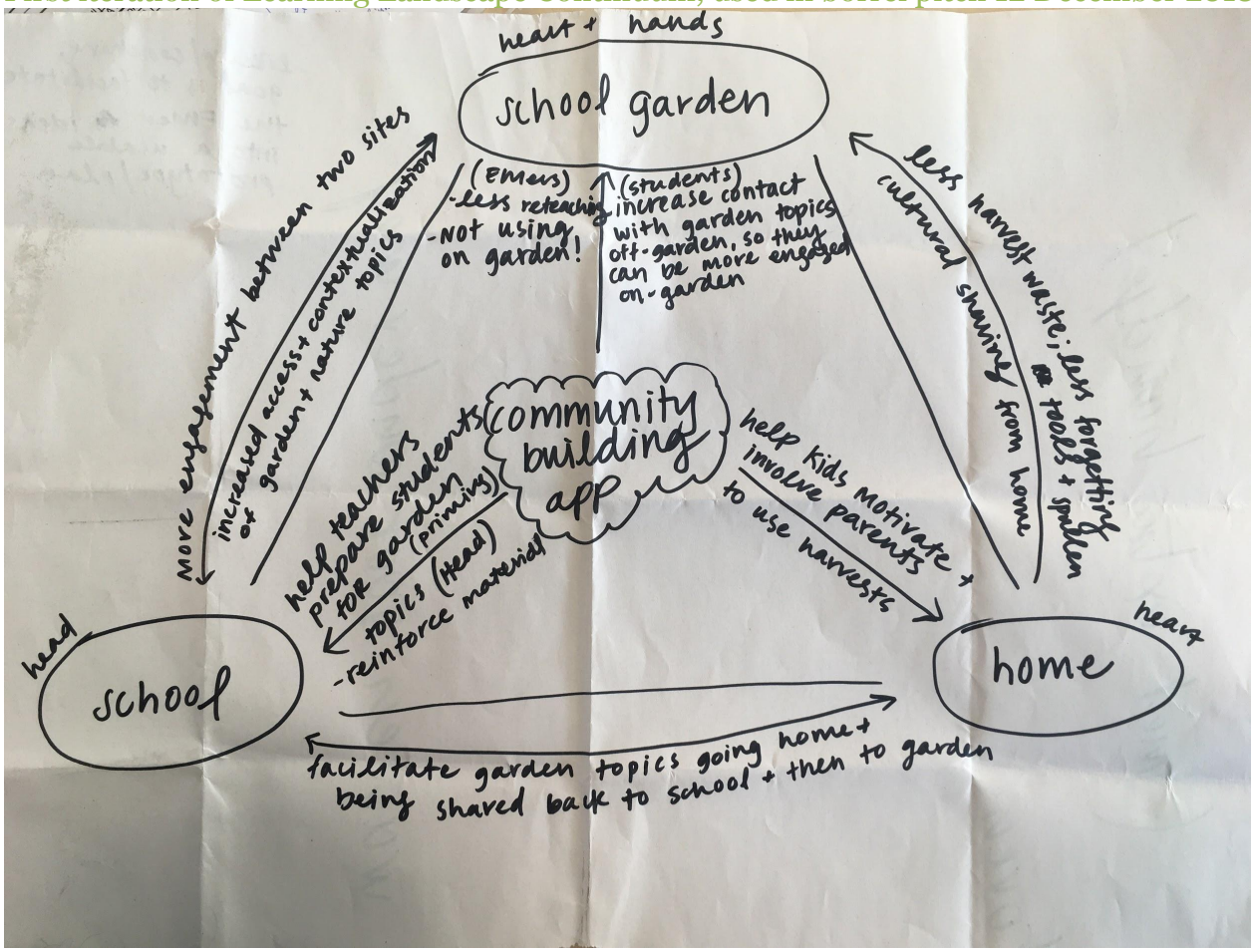
Appendix A: Substudy 1

Sample of lesson observation notes



Appendix B: Substudy 2

First iteration of Learning Landscape Continuum, used in borrel pitch 12 December 2018



Project team pitch email

Hey Collega's!

I'm looking for participants for a project team exploring the design and development of a school garden app. This project is a part of my Masters thesis, and I am looking for 4-6 participants (ideally at least one EM per cluster) who are interested in collaborating on a supportive tool that will help students connect to garden topics when they are not physically present on the garden. The app development process is especially important to me to be collaborative with the EMers, as they are the ones that are putting in so much work every year to ensure that children are connecting to garden and nature topics, so they should feel ownership of the app and that they will find it useful. Reggie will be helping me move the project forward as a coach (to help facilitate the meetings in mostly Dutch). The goal is to design and test out a few prototypes to see how educators, teachers, and children respond to opening up more lines of communication across the garden, home, and school.

If you are interested in joining my team and having input on future school garden tools, please know that although it is volunteer-based and I will be as flexible to the school garden calendar as I can within my Masters period, it will be a small time commitment (between 2-4 hours, 1-2 meetings) monthly from January until June.

Project timeline and log

Proposed timeline	**Project log**
December/January: put team together, preliminary questionnaires and baseline attitude assessment	**End December**: identification of potential project members, development of interview scheme, strategizing of vertical vs. shared leadership, pitched project team to colleague borrel to drum up interest, 2 educators signed on with 3-4 interested in being reserve, 2-3 interested but too busy. **Beginning January**: 9-listserv email asking for more volunteers, split the project time commitment into 3 phases over email (design/development, piloting, feedback), restructured TB and methods to reflect educator focus and adaptation of TDT and design thinking rather than direct incorporation, updated interview scheme to include teaching style question.
End January/February: team goals established, schedule confirmed	- First meeting on 20 february with Reggie, Fenna, Fiona: problem definition and first brainstorm of possible prototype focus. - Lost Frank as practical team member (busy with his own experiment) and gained Juultje as flex participant primarily functioning as giving feedback and brainstorming. Stephanie also signed on to pilot and give feedback. - Created the first prototype based on the brainstorm session.
February-March: weekly/bi-monthly meetings to prototype; check-ins with questionnaires; design sprint process (input from Irene's teacher group about attitude and willingness to implement in their classroom/what is necessary to feel comfortable incorporating into school garden preparation,etc.)	First feedback session: group interacted with the first prototype. Gave impressions as well as discussed how they expected children and teachers of pilot groups to interact with the prototype- which indicated the types of changes they would like to see based on the outcomes they hope for and expect (make the pages more clickable and interactive within the constraints of the program and my programming abilities). - A brief was requested to be made to help explain the project to teachers, and the goals of the pilot sessions were refined. The brief was sent to EMers and pilot groups are being identified by EMers. - A schedule to meet with pilot groups is going to be made so that contact is made on the gardens between myself and the participating teachers, before organizing the pilot sessions (mini-lessons) being built for the teachers) and planning the pilot session times.
March-mid April: selection of schools to pilot	EMers choosing their own pilot groups- filling out a form to explain their pilot group choice and the

prototype; pre-test & post test (check in with Irene about schools to include in pilot sessions; go in and introduce the app/feedback session with select school garden groups)	rationale will be included in the discussion of how to move the project forward beyond the pilot sessions. - Visit the pilot group on the garden between 1-2 buitenlessen weeks, set up pilot within first 6 weeks and follow up observation session within 1 week of pilot.
April-May-beginning June: analysis of 1st prototype; report on attitudes, reflection of development process and debrief May- looking forward: - Arrange a second pilot session (Fenna/P. or Juliette/TBD) - Get in touch with friend of Reggie who designs games for apps (educational?) for an interview - Send out surveys to leerkrachten and EMers about feedback - Possible feedback session with past group of Reggie- how much do they remember from last year? What would they want in an app (match to Tulpen group feedback) - Project team feedback- various levels of engagement; what could we have done differently looking back- feedback on carrot pilot - Transcribe audio and video from pilot with observation scheme - Outline "lessons from the garden" concept with TB underpinning	April: development of prototype (first version based on brainstorm session with project team), pivoting to second version of prototype pilot-specific (carrot/seed) & pilot session with Reggie's 2nd choice group De Tulpen (24 and 25 May) - Pilot groups were not chosen and confirmed early enough to have the first prototype be relevant. Groups also dropped out, were hesitant to commit, or the spring holidays got in the way of scheduling and committing to a pilot session despite enthusiasm from one group. May: Processing pilot results, writing, getting feedback
Early June: feedback sessions on design/development and pilot processes for NME group, analysis of data and processing for writing - 18 June: Coordinatoren overleg - 21 June: Presentation of research @ UU	Bloemles pilot (how many gardens want to participate?)
July: writing/editing and analysis continued - Draft due	
August: submission to UU (August 7th)	

Project team intake surveys
Reggie

This survey should take approximately 20-30 minutes to do. If possible, please type up your answers (in Dutch or English, or both.) Please fill it out as detailed as you can. Your answers will help shape the project and my thesis. Thanks! :)

Problem definition: Over the last year through my observations and conversations with colleagues, it has become apparent that there is a problem amongst school groups visiting the garden, that has an impact on the teaching style and job satisfaction of the Educatief Medewerkers across the schooltuinen. What I have observed is this: between sessions on the garden, students seem to have a difficult time remembering the red threads of school gardening, which results in EMers reteaching tasks and concepts well into the outdoor season, taking more valuable time on old topics and leaving little room for creativity, spontaneity, and other nature-related topics. I believe this is due to the fact that student groups have little access to garden-related topics when they are not physically on the garden, unless their parents or teachers are more inclined to include them in their "regular" education or at home. Constantly having to re-teach students how to use tools (beyond what is normal in education as far as repetition goes), identify plants in their garden, or even how the garden is arranged as well as incorporating new information into each session with students has been observed to frustrate and tire-out EMers.

1. After hearing this, do you recognize this, or believe this is a problem as well?

Yes, this can sometimes be troublesome.

1. If yes, how have you witnessed this problem on your garden?

Some kids still do not know what parts of the garden is theirs, even after 15 outdoor lessons. With some groups, if you do not repeat the names of the plants every weak, they might pull out/harvest the wrong one after instruction. These groups need more repetition than is normal on average. All the repetition could be boring to the fast learning children, to a degree where they also start disliking school gardening in general.

1. Have you thought about, or come up with, a solution?

Working with a buddy system where you would instruct or repeat to 1 child and he/she will instruct his/her buddy. (Trying it this year) Or asking another child to explain it to his/her neighbour. Also, stopped doing repetitions after a while for all children of some schools and started focusing on individual children that have a hard time memorizing what is going on (which still takes a lot of time). Came up with the idea of having the teacher repeat it at school in a digital environment.

Solution direction: In response, I have proposed the gathering of a project team to address aspects of this problem. I believe a good starting place for addressing this problem is to 1) create a collaborative team space where we can share ideas on how to address this problem through a supportive, digital tool (app), and 2) put words to actions, creating prototype of this tool, so that we can start testing out new methods of addressing an old problem.

1. What do you consider as your teaching style? You can choose more than 1, but please explain

below how the teaching styles mix together for you.

Frank: - Bij lessen met nieuwe leerdoelen en weinig voorkennis - Opslaan van feitenkennis	Astrid: - Aanleren en verwerven van complexe kennis - Toepassen van kennis - Structureren van de leerstof (hogere ordes van denkfuncties)
Stijn: - Leerlingen worden actief bij hun eigen leerproces betrokken - Leerlingen creëren zelf nieuwe kennis (exploratie gedrag wordt uitgelokt) - Leerlingen leren samenwerken	Noah: - De leerling wordt informatie vaardig met focus op kritisch denken

Please explain :)

Starting out as a Frank. I do, they repeat. Monkeys see, monkeys do. Then, try to be more Astrid, but every new element is introduced as a Frank. Trying to be more Stijn with additional activities, but usually don't have much time. Once or twice I've asked my group to try to do an extra activity at school, where they would have to look up some information. Success really depended on their own teachers support.

How do you envision your participation in the project team impacting...

1. … this project?

I hope to add new ideas to the project and make my colleagues more enthusiastic, make them see the possibilities. I'm also da coach, fo sho!

1. … your teaching style?

Basic school gardening will always be Frank/Astrid to start with, but I would like to add more Stijn/Noah earlier in the season, by pointing them in the right direction with app support..

1. What are your expectations for…
    1. ... this project group?

That we come up with awesome new idea's that will spread among the non-participating colleagues.

1. … the "end" product?

A great app design of course that will make sense to school teachers. Convince them to invest their precious time as well.

1. What are your hopes for...
    1. ...the project group?

That everyone is as enthusiastic as myself, and able to find time and effort for this project.

1. ...the resulting prototype?

That it will convince our superiors to invest their time as well and make it eventually happen.

1. Are you interested in learning how to use the prototyping program yourself, or do you prefer to work with a template or draft already designed?

I would like to learn to use the program.

1. How long have you been an Educatief Medewerker? (and/or how long have you been involved with the NME program?)

Almost 9 years EM.

1. How would you describe your workplace satisfaction?

It's my 2nd home.

1. Do you have any questions/comments/concerns before we get started?

1. As a pre-group meeting exercise, please take a moment to either sketch, draw, or write out what you would like to see in a school garden app. It can include anything you'd like, as long as you give an explanation of why you've included that in your app. Please email me a picture of your sketch or drawing! :)

Will do that.

Fiona

This survey should take approximately 20-30 minutes to do. If possible, please type up your answers (in Dutch or English, or both.) Please fill it out as detailed as you can. Your answers will help shape the project and my thesis. Thanks! :)

Problem definition: Over the last year through my observations and conversations with colleagues, it has become apparent that there is a problem amongst school groups visiting the garden, that has an impact on the teaching style and job satisfaction of the Educatief Medewerkers across the schooltuinen. What I have observed is this: between sessions on the garden, students seem to have a difficult time remembering the red threads of school gardening, which results in EMers reteaching tasks and concepts well into the outdoor season, taking more valuable time on old topics and leaving little room for creativity, spontaneity, and other nature-related topics. I believe this is due to the fact that student groups have little access to garden-related topics when they are not physically on the garden, unless their parents or teachers are more inclined to include them in their "regular" education or at home. Constantly having to re-teach students how to use tools (beyond what is normal in education as far as repetition goes), identify plants in their garden, or even how the garden is arranged as well as incorporating new information into each session with students has been observed to frustrate and tire-out EMers.

1. After hearing this, do you recognize this, or believe this is a problem as well?

I think this is a problem, but I am not sure if it is normal or not. I think you need to hear things multiple times to remember it. Also children that have a hard time remembering what happened last week or in other classes, usually also have a hard time at school, because they can't concentrate, have a learning or behavioral problem, or problems at home.

2. If yes, how have you witnessed this problem on your garden?

Yes I have seen it on my garden

3. Have you thought about, or come up with, a solution?

I think it is a common problem, but I am not sure if de solution lies with us. It helps to make pictures instead of texts and let children repeat something instead of doing it yourself.

Solution direction: In response, I have proposed the gathering of a project team to address aspects of this problem. I believe a good starting place for addressing this problem is to 1) create a collaborative team space where we can share ideas on how to address this problem through a supportive, digital tool (app), and 2) put words to actions, creating prototype of this tool, so that we can start testing out new methods of addressing an old problem.

1. What do you consider as your teaching style? You can choose more than 1, but please explain below how the teaching styles mix together for you.

Frank: - Bij lessen met nieuwe leerdoelen en weinig voorkennis - Opslaan van feitenkennis	Astrid: - Aanleren en verwerven van complexe kennis - Toepassen van kennis - Structureren van de leerstof (hogere ordes van denkfuncties)

Stijn:	Noah:
- Leerlingen worden actief bij hun eigen leerproces betrokken - Leerlingen creëren zelf nieuwe kennis (exploratie gedrag wordt uitgelokt) - Leerlingen leren samenwerken	- De leerling wordt informatie vaardig met focus op kritisch denken

Please explain :)

Frank, because that it how we teach at schoolgardens, this is how our 'system'works.
I am trying to use 'het onderzoekend leren' in my lessons, not sure which style that is..

How do you envision your participation in the project team impacting...

a. … this project?

I hope to make sure that the tool that is developed can be used by all children, not just the ones with parents that are (already) interested.

b. … your teaching style?

I hope to use the tool in my classes

2. What are your expectations for…
   a. ... this project group?

Expect everyone to be enthusiastic

   b. … the "end" product?

An interesting, useful tool available for every child

3. What are your hopes for...
   a. ...the project group?

I hope everyone is realistic and will be able put in the time this project needs

   b. ...the resulting prototype?

I hope this is a good start that only needs tweaking

4. Are you interested in learning how to use the prototyping program yourself, or do you prefer to work with a template or draft already designed?

I do not know yet.

5. How long have you been an Educatief Medewerker? (and/or how long have you been involved with the NME program?)

2 years

6. How would you describe your workplace satisfaction?

8

7. Do you have any questions/comments/concerns before we get started?

8. As a pre-group meeting exercise, please take a moment to either sketch, draw, or write out what you would like to see in a school garden app. It can include anything you'd like, as long as you give an

explanation of why you've included that in your app. Please email me a picture of your sketch or drawing! :)

I think the app need recipes, also 'wildpluk'recipes.

Fenna

This survey should take approximately 20-30 minutes to do. If possible, please type up your answers (in Dutch or English, or both.) Please fill it out as detailed as you can. Your answers will help shape the project and my thesis. Thanks! :)

Problem definition: Over the last year through my observations and conversations with colleagues, it has become apparent that there is a problem amongst school groups visiting the garden, that has an impact on the teaching style and job satisfaction of the Educatief Medewerkers across the schooltuinen. What I have observed is this: between sessions on the garden, students seem to have a difficult time remembering the red threads of school gardening, which results in EMers reteaching tasks and concepts well into the outdoor season, taking more valuable time on old topics and leaving little room for creativity, spontaneity, and other nature-related topics. I believe this is due to the fact that student groups have little access to garden-related topics when they are not physically on the garden, unless their parents or teachers are more inclined to include them in their "regular" education or at home. Constantly having to re-teach students how to use tools (beyond what is normal in education as far as repetition goes), identify plants in their garden, or even how the garden is arranged as well as incorporating new information into each session with students has been observed to frustrate and tire-out EMers.

1. After hearing this, do you recognize this, or believe this is a problem as well?
   Ja, ik herken het zeker. Wat me vooral opvalt is dat kinderen snel vergeten welke planten ze allemaal in hun tuin hebben. Ze hebben daardoor veel moeite met het onderscheiden van onkruid; daar ben je veel tijd aan kwijt met hulp.

2. If yes, how have you witnessed this problem on your garden?
   Kinderen vinden het lastig onkruid te onderscheiden en willen hier vaak en veel hulp bij. Daarnaast is het een probleem om met de indeling van nieuwe zaadjes/plantjes. Vaak weten kinderen niet waar ze nu moeten beginnen.

3. Have you thought about, or come up with, a solution?
   Ik heb afgelopen jaar de kinderen elkaar laten helpen; "vraag maar aan je buurman/vrouw". Dit gaat alleen niet altijd goed. Aankomend jaar wil ik ze meer met het teeltplan laten werken (zo ben ik in de eerste les met sommige klassen hier al in gaan oefenen).

Solution direction: In response, I have proposed the gathering of a project team to address aspects of this problem. I believe a good starting place for addressing this problem is to 1) create a collaborative team space where we can share ideas on how to address this problem through a supportive, digital tool (app), and 2) put words to actions, creating prototype of this tool, so that we can start testing out new methods of addressing an old problem.

1. What do you consider as your teaching style? You can choose more than 1, but please explain below how the teaching styles mix together for you.

Frank: - Bij lessen met nieuwe leerdoelen en weinig voorkennis - Opslaan van feitenkennis	Astrid: - Aanleren en verwerven van complexe kennis - Toepassen van kennis - Structureren van de leerstof (hogere ordes va denkfuncties)

Stijn:	Noah:
- Leerlingen worden actief bij hun eigen leerproces betrokken - Leerlingen creëren zelf nieuwe kennis (exploratie gedrag wordt uitgelokt) - Leerlingen leren samenwerken	- De leerling wordt informatie vaardig met focus op kritisch denken

Please explain :)

Ik denk dat Stijn het meest bij mij past. Omdat ik dit werk nog geen jaar doe vind ik het lastig hier een goed antwoord op te geven maar de stijl die mij het meest aanspreekt is die van Stijn. Ik ben een voorstander van kinderen zelf veel te laten doen en ontdekken. Daarnaast vraag ik vaak aan ze elkaar te helpen.

How do you envision your participation in the project team impacting...

a. … this project?

Conceptmatig nadenken en hier creatief mee omgaan vind ik altijd leuk om te doen. Hopelijk kan ik hiermee van hulp zijn. En misschien doordat ik nog niet heel lang werkzaam ben als educatief medewerker op de schooltuinen dat ik nog een andere kijk op bepaalde onderwerpen heb.

b. … your teaching style?

Het zorgt hoogstwaarschijnlijk voor inspiratie en gedachte dingen anders aan te pakken

2. What are your expectations for…
   a. ... this project group?

Die heb ik niet veel. Ik vind het een interessant project en wil graag van hulp zijn.

   b. … the “end” product?

Dat het een leuke, leerzame en handige start van een uitbreiding kan zijn op het huidige schooltuinprogramma.

3. What are your hopes for...
   a. ...the project group?

Dat het een project groep is met een goede dynamiek waarbij we open en creatief aan de slag kunnen.

   b. ...the resulting prototype?

Dat alle kinderen, leerkrachten en EM’ers er uiteindelijk profijt van hebben, het aansluit op de nieuwe (app)generatie en dat het een mooie verbinding kan maken tussen school en schooltuin.

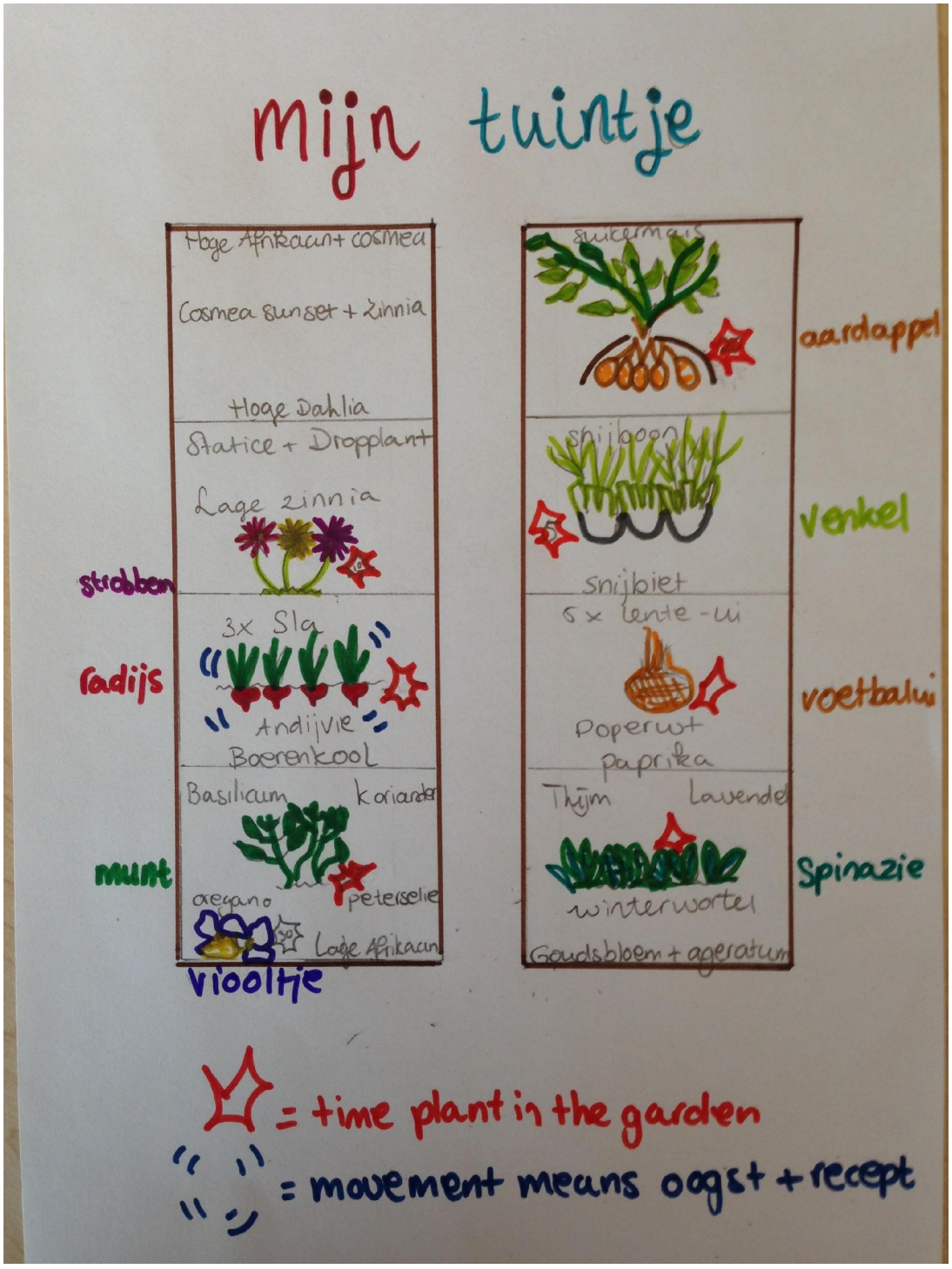
4. Are you interested in learning how to use the prototyping program yourself, or do you prefer to work with a template or draft already designed?
   Ik denk dat ik beter met een template kan werken. Websitebouwen is ook niks voor mij.

5. How long have you been an Educatief Medewerker? (and/or how long have you been involved with the NME program?)
   Bijna een jaar. Sinds maart 2018

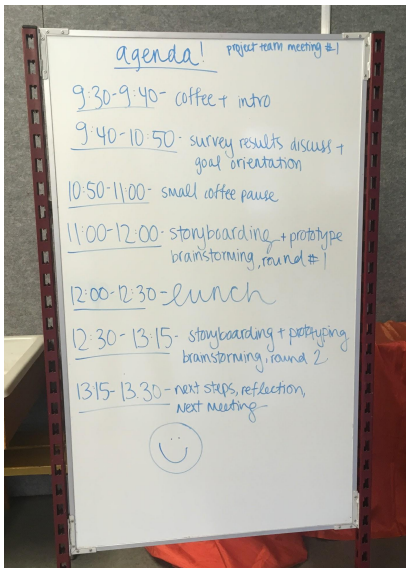
6. How would you describe your workplace satisfaction?
   Ik vind het zeer voldoenend om met kinderen en natuur te werken. De combinatie is geweldig. En het enthousiasme van de kinderen maakt het zo waardevol.

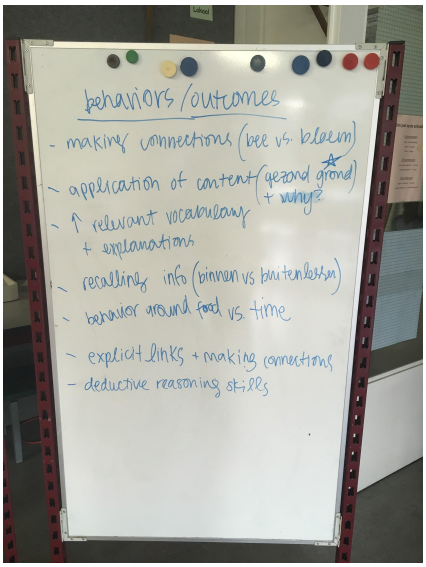
7. Do you have any questions/comments/concerns before we get started?
   Nope

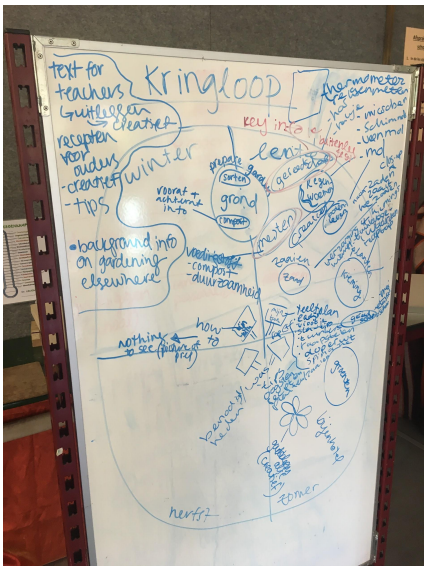
8. As a pre-group meeting exercise, please take a moment to either sketch, draw, or write out what you would like to see in a school garden app. It can include anything you'd like, as long as you give an explanation of why you've included that in your app. Please email me a picture of your sketch or drawing! :)
   Het lijkt mij tof om een tuintje als soort spelletje vorm te geven met daarin geschreven alles wat er op het teeltplan staat. Wanneer de kinderen iets planten kunnen ze het gewas aanklikken en wordt deze gekleurd. Er komt een tijdsbalkje/blokje bij die aangeeft hoeveel dagen de plant in de tuin staat. En in de week van de oogst gaat de specifieke plant bewegen/schudden. De kinderen kunnen hier dan op drukken om een bijhorend recept te krijgen. Zo houden ze meer bij wat er nog geplant moet worden, hoe lang iets duurt voordat het geoogst kan worden en kunnen ze hun ouders alvast inlichten over wat er gekookt kan worden. Zie schets hieronder:

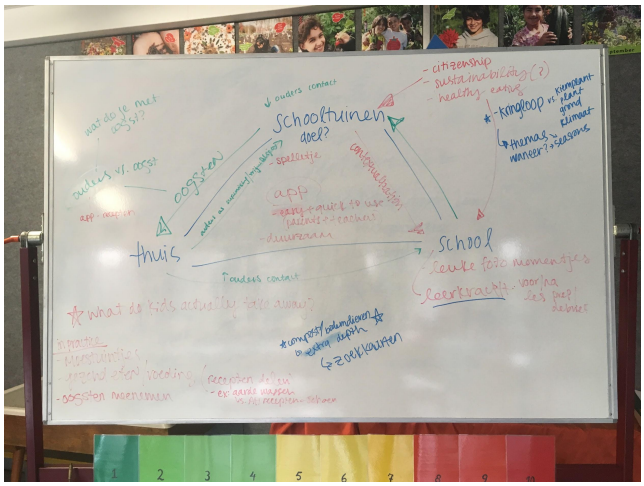

mijn tuintje
Hoge Afrikacun+ cosmea
Cosmea sunset + zinnia
Hoge Dahlia
Statice + Dropplant
Lage zinnia
stokbon
3x Sla
radijs
Andijvie
Boerenkool
Basilicum
koriander
munt
oregano
peterselie
Lage Afrikacun
vioolTje
suikermais
aardappel
snijboon
venkel
snijbiet
5x lente-ui
voetbalui
Paperwt
paprika
Thijm
Lavendel
winterwortel
Spinazie
Goudsbloem + ageratum
= time plant in the garden
= movement means oogst + recept

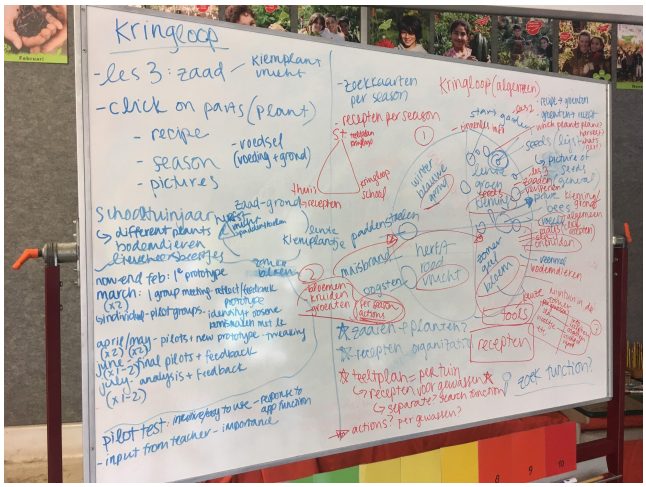
Brainstorming session photos: February 20, 2019



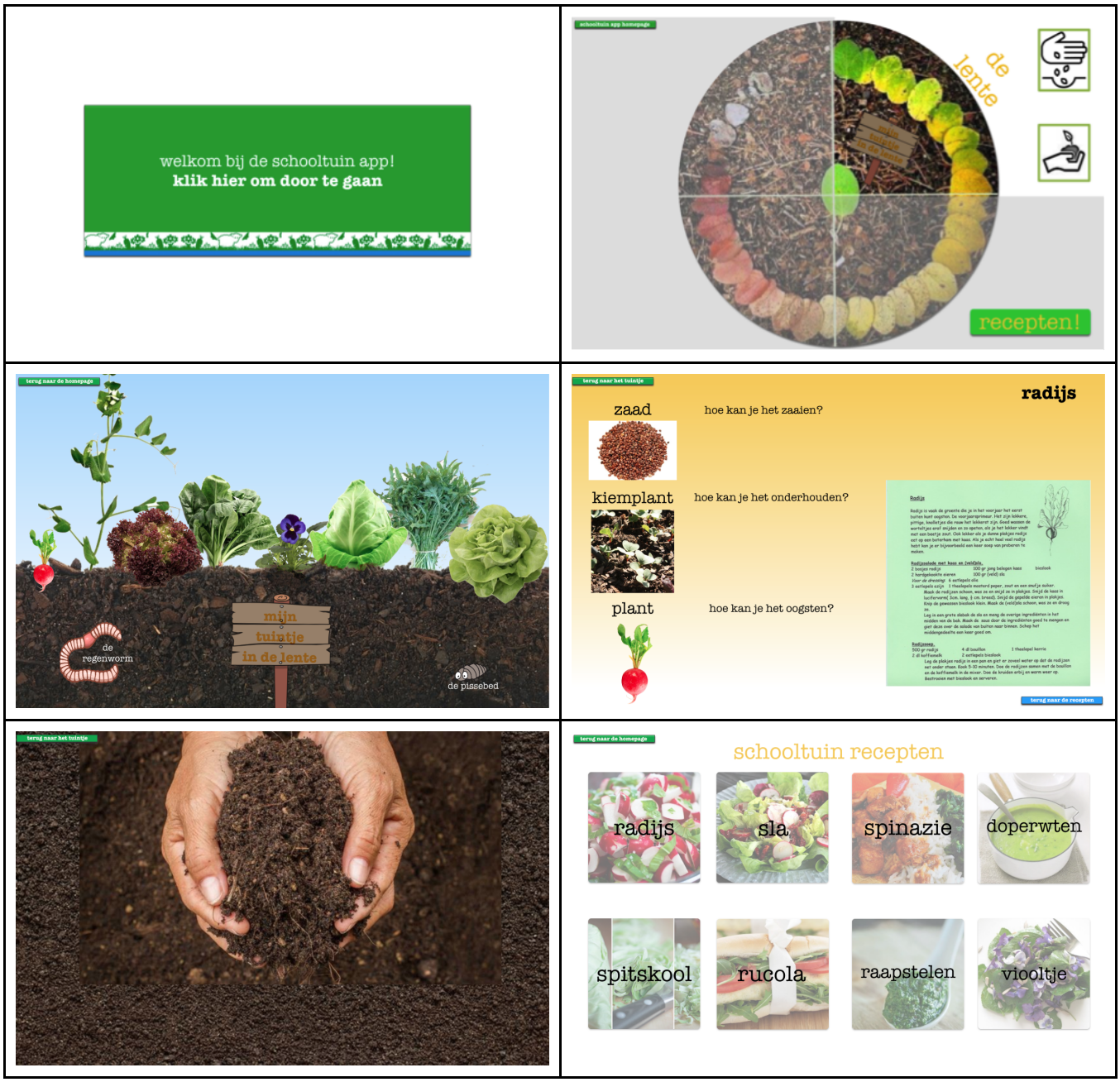








Prototype #1 artboards



Project team brief for pilot teachers

Dear teacher,

Thank you for your interest! My name is Taylor Early, I'm a masters student in the Science Education and Communication program at Utrecht University, and this activity is for my masters research project. In this project, myself and a group of Educatief Medewerkers are taking the first few steps into the process of making a school garden app for the school garden program. The goal of this project is to understand a bit better how to support the connections between school, home, and the garden, and to give teachers like yourselves, parents, and children the opportunity to engage with the school garden topics while they're not physically present at the garden. Our focus in this period of time is gathering information about the prototype that has been put together to investigate two things:

1. *First pilot aim: recall of prior knowledge learned in the indoor lessons 1, 2 and 3.*
    - Goal: Your students will engage with the app/website at school. During the first few outdoor lessons, I will hopefully observe your students using terms and concepts they learned during the lessons in January, February, and March.
2. *Second pilot aim: introducing new concepts for outdoor lessons.*
    - Goal: Your students will engage with the app/website at school. During the first few outdoor lessons, I will observe if students will utilize new information (such as how to harvest a vegetable) at the garden.

The prototype is a website that represents a digital app. It has screens that are interactive and clickable, and can be accessed on tablets and on a desktop. For the pilot, access to a beamer would be excellent so that the whole class can interact with the prototype at the same time, and specific parts of the prototype can be focused on at a time.

With these pilot sessions, they will help us understand what we should include in the app from the perspective of you, the teachers, the children, and possibly the parents. The pilot sessions will take no more than 30 minutes, and a mini-lesson will be provided to you, and I will be present during the mini-lesson to help guide you through the prototype as well as to observe how the children interact with the prototype. Ideally, we would love to have you sign on to do both pilots with us. :)

Please let me know if you have further questions, I am reachable by email or by telephone.

Appendix C: Substudy 3

Pilot group selection rationale form

Name: *Reggie*
Garden: *Reigersbos*

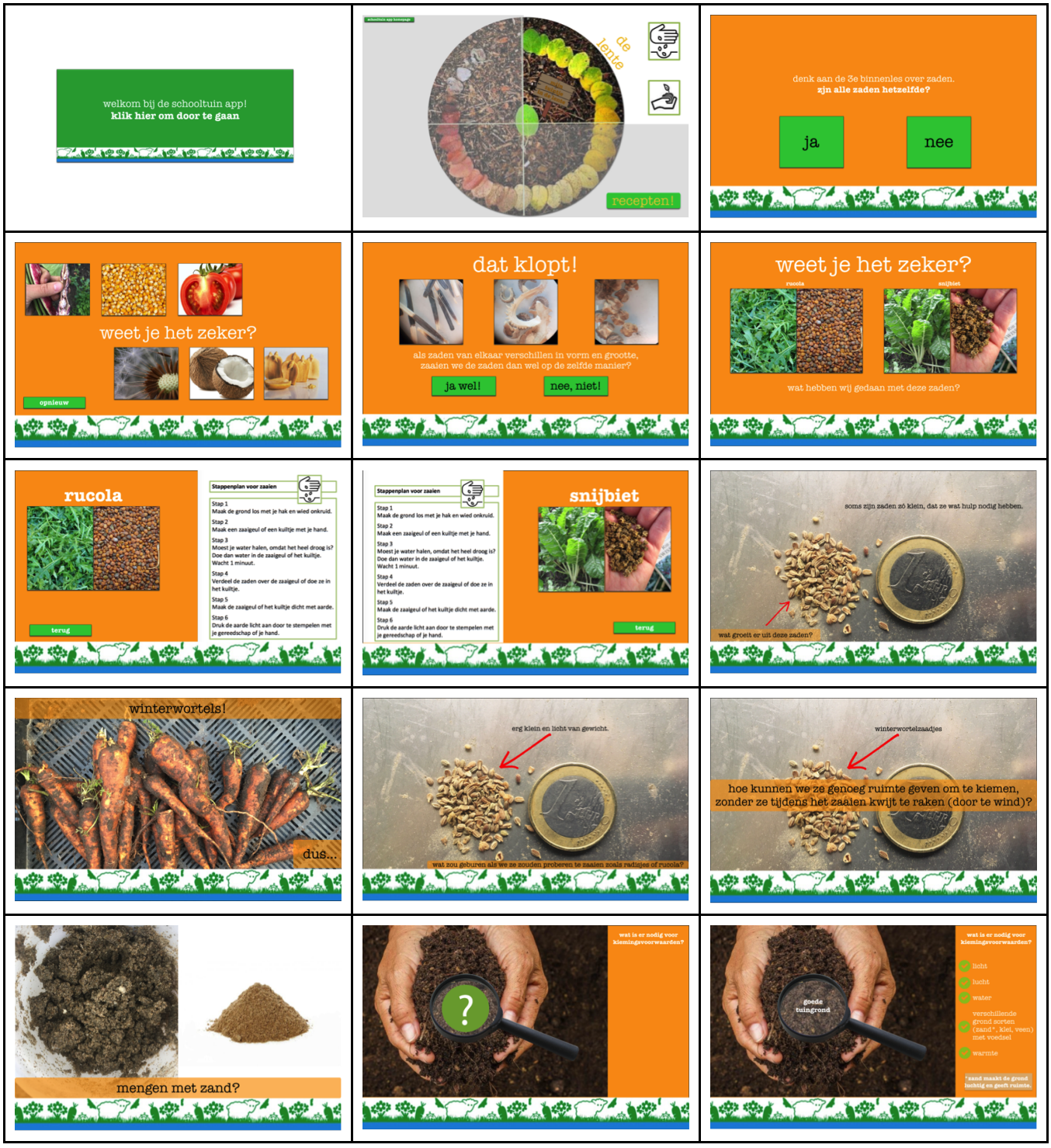
First pilot aim: recall of prior knowledge learned in lessons 1-3.
Goal: groups engage with the app before coming to the garden (at school with their teacher), to hopefully observe students using terms and concepts they learned during the indoor lessons in the first few outdoor lessons (on the garden).

Second pilot aim: introducing new concepts in outdoor lesson.
Goal: groups engage with the app before coming to the garden (at school with their teacher), to observe the effect of introducing new information (such as how to harvest a vegetable or what method will be used to plant/seed a new vegetable or herb) on engagement of the group at the garden for that specific lesson.

Name of school:	De Tulpen, groep 6
Address of school:	*Amsterdam Zuidoost*
Type of school (example, openbaar, Montessori):	Openbaar
Name of teacher/custodian:	R. N.
Number of students in group:	27
Ethnic/cultural background of the students (if known):	Mix
Parental involvement (parents come with the group often, not at all, sometimes, etc.)	At least a grandmother each week and sometimes 1 or 2 moms
Why have you chosen this group? Good representation for a typical "Zuidoost" school with kids that show, on average, very little pre-knowledge about the subject and there's not a lot of parental involvement.	
How do you expect this group to react to the prototype? Since it's something digital I expect them to show interest.	
How do you expect the teacher to react to the prototype? With enthusiasm as long as it fits their schedule at school. It's a big group at school and they need all the time they have.	

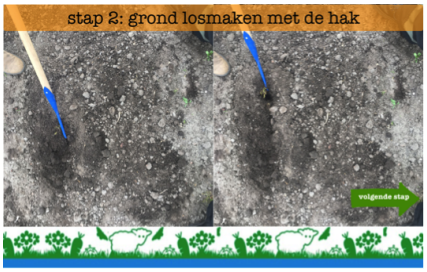
Anything else?

Prototype #2 artboards




winterwortels zaaien: het stappenplan
start!


stap 1: onkruiden weghalen (wieden)
volgende stap


stap 2: grond losmaken met de hak
volgende stap


stap 3: maak een zaaigeul met je hand- 5x
volgende stap


stap 4: zaaien (was je handen met zand)
winterwortel zaadjes met zand gemengd


stap 4: zaaien (was je handen met zand)
volgende stap


stap 5: maak de zaaigeul dicht
zaadjes met zand


stap 5: handen wassen of knippen
volgende stap


stap 6: stempel met de achtekant van je hand
volgende stap


stap 7: leg de bamboestokje over je zaadjes
meester of juf onkruiden!
je bent klaar!
test your skills!


vul de lege plekken in!
stap 1: _____ weghalen (wieden)
stap 2: maak de grond los met ____
stap 3: maak een zaaigeul met je _____
stap 4: _____ (met je handen met zand)
stap 5: maak de _____ dicht door handen wassen of _____
stap 6: _____ met de achterkant van je hand
antwoorden


antwoorden
stap 1: onkruiden weghalen (wieden)
stap 2: maak de grond los met de haak
stap 3: maak een zaaigeul met je hand
stap 4: zaaien (met je handen met zand)
stap 5: maak de zaaigeul dicht met handen wassen of knippen
stap 6: stempel/aandrukken met de achterkant van je hand
terug

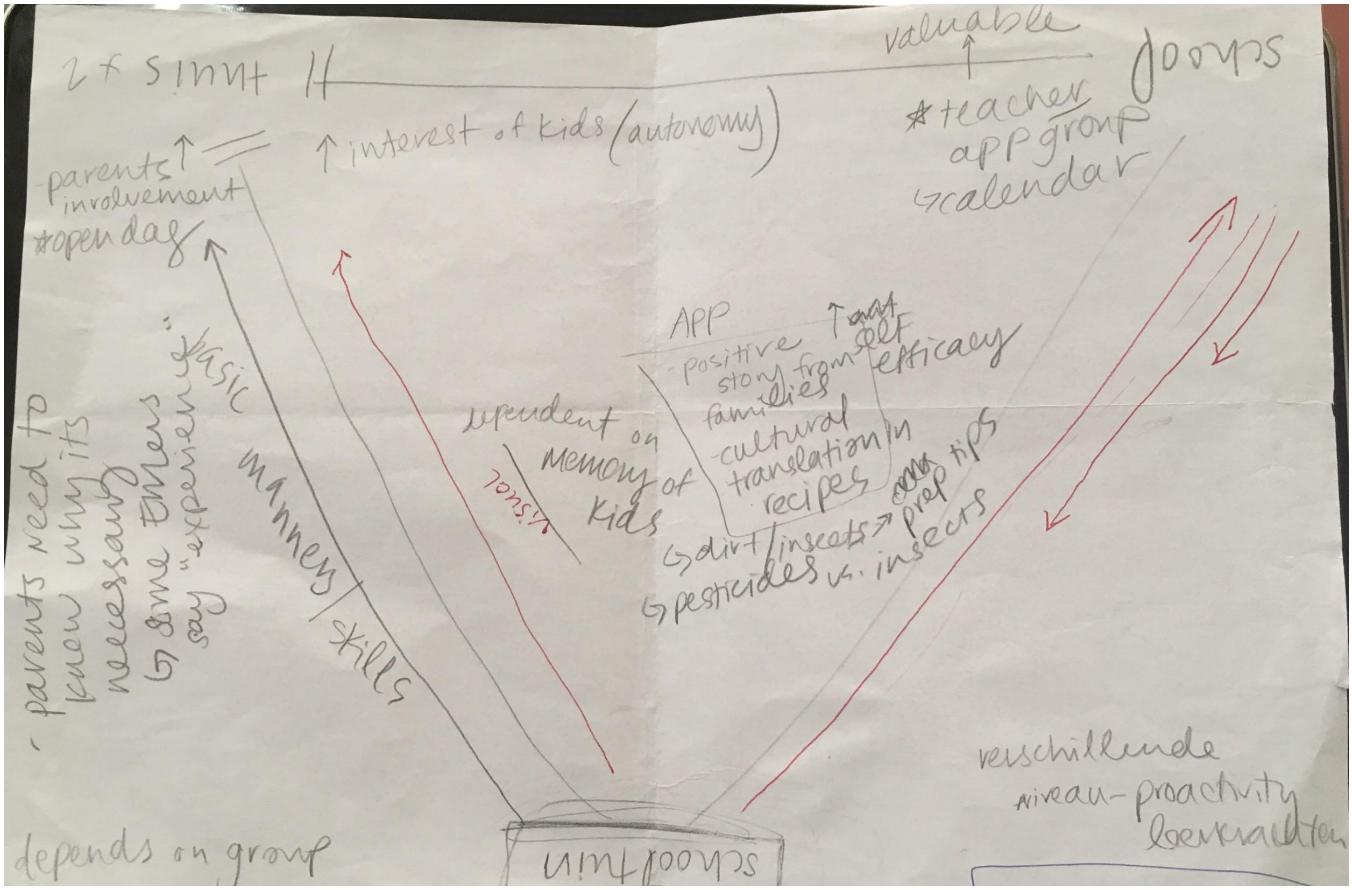
De Tulpen pilot student survey results

De Tulpen survey results																														
kleur een smiley in	:)		:)	:)	:)	:)	:)	:)	:)	:)	:)	:)	:)	:)	:)	:)	:)	:)	:)	:)	:)	:)	:)	:)	:)	:)	:)	:)	:)	:)
Welke tip neem jij morgen mee naar de schooltuintjes, waar je zelf winterwortels gaat zaaien?	die van de zaaigeul en niet te veel luisteren naar meester Reggie		goed aandrukken	*illegible/cross ed out an ter uit*	n/a	alle tippen	allemaal	alle stappen	ik moet het onkruid wieden eingelijk alles wat we van de juf geleerd.	allemaal	allemaal	ontkruid weghalen met de hak de grond los, maken een geul maken met je hand 5x en zaaien & handen wassen of knippen	allemaal	ik moet het onkyrt weg halen uit neb ik vande juf gelert	(deze) niet alles geloven	onkruid weg / aandrukken	zaaien	knippen zaden	onkruid weghalen, zaaigeul 5x, mengen met zand	alamaal	alle tips zijn belangrijk	alle tips volgen	te allemaal	alle tips	mengen met zand, onkruid weghalen, stempelen, zaaigeul maken 5x	niet alles wat meester Reggie zegt is waar	niet alles geloven wat meester zegt!!!!!!	niet alles wat meester Reggie zegt is waar	?
Stel: er komt een schooltuin-app die je op school of thuis op een tablet of smartphone kunt gebruiken. Jij mag bepalen wat er zeker in deze app moet komen. Wat zou dat dan zijn?	een spel en meer infor die meester niet mag weten		beslissen met ze alle uitleg als je het niet zo snap, meer informatie	n/a	n/a	geheimen van meester Reggie en informatie	hoe je een plant moet planten	geheimen van meester reggie praten, praten met meester robin op watsapp	een schooltuin spelletje met de vragen over de winterwortel westrijd	dat is cool en (illegible)	veel lessen en uitleg filmpjes	er moet staan hoe je goel kan zaaien en vragen stellen zodatje je zelf (illegible) en zo (illegible) je beter en beter!	tippen	n/a	meehelpen en meer vragen	n/a	n/a	tips over zaaien	een filmpje over winter-wortels	hoe je moet planten en instructies filmpjes	infor[ma]tie schooltuin spelletjes	plante en zaden memori	stappen spelletjes	een app waarin we schooltuin games en filmpjes kan doen	en mogen schooltuin spelletjes op die app	n/a	qiz	tips om goed te zaaien, tips om goed tuineren

Appendix D: Interview notes

Educatief medewerkers

Wilbur: June 6, 2019, informal recorded conversation



Quotes from the audio were taken, but full transcript not completed.

Reggie: July 31, 2019, in-person interview/conversation

Questions:

1. theory of change (self efficacy)
2. discontinuity across levels
3. learnification
4. how was the process for him?
    - what had he wished went differently
    - recommend differently
    - points of feeling confident: highs and lows of process
    - strength of voice
    - growth in terms of understanding different approaches to CR - feel more knowledgeable?
    - his major lessons learned? perspective of a participant and coach and pilot group
5. comparing the garden program to another kind of system (machine, ecosystem, etc)
    - trophic levels
    - describe the garden as an ecosystem: how do the parts function?
6. app function: what do you expect other EMers (old school ones) to need in forms of support

structures from administration in order to 1) use the app and working backwards 2) help contribute to its development
7. what is the major complaint of educators?
8. do you feel properly supported by coordinatoren/admin/PM in order to branch out and try new things or feel competent in joining projects? or does that come mostly from your own support system on reigersbos?
9. What support do you feel exists? How do you experience feeling supported at work: by what (things PM etc does, infrastructure of admin) and by whom?

Transcript*:

Taylor: I'm really curious about… Paloma and I were just talking about the NME program as an ecosystem, and before the consolidation of management, every garden was a self-standing, self-managing organism. So if it were a part of a forest, it would be like a stand, it did its own nutrient cycling, and did its own thing.

Reggie: yeah.

T: And now with the oversight, it's kind of diminished a lot of autonomy of each garden's culture, and that kind of trickles down into the way that you guys are perceiving support structures. And to have the administration say… with all of the secretive stuff, like it should just be open communication.

R: Mhmm.

T: Cause in an ecosystem, there are no secrets. Everyone plays a role, and everyone communicates with each other. And it's largely because of this network underground connection, like via in the forest with the fungal network, and all the roots are connected. So it should be used more efficiently, and you guys have the ability to be more efficient. But because of these layers of management, and the discontinuity, like the perception of, well like ANMEC says these are the learning goals, and that doesn't get communicated to you guys-

R: Mhmm.

T: So when I come in and say, "I wanna design a project, and I want to get you guys involved.", I'm missing the point. What the point is, it should be *how can this project serve the educators first, and then serve the children,* and not the other way around. And I have been talking about my project saying that this is a supportive tool for the educators, going through the kids first, and it should be reversed. And any type of curriculum reform or professional development, like with the *werkgroep* with Lianne, all that stuff should be educator-focused first, and then how does when you guys feel supported, how does that impact the children.

R: Mhm.

2:00

T: I think that in informal education programs and networks, it's the opposite way around. Because it's difficult to assess the impact of the program because its, not like traditional education in a classroom where you can take a

test and say, “ok, this kid passed, that means it’s effective”. Which obviously we both know isn’t the case anyways.

R: Mm, yeah.

T: So, the way that I’ve been thinking about this is that this is a very important year and a half to understand the dynamics of, what are the kinds of supports that then need to be followed up on. For example, if Boris wanted to get involved in a project, he’s not going to because he’s not supported in *this way, this way, and this way*. Whereas you may be supported in your self efficacy because you have the background-

R: Mm.

T: - or you and I have a good rapport, or you feel supported from PM, or you have an understanding that if you were to deviate from your regular duties, like your regular Educatief…

R: wait a minute- *converses with colleagues and leerkracht Megan, in Dutch about a school kid joining GPD in the fall.*

3:00-4:18

R: It sounds like you’re more focusing on the organization.

T: Because, ultimately, like, the coordinatoren and the kern team and all of those channels to make things more efficient and more equitable-

R: Mhm.

T: - it’s not working to the best of its capabilities, especially in relation to you guys. And then all of that burden is then shifted to you to then still provide an educational experience to these kids without really compensation-- monetarily--

R: Mm.

T: But also, emotional, psychological, physical support. And then where the changing the school garden book and trying to modernize the curriculum- that’s all well and good, but it’s still kid-focused rather than, what are the things we need to change in order for the *educatief medewerkers* to be able to continue to do their job at a sustainable pace. But also provide the best education experience. So combining the two. I have moved a bit more towards the organization because that’s actually what came out of me analyzing everything-

5:30

R: Mm.

T: At every stage of this project, it has become extremely clear that there are issues with the support infrastructure of this program. And it’s not, I mean, it’s ending up with people yelling at PM on the boat.

R: Mmm! (*laughs*) Yeah.

T: You know?

R: Mhm, mhm.

T: And I am really lucky that I get to continue thinking about this in this way in the next 6 months, but it's really difficult to kind of like, say, okay… Like I said to PM, I really believe in this app helping shift some of the burden from the colleagues, and she kind of is starting to think about it like that, but with all of these levels… At every turn, at every conversation I've ever had, everyone has had something to say about when the gardens were consolidated in management, that's when things started to fall apart.

6:32

T: I think that that's really important to pay attention to. Obviously I don't have a solution for that-

R: Mhm.

T: --obviously, and I know that I have to be careful with how I talk about it. But that's why I wanted to compare it to a forest and an ecosystem, because in a forest you have all of these different stands, that's fine, they're self contained and self organized, and I think that that's a very good comparison to the gardens-

R: Mhm.

7:00

T: - that they're all connected within a system, by the underground support system. I think that that's what needs to be focused on.

R: Ecoducts.

T: Yeah. Yeah! (*laughs*). So that's why I've been missing, basically. I've been trying to sort this out, he said, "you know, I want to know how you feel about your conclusion and discussion, cause your intro is strong and interesting, but your conclusion doesn't match that, it feels very stale, like there's something missing."

R: Mhm.

T: And he was like, "the way that you speak about it is not the way that you write about it." And a lot of that is because my first supervisor was steering me away from talking about it and focusing on you guys, but I was still continuing to say that "this is a supportive tool, I want to support the educators, I don't really care that much about the kids, I know they do, but I think it's really important for them to be focused on", because you guys never get focused on.

8:00

R: Mhm.

R: (*chuckles*) We have feelings too.

T: You have feelings too! But the thing is, the *werkgroep* and some of the professional development stuff, that's all still curriculum-and kid-focused. When you guys do anything to enrich yourselves, it's your teaching styles or something for stuff to do to implement in work. It's not necessarily stuff to implement to make a "whole teacher". So I don't have all of the answers, but I'm trying to figure out how to organize this in a way to say, "ok, we need to think about this holistically, think about this program as a system in order to be able to efficiently run

the system and move it forwards, we have to consider these things, and these are the principles that have come out of this analysis.

R: What an interesting thought.

T: Yeah, and I have one week to get my shit together.

9:00 (*T and R laugh*)

T: Yeah. But I think I was having a really hard time writing about it because this was happening in the back of my mind, of like, okay, this is not working the way that I want it to work and I kept thinking about you guys, but I was still writing about the pilot. Or still writing about the kids and that impact on them, and I wasn't collecting… Basically I should have been recording our conversations this whole entire year.

R: Mhm.

T: Cause everyone has come to me and said this is a problem, and I've kind of just been like "ok yeah let me empathize and let me put that into some context and I'll put it in the discussion a little bit". But this genuinely should be the focus... And I think that this is a trend in museum education as well.

R: Hm.

T: I think that in informal education programs, there's not the built-in infrastructure for, okay well here's a psychologist you can go to or we have a physiotherapist on call, like those things are not inherent to these informal programs because the, BECAUSE the contextualized science experience is so unique, ALL of the focus is on that, all of the money goes to that, all of the energy goes to that. Whereas YOU GUYS should the most important part, because you are facilitating all of it.

R: Mm.

10:23

T: So, now I'm actually finally writing about it. And there's this idea of learnification, and in the last 10 years, we've been moving away from learnification, and learner-centered education and saying well ok, who cares about the educators as long as the kids are having an experience.

R: Mhm.

T: So we're moving away from that. And there is this Dutch education philosopher, Biesta I think is his last name, who basically makes a claim for-- education as it is, as it's been developed and as its been perpetuated, it's not the only way… it's not the only of school, it's not the only point of school. And it's not the only point of this job. This is your job-

R: Mhm.

11:00

T: Of course part of your function is to serve the kids, but your job is also your job and your livelihood. So it puts my research in a couple different camps-

R: Mhm.

T: But mostly it puts it very very strongly in the teacher/educator support debate about how teachers are getting forgotten, and even more so in informal education.

R: Yeah. Okay, cool. Wow.

T: Yeah, I just said a lot of words, so feel free to digest.

R: Please eat!

T: Yeah, (laughs) you can talk now.

R: But um, yeah, I'm happy that we are taken into consideration as the main target instead of the kids (chuckles).

T: Well that's what I went to Wouter with, I had two questions: how can we make this app, and what support systems are necessary, and he said "leave that behind , you have to focus on one." And I told Arthur, my new supervisor, when we were talking and he said "have you considered a subquestion focusing on the support systems?" And I said (bangs on table) "motherfucker I had it in there, and i was told to take it out"-

R: Mmm.

T: And he goes "that's really unfortunate, cause that's what this direction is going towards and that's what you've learned.

12:30

R: Two main problems, not just kids not being able to communicate about the garden with their parents, or that they're not able to describe what's going on here because they don't have sufficient knowledge. Some kids really have trouble expressing themselves, or what they do at the garden. They're enthusiastic about it, but they don't know how to tell their parents what they do here. So that's one problem.

T: And that's a skill they also learn here..

R: And the other problem is what we face. We face kids with no knowledge at all, which is, like our job to teach them stuff, but it would help if they were already- well how do you say that - if they've already seen stuff without spoilers.

T: Like, primed?

R: A little bit of information-

T: That's priming knowledge.

R: -- to make them more interested. Like make them curious. Maybe they have a teacher that's good in that stuff, to tell them, "Oh you're going to school gardens and it's gonna be awesome"--

T: "And we're going to do this today", but-

R: Yeah, but if they have some sort of structure in making them enthusiastic, not just telling them about the corn after the summer holidays already, but first telling them, "well, we're going to get introduced to the cool garden,

and see what's going on there, and they'll teach a bit about soil", and then they have a bit of structure. And that helps us, for example, if we have the square meters--

T: Mhm.

14:30

R: -- sometimes we ask the kids "what do you know about it? Did you already do some math with square meters?" And some kids are like *pssh (shrugs)*...completely clueless, and the teacher is like "I told you guys!" and they still don't know. But sometimes they already know, and you move on to the next… you talk about it, you do the math in the classroom, and you move on to the next subject, and they get so much more input. And the other kids, you really have to teach them how it works. And then you're like, 15 minutes further in your lesson.

T: It's like you're showing up for an exam that you don't know exactly what it's on.

15:00

R: Yeah. But like an assignment could be to estimate how big your bedroom is. And then you'll learn about how big your garden is gonna be in the next school garden lesson.

T: So matching the curriculum-

R: So they already have, they already imprinted their bedroom, and maybe they don't exactly know how to calculate it, but they're already working with the subject of square meters, or size of a room. But yeah, the good thing is that with an app, it's more flexible than a book. You just add some basic stuff at first, add some recipes first, that do not really change, which is like for every garden the same, then slowly add garden-specific lessons, garden-specific information--

16:00

R: and like, widen it a bit-

T: Expand it a bit.

R: Yeah! Then kids can click on a garden that they belong to, and there's some general information.

T: So how do you envision that then directly supporting your colleagues and you, like what's the connection explicitly? Cause I know it, but I want you to say it so I have it on tape. (chuckles)

16:30

R: (chuckles): Okay ask me the question again?

T: How do you envision the app, as you just described, then directly impacting the support, like how does that support your colleagues in their everyday job?

R: Well, like I said, it would prime the kids with some knowledge so you have to explain it less times. And some very simple, basic information, like the address of the school garden, all that stuff that you have to think about like, "oh shit! I have to give the flyers to my teacher because the parents of these kids need to know where to

come visit their kids"-- it's already in there in the app before we even talk about visiting the garden, the parents already know where to go to.

T: It's like decluttering your brain.

17:30

R: Yeah, it's all that extra stuff that you have to do sitting behind the computer, checking emails, then sending emails to teachers, sending emails with flyers, making sure… and then instead of Ellis having to ask all the different gardens about all that stuff, and you know, she has to assemble the flyers, they're all different, you can just load them up into the app and it's all in there for all the school gardens. So, and it also saves a lot of paper, time.

T: So do you feel that the role you have as an *educatief medewerker* is split into too many parts?

R: You always have the garden part, and all the extra parts. All the extra stuff, that a school teacher has even got more of, after teaching they have all that paperwork. We also have paperwork, but some are really bad at that stuff, the paperwork. They are great at gardening, but they are too disorganized in their heads with the computer and keeping track of all the emails and stuff. So that's one thing. But..

T: So do you feel that that's something that should be a part of your role--

R: Yeah yeah.

T: -- Or should that be offloaded somewhere else?

R: Sure, it's always a small portion.

T: Is it too big now? Cause from my experience, in observing you guys have to switch gears, and almost like codeswitch your brains--

R: Yeah.

19:00

T: - from physical labor to mental labor, it seems very abrupt. It's not seamless.

R: Some parts of that are picked up by one person on the garden. So one person says "oh I will email all the teachers." And we all depend on that one person remembering it, or like we all know we have to cancel a lesson, but nobody picks up the phone to do it. Because we are too busy with teaching, and we have our paper agenda of course that we write stuff in.

T: Mhm.

(Audio "Reggie 2", 25:19)

R: We could implement a lot of static information into the app that never changes.

T: That you still have to constantly tell.

R: Like the kids change, and we have to tell the kids every time.

T: But the information stays the same.

R: Yeah, also, the information that teachers need to log into the system is always the same, so they always ask us for the same information, when if they just download the app, it's in there. You just make a separate teacher log in thing, or whatever, but they also need a new password, which is not convenient.

T: Yeah, but that's pennies to an app company or whatever.

R: Yeah.

T: So, okay. Then like…

1:00

R: Hit me with more questions!

T: Okay, so. How about we talk about… Alright, so same kind of thing. You said there are two problems, so what I wrote yesterday was, "what's the major complaint of you and the colleagues? Like, do you feel properly supported by, coordinatoren, kern team PM, admin, in order to branch out and try new things, and feel competent in joining projects and experiments? Or does that mostly come from the garden support system. Cause I know Reigersbos is super tight, and the dynamics here feel very supported and make you feel like, "yeah, I can take this on, cause I know someone's got my back". If you could write out your support systems, how would you list them out? What are your major support systems?

R: We didn't have much support back then, like years ago.

2:00

R: We're getting more and more support to try out new stuff. But, it's all outdoors stuff. It's always new things, like have to do with soil, or how to manage your gardens, or teach new things.

T: So still learner-centered.

R: Yeah. And it also depends on the colleague. Some say "well I want to try out new stuff, but I have no idea what. Cause there's a possibility to do something, but I have no idea what to do." And it's always the same people with the ideas, it's always the same already interested… There's also a lot of people, they just want to keep what's going on- maintain it, and don't change much. They already have too much on their minds, and they're like rusted.

3:00

T: (laughs)

R: They go in a specific direction every year, it's always the same. But the support systems… Well, basically it's PM paying an intern to guide everything.

T: Ah!

R: It's interns that guide our experiments. They put it on paper, they present what's going on at the different gardens. And we don't have, we have ADW of course to share stuff, but not everyone is familiar enough to share stuff on TamTam. So if there's something going on in some specific garden, you only heard… If someone is working on two gardens, they know what's going on at a different garden and they spread the word.

T: Yeah.

4:00

R: And you have every couple of weeks or months and you have presentations that explain what they are experimenting--

T: And not a lot of people go to those--

R: And then not a lot of people go there. And eventually everyone knows a bit about what's going on, but it's not that specific.

T: Do you feel like that then changes the way that you guys interact with each other, or at least experience feeling like an entire cohort, or like group, or like ecosystem? Do you feel like everything is like "our garden, things happen on our garden and that's it".

R: And everyone has their own opinion on what works and what doesn't work. Some gardens start something new. Another garden's trying something new, and a third garden is saying "well we can try this and that from the other garden and combine that and we;re also gonna try this". The biggest problem is time. It takes a year to try something out, and another year to refine it, and make it work. Dieuwertje said she's doing a second year of experimentation, and she changed some stuff that didn't work, and she felt familiar with the subject shed' doing so it went more smooth. And it takes a third year maybe to put it on paper, and maybe take another year to spread it around to other gardens. And there are probably some gardens saying "well this doesn't work for our garden".

T: "so I don't wanna do it." Yeah, everything happens very slowly here.

R: So all the 13 gardens were separate islands in the beginning that they wanted to melt into one big school garden team, and now because of the experimentations, you get these islands again (*chuckles*).

6:00

R: It's also a disadvantage of all this stuff. We want to make a unity of all the gardens. Like, gardens facing the same direction. And then slowly some gardens are experimenting more than other gardens, so they move ahead.

T: Yeah.

R: And other gardens, what about those gardens that stay behind? Maybe it works for them to keep doing what they're doing, maybe they're not interested, or maybe they find it too troublesome or difficult to change, or maybe people are too old--

T: (chuckles)

R: So it's--

T: Ultimately it sounds like that has an impact on the education experience of all of the kids. Like, you have some kids that go deeper in material, and you have some kids that get the baseline whatever-

R: Yeah.

T: But then, in my mind, and talking to everyone-

R: Mhm.

7:00

T: --everyone on their own, and then within the garden, and then within their sister garden, and then within everything else, there's like 4 or 5 different perceptions of the purpose of school gardening.

R: Yeah.

T: And even within your groups, like the ones you teach, we've talked about the cognitive levels-

R: Yup.

T: - and being able to go into more detail or to be able to take more topics like bees and stuff… It feels very disjointed in that everyone… no one is ever seeing through exactly the same lens.

R: No. And it will never happen.

T: So then what's the point of the consolidation of management? Like, if it's already so difficult… Like, why is it so bad if people do their own thing? You know? Okay, from a curriculum developer standpoint, it's not equitable. It means that kids are having educational experiences that might match their learning styles better vs kids that are just getting the bare bones, taking giant zucchini home and then calling it a day.

8:00

T: On the other hand… So the consolidation was very learner-focused… Whereas the individualization is being able to say that this garden has this culture, this is their autonomy, this is how they do it-- that feels more educator-focused.

R: Mhm.

T: So, what do you think could be a solution? Do you think that's where the app comes in, to push the two together? Have you ever thought about it or perceived something to maybe fix those connections?

R: Well maybe… We don't want to force people to do different stuff, but to give insight into different possibilities of telling your story. Giving kids a different experience. Cause all the school gardens give an experience that they'll never forget. DOesn't matter how simple it is, just having the garden, or doing other stuff.

9:00

T: Or making pizza, sambal…

R: Yeah, and usually the kids will never know what they missed out on, or know what different gardens are doing. But it helps for the… It helps for the garden instructors-- the teachers-- that they can grow their insight… Their insight is growing. That I do it this way, and we can also do it that way, and we can give the kids this experience, and choose to give the kids that experience. If I have difficulty with time management, I can give a small portion of the experience, or If i have to move to another garden as a teacher because I am being replaced, it does not mean

that I have to lose whatever I'm doing and have to do something different, and can take the experience and already know a bit about how to do it on a different garden.

10:00

T: Yeah.

R: So it's just… Spread the knowledge, keep the knowledge in the team. THere are many ways to Rome, is what we say. And the app might cover it all! It's just like an encyclopedia of information, of recipes, of teaching styles, of… like that's what we're building. Like an encyclopedia.

T: So what do you think right now are the major hurdles for your colleagues to say, "ok, I saw Wilbur do this on the Reigersbos and i'm interested in implementing that kind of thing--"

R: Yeah.

T: -- what do you think is the major hurdle for them to incorporate it into their teaching strategies?

11:00

R: Well, it's usually the thought that it will take them a lot of time and effort, or they don't know why, and they think, "well, it already works, what I am doing, why should I change it?"

T: Mm! Mhm.

R: It's a misconception that it takes a lot of effort. It doesn't have to take a lot of effort.

T: How so?

R: Well, sometimes it's just, like a different way of asking a kid a question. Instead of telling them what's going on, first instead priming them with a question--

T: Those IBL strategies!

R: Ask them to do cooperative work. Not all the time, maybe once or twice to start with.

T: Mhm.

R: And for a lot of teachers, the digital world is scary.

12:00

R: So, having an app, they think "oh shit! I have to point at the app during my lesson!" so they have a misconception about the app itself.

T: How to actually integrate it into their teaching strategies.

R: Yeah! So they just think, "well its another thing for me to worry about in my lessons." Also, we tried something, you know the word posters?

T: With the umbrellas?

R: Yeah, in the beginning, we printed those things and laminated them, and we were standing on the garden like showing them, the umbrella word stuff to the kids, and now nobody is doing that anymore.

T: Why do you think that failed?

R: It was too much stuff to bring.

T: Oh, physical things.

R: BUt when you have a *word wand*, a wall with posters, you can just hang up the posters and it's like partly decorative, but there are always kids reading it, seeing it.

13:00

T: It's passive for them and allows them to interact with it at their own pace.

R: Yeah, and sometimes you point at it. Sometimes you just let it be.

T: Yeah.

R: It doesn't have to always be used.

T: Yeah. So what do you think….

R: And a lot of teachers [EMers] are afraid that the school teachers don't have time to use it [app].

T: Yeah.

R: "Oh well school teachers have so much stuff to do already, they're not going to use an app in the classroom."

T: Yeah.

R: But then the interested kids can always take it back home, and the non-interested kids can find something that will interest them in there. All kids should try it out once, and they might all find something interesting, like bigger the app gets-- the more information that's in there and the more fun stuff there is to do in there, there's always a kid finding something interesting, remembering something. Maybe it helps them connect to their parents--

T: Community building!

R: So yeah.

T: And that's what I was hoping for this, and it feels like a big project, but it really is a very small intervention that has multiple faces that allows for traveling dialogue and information to be transmitted in a more efficient way.

R: Yeah.

T: Yeah. I'm gonna try to consolidate some of these questions now. How did you perceive this development project process? Like, working with these kinds of concepts and working with Femke and Femke, and working with me, and working with the prototypes, and interacting with kids and me and the teachers. Like, how was all of that for you?

15:00

R: It was way less time consuming than I estimated in the beginning. (*T laughs*) First I thought there would be a lot of meetings and trying out stuff, and in the end, it just went with everything else, just implement it. And it's necessary to try stuff out, to tweak it, to make sure that… well, especially finding the groups that's the hard part. That was difficult.

T: Yeah, that was difficult. How would we do that differently next time? Cause that was a smaller window of time, it was about a month where we tried to get groups.

R: Yeah. That was a bit difficult because of… (*pauses)*

T: Was it the time of the year do you think?

16:00

R: Maybe. Or.. You expect certain teachers to respond in a certain way. And then there was an outcome. A teacher *wasn't* interested, when you thought he or she was. Or there was a different teacher! That was what happened with that group. I thought that teacher would be really supportive, then that teacher was out.

** full transcript not available, as the conversation switched to Dutch, additional quotes taken from audio

Coordinator Leonie: August 9, 2019, telephone correspondence

4 years ago: management consolidation
stichting - long time ago

Joined NME program 8 years ago

Prior to consolidation:

- smaller group management by region, much easier and faster to make plans and make it happen
- asked for subsidies to do extra activities
    - now difficult because it's not allowed to ask for subsidies because Onderwijs is a part of the gemeente
- before: had more freedom to do different programs all over the place- working together with noorderpark, stads ecoloog art projects
- less people and less rules

positives of consolidation
repair and organizations of expectations

- new garden on ijburg as a result of consolidation, wouldn't have happened before if we were split up in islands
- good to check on the quality of education, hasn't happened yet
- KOS: new project manager leading quality management to implement (Abby to assist)

negatives of consolidation

- power of management broke a lot of people
- management: difficult to find communication strategies with colleagues
    - makes a lot of things "very black"
    - some people can be rude and asocial to management

good for quality to have some framework

- “this is what we do minimum, all of us”, minimum structure
- cannot be 100% anything anymore (doesn’t match world we live in)

a lot of rules being a part of the central gemeente

- we are only department with people working in the field with children doing practical work
- hard for management sometimes to find link in gemeente

H & W: happy to do experiment with no planning, “learn you also to deal with the situation, and not do everything following the same steps year after year” - same happiness communicated from D